Companion Encyclopedia of Archaeology

Edited by
Graeme Barker

Volume 1-2

ROUTLEDGE

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EDITED BY

GRAEME BARKER

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CONTRIBUTORS

GRAEME BARKER started his university training at Cambridge as a classicist, but graduated in prehistoric archaeology. He then took his Ph.D. at Cambridge on the prehistory of central Italy, with a spell at the British School at Rome as a Rome Scholar. Between 1972 and 1984 he was a Lecturer and then Senior Lecturer in prehistoric archaeology at the University of Sheffield, he was Director of the British School at Rome between 1984 and 1988, and since then has been Professor of Archaeology and head of the School of Archaeological Studies at the University of Leicester. His principal research interests have been in the archaeology of subsistence and agriculture, first with a special focus on archaeozoology but later in landscape archaeology. He has conducted fieldwork in Italy, Mozambique and the former Yugoslavia, and directed interdisciplinary field projects in Italy and Libya, and currently in Jordan. His publications include *Landscape and Society: Prehistoric Central Italy* (1981), *Archaeology and Italian Society* (1981, co-edited with R. Hodges), *Prehistoric Communities in Northern England* (1981), *Prehistoric Farming in Europe* (1985), *Beyond Domestication in Prehistoric Europe* (1985, co-edited with C.S. Gamble), *Roman Landscapes: Archaeological Survey in the Mediterranean Region* (1991, co-edited with J.Lloyd), *A Mediterranean Valley: Landscape Archaeology and* Annales *History in the Biferno Valley* (1985, with the companion volume *The Biferno Valley Survey: the Archaeological and Geomorphological Record*), *Farming the Desert: the UNESCO Libyan Valleys Archaeological Survey* (1996, two volumes with D.Gilbertson, B.Jones and D.Mattingly), and *The Etruscans* (1998, with T.Rasmussen). (Institutional address: School of Archaeological Studies, University of Leicester, Leicester LE1 7RH, UK.)

JOHN BINTLIFF took his first degree in Archaeology and Anthropology at Cambridge University, where he also completed his Ph.D. under the supervision of David Clarke and Eric Higgs. From 1977 to 1990 he taught Archaeology at Bradford University, and since 1990 has been Reader in Archaeology at Durham University. From 1978 to the present he has been co-director with Anthony Snodgrass of the Boeotia Survey Project in central Greece. Published books include *Natural Environment and Human Settlement in Prehistoric Southern Greece* (1977), *Mycenaean Geography* (1977), *Palaeoclimates, Palaeoenvironments and Human Communities in the Eastern Mediterranean in Later Prehistory* (1982, with W.van Zeist), *European Social Evolution* (1984), *Archaeology at the Interface* (1986, with C. Gaffney), *Extracting Meaning from the Past* (1986), *Conceptual Issues in Environmental Archaeology* (1988, with E.Grant *et al.*), *Recent Developments in Yugoslav Archaeology* (1988, with J.Chapman *et al.*), *The Annales School and Archaeology* (1991), *Europe Between Late Antiquity and the Middle Ages* (1995, with H.Hamerow), *Structure and Contingency in the Evolution of Life, Human Evolution and Human History* (1997) and *Mediterranean Landscape Archaeology 2: Demography and Regional Survey in Mediterranean Europe and Beyond* (1998, with K.Sbonias). (Institutional address: Department of Archaeology, University of Durham, South Road, Durham DH1 3LE, UK.)

PETER BOGUCKI completed his undergraduate studies in anthropology at the University of Pennsylvania and received his Ph.D. in 1981 from Harvard University. Since 1983 he has worked at Princeton University, first as director of studies of Forbes College and, beginning in 1994, as assistant dean for undergraduate affairs in the School of Engineering and Applied Science. He has also taught courses in archaeology and European prehistory. His research interests lie in the transition from foraging to farming and early agricultural societies in Europe. Since 1976, he has conducted archaeological fieldwork at sites in Poland, with a focus on settlement patterning and faunal remains. He is the author of *Early Neolithic Subsistence and Settlement in the Polish Lowlands* (1982) and *Forest Farmers and Stockherders: Early Agriculture and its Consequences in North-Central Europe* (1988) and the editor of *Case Studies in European Prehistory* (1993). (Institutional address: Office of the Dean, School of Engineering and Applied Science, Princeton University, ACE-23 Engineering Quadrangle, Princeton, New Jersey 08522–5263, USA.)

TONY BROWN trained as a physical geographer at UCL London and Southampton and wrote his Ph.D. on floodplain sediments and palaeoecology. This led to an interest in the geoarchaeological potential of alluvial sediments and to collaboration with archaeological projects in Britain and elsewhere. Following his appointment to the Department of Geography at the University of Leicester, he developed research into the alluviation and land use history of river valleys in the East Midlands, and following his appointment in 1991 to a joint lectureship at Leicester with the School of Archaeological Studies he expanded his interests to include changing riverine environments in the Mediterranean. In recent years he has worked as a geoarchaeologist with archaeological projects in the Midlands, northern England and at Lindisfarne (Holy Island) in Britain, and in central Italy and Tunisia, in tandem with theoretical research on palaeohydrology, alluvial processes, sedimentation and floodplain forests. Much of this work is combined in his *Alluvial Environments: Geoarchaeology and Environmental Change* (1997). (Institutional address: Department of Geography, University of Exeter, Amory Building, Rennes Drive, Exeter EX4 4RJ, UK.)

MARTIN CARVER was an army officer for fourteen years and a freelance field archaeologist for thirteen, before being appointed Professor of Archaeology at York. His main academic interest is early medieval Europe, and his initial research operations from 1972 onwards were mainly government-funded investigations of early towns in England, France, Italy and Algeria. The results led to the publication of *Underneath English Towns* (1987) and *Arguments in Stone: Archaeological Research and the European Town in the First Millennium* (1993). In 1983 he was appointed director of the new campaign of excavation at Sutton Hoo, which was completed in 1993 and is now ready for publication: interim studies appeared in *The Age of Sutton Hoo* (1992) and *Sutton Hoo: Burial Ground of Kings?* (1995) as well as in three feature films for the BBC. In the early 1970s he began to promote a staged approach to fieldwork, using the concept of predictive evaluation, which is convergent with archaeological practice in the USA. In addition to numerous papers on this theme, a major handbook on this approach to archaeological fieldwork is in preparation with Nan Rothschild. (Institutional address: Department of Archaeology, University of York, King's Manor, York YO1 2EP, UK.)

ANDREW T.CHAMBERLAIN studied Geology and Geophysics at the University of Liverpool and Archaeological Science at the University of Southampton, completing his Ph.D. in Palaeoanthropology at the University of Liverpool in 1987. After undertaking postdoctoral research with Professor Bernard Wood at Liverpool, he joined the Department of Archaeology and Prehistory at the University of Sheffield in 1990, where he is currently Senior Lecturer and co-director of the M.Sc. course in Osteology, Palaeopathology and Funerary Archaeology. He is the author of *Human Remains* (1994), and his research interests are in palaeoanthropology, biological anthropology and palaeodemography. (Institutional address: Department of Prehistory and Archaeology, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK.)

NEIL CHRISTIE studied archaeology at the University of Newcastle upon Tyne, where he wrote his Ph.D. thesis on *Byzantine and Longobard Northern and Central*

Italy. In 1985–86 he held a Rome Scholarship at the British School at Rome, researching Byzantine Liguria in the sixth and seventh centuries AD, and then preparing for publication three British School excavation reports (published as *Three South Etrurian Churches: Santa Cornelia, Santa Rufina and San Liberato* in 1991). He held the Sir James Knott Research Fellowship (1988–91) at Newcastle upon Tyne and a British Academy Postdoctoral Fellowship (1991–93) at the Institute of Archaeology, University of Oxford, researching late Roman and early medieval Italy, before taking up his present appointment as a lecturer in medieval archaeology at the University of Leicester. He is the author of *The Lombards* (1995), editor of *Settlement and Economy in Italy 1500 BC–AD 1500: Papers of the Fifth Conference of Italian Archaeology* (1995), and co-editor of *Towns in Transition: Urban Evolution in Late Antiquity and the Early Middle Ages* (1996). (Institutional address: School of Archaeological Studies, University of Leicester, Leicester LE1 7RH, UK.)

JOHN COLLIS started excavating as a schoolboy in his native Winchester. Subsequently he did his first degree in Archaeology and Anthropology at Cambridge, continuing with his doctorate on the beginnings of urbanization in the Late Iron Age in central and western Europe, and studying in Czechoslovakia and West Germany. He was intimately involved in the change of direction of iron age studies in the late 1960s and 1970s, especially on the nature of iron age coinage. His first major excavation in the 1960s was of an iron age and Roman farming settlement at Owslebury near Winchester. In 1970 he took up a lecturing post at Exeter University, and carried out a major excavation in the Roman and medieval city. In 1972 he moved to Sheffield, where he is now Professor in the Department of Archaeology and Prehistory, teaching the European Iron Age and Techniques of Excavation. Since 1973 he has worked on iron age sites and survey in central France, but was also involved in surveys of bronze age field systems on Dartmoor with Andrew Fleming. His major publications are *The European Iron Age* and *Oppida: Earliest Towns North of the Alps*. At present he is preparing a book on the 'invention' of the Celts. (Institutional address: Department of Archaeology and Prehistory, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK.)

JAMES A.DELLE studied anthropology at the College of William and Mary, where he received his MA in 1989, and at the University of Massachusetts at Amherst, where he was awarded his Ph.D. in 1996. He has held teaching positions in archaeology and social anthropology at the University of Massachusetts in Amherst and New York University, and in social anthropology and international development at Clark University in Worcester, Massachusetts. Currently he is Assistant Professor of Anthropology at Franklin and Marshall College in Lancaster, Pennsylvania. He has published several articles based on field research conducted in the Netherlands Antilles, Ireland and Jamaica, and is the author of *An Archaeology of Social Space* (Plenum Press, 1998). (Institutional address: Department of Anthropology, Franklin and Marshall College, Lancaster, PA 17604, USA.)

ROBIN DENNELL first worked on an archaeological excavation when he was eleven. He specialized in the palaeolithic and human evolution for his BA whilst at Cambridge (1966–69), but focused on archaeobotany and the earliest farming settlements in Bulgaria for his Ph.D., which he completed in 1975 as part of the British Academy major research project into the early history of farming in Europe directed by Eric Higgs. In the 1970s his main fieldwork was in Iran and concerned with the origins of farming and patterns of land use. After the Iranian Revolution terminated this work, he wrote *European Economic Prehistory: A New Approach* (1983), since translated into Spanish and Japanese. His main fieldwork since 1981 has concerned the palaeolithic sequence of northern Pakistan; so far, ten seasons of fieldwork have resulted in one research monograph and about thirty research papers. In addition to working in Bulgaria, Iran and Pakistan, he has also undertaken archaeological fieldwork in Denmark, Germany, Israel, Italy, Tunisia and Turkey. He was appointed to a lectureship at Sheffield in 1973; after a four-year break between 1988 and 1992 as a Leverhulme Senior Research Fellow as director of the British Archaeological Mission to Pakistan, he now holds a personal chair in prehistory at Sheffield. (Institutional address: Department of Archaeology and Prehistory, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK.)

STEPHEN L.DYSON is Professor of Classics at the State University of New York at Buffalo. He received his BA from Brown University where he studied both classical and North American archaeology. At Oxford he took a diploma in classical archaeology with a speciality in Roman Britain. His MA and Ph.D. are from Yale, with a dissertation on the ceramics from Dura Europos. His fieldwork has focused on the rural archaeology of Roman Italy, first with villa excavations in southern Italy and then with survey and Roman rural settlement reconstruction in southern Tuscany. Most recently, he has been doing field research in Sardinia. The research on the Roman countryside resulted in his book *Community and Society in Roman Italy* (1992). In the area of Roman frontier studies he has published *The Creation of the Roman Frontier* (1985) and edited *Comparative Studies in the Archaeology of Colonialism* (1985). His most recent research has focused on the history of archaeology, with a book on classical archaeology in America, *Ancient Marbles to American Shores*, to be published in 1998. He is currently President of the Archaeological Institute of America. (Institutional address: Department of Classics, 712 Clemens Hall, SUNY Buffalo, NY 14260, USA.)

TIMOTHY EARLE is Professor and Chair of Anthropology at Northwestern University. He received his Ph.D. in Anthropology from the University of Michigan in 1973. His research interests include the evolution of pre-industrial societies, institutional finance and prehistoric economies. He has carried out research in the Hawaiian Islands and in Andean South America, and is presently involved in a long-term study of the Neolithic, Bronze and Iron Ages of Thy, Denmark. Earle is editor or co-editor of a number of volumes, including *Exchange Systems in Prehistory* (1977), *Modeling Change in Prehistoric Subsistence Economies* (1980), *Contexts for Prehistoric Exchange* (1982), *Specialization, Exchange and Complex Society* (1987), and *Chiefdoms: Power, Economy and Ideology* (1991). He is author of *Economic and Social Organization of a Complex Chiefdom: the Halelea District, Kauai, Hawaii* (1978, with A.Johnson), *The Evolution of Human Society* (1987) and *How Chiefs come to Power* (1997). (Institutional address: Department of Anthropology, Northwestern University, 1810 Hinman Avenue, Evanson, Illinois 60208–1310, USA.)

CHRIS GOSDEN studied for his BA and Ph.D. in the Department of Archaeology and Prehistory of the University of Sheffield (England), taking his Ph.D. on the production and exchange of pottery in iron age communities in central Europe in 1983. He then held the positions of Lecturer and Senior Lecturer in the Department of Archaeology at La Trobe University (Australia) from 1986 to 1993, before taking up his present position as Lecturer and Curator in Archaeology at the Pitt Rivers Museum of Oxford in 1994. His principal research interests include social theory and archaeology, the links between archaeology and anthropology, and the archaeology of colonialism. He has undertaken fieldwork in Papua New Guinea on sites ranging from the Pleistocene to the period of European contact, and in Turkmenistan, where he is part of a team interested in palaeolithic and neolithic sites, and he is also excavating iron age sites on the Berkshire Downs in southern England with Gary Lock. His publications include *Social Being and Time* and (with J.Allen) *Report of the Lapita Homeland Project*. (Institutional address: Pitt Rivers Museum, University of Oxford, 64 Banbury Road, Oxford OX2 6PN, UK.)

ANNIE GRANT has an MA and a Ph.D. in archaeology from the University of Cambridge. She has worked as a freelance archaeozoologist, and has held research posts at the Institute of Archaeology at the University of Oxford and in the Department of Archaeology at the University of Reading. Currently at the University of Leicester, she is both an Honorary Lecturer in the School of Archaeological Studies and Director of the university's Educational Development and Support Centre. Her research interests have centred around the role of animals in past societies. She collaborated with Barry Cunliffe for many years, with studies of the fauna from his excavations of sites such as Portchester, Mountbatten, Bath and Danebury. Her publications include two edited books—*The Countryside of Medieval England*

(Blackwell 1988, co-edited with G.Astill) and *Animals and Animal Products in Trade and Exchange* (L'Homme et L'Animal 1994) —and numerous papers on archaeozoological methodology, animal husbandry at sites in Britain, Spain and North Africa, and the social, religious and economic aspects of human/animal interrelationships. More recently, her interests have broadened to include landscape archaeology, and she is co-director (with Graeme Barker and Tom Rasmussen) of the Tuscania Archaeological Survey in central Italy. (Institutional address: School of Archaeological Studies, University of Leicester, Leicester LE1 7RH, UK.)

ANTHONY HARDING studied classics and archaeology at the University of Cambridge, taking his Ph.D. there in 1973. Since that time he has taught archaeology at the University of Durham, where he became Professor in 1990. He specializes in the archaeology of the Bronze Age in the Old World, and in particular the study of connections between the civilizations of the bronze age Aegean and those of west, central and northern Europe. His books include *The Bronze Age of Europe* (1979, jointly with J.M.Coles), *The Mycenaeans in Europe* (1984), *Henge Monuments of Great Britain* (1987), and *Die Schwerter im ehemaligen Jugoslawien* (1995). He has conducted field projects in Britain, Poland and the Czech Republic, and is particularly involved in collaborative work with local scholars on the archaeology of central and south-eastern Europe. (Institutional address: Department of Archaeology, University of Durham, South Road, Durham DH1 3LE, UK.)

FEKRI A.HASSAN is the Petrie Professor of Archaeology at the Institute of Archaeology, University College London. He was born in Cairo, Egypt, where he received his B.Sc. and M.Sc. in Geological Chemistry. In 1973 he took his Ph.D. at the Southern Methodist University in Dallas, Texas. Following an initial appointment at Wayne State University, Detroit, he was appointed Assistant Professor at Washington State University, Pullman, in 1975, became a professor in the same department in 1983, and took up his present position at UCL in 1994. His interest in demographic archaeology began with work on the origins of agriculture in the 1970s. He is the author of *Demographic Archaeology,* and is currently engaged in an examination of the relationships between cultural evolution and population change, and the population dynamics of the Egyptian civilization, to provide an archaeological perspective on contemporary population issues. He has published widely in geoarchaeology and the prehistory of Egypt, is currently involved in fieldwork in Egypt in the East Delta and at Farafra Oasis, and is coordinator of the Environment and Civilization Global Project (ECGP). (Institutional address: Institute of Archaeology, University College London, 31–34 Gordon Square, London WC1H 0PY, UK.)

SIMON HILLSON graduated from the University of Birmingham in 1974 with a joint degree in Geology and Archaeology, through which he was introduced to bones and teeth in the study of vertebrate palaeontology. He followed this interest into a Ph.D. supervised by Don Brothwell at the Institute of Archaeology, University College London, in which he studied the biology of ancient human populations from Egypt and Nubia, and developed a particular interest in teeth. In 1978 he took up a lectureship in archaeological science at the University of Lancaster, and returned to the Institute of Archaeology in London during 1987, where he is now a Reader in Bioarchaeology at University College London. Simon Hillson has written three textbooks: *Teeth* (1986) and *Dental Anthropology* (1996), both published by Cambridge University Press, and *Mammal Bones and Teeth* (1992), published by the Institute of Archaeology. (Institutional address: Institute of Archaeology, University College London, 31–34 Gordon Square, London WC1H 0PY, UK.)

MATTHEW JOHNSON was born in Texas and brought up in Britain. Having gained his BA in Archaeology and Anthropology at St John's College, Cambridge, he continued at Cambridge to research his Ph.D. on late medieval and early modern traditional houses in Suffolk, England. After holding posts at the University of Sheffield and St David's University College Lampeter, he has been Lecturer in Archaeology at the University of Durham since 1991, appointed Professor in 1998. His research interests include archaeological theory, architecture, and landscape history in England and Europe AD 1200–1800; he is currently researching in the field of later medieval castles. Matthew Johnson has published two books: *Housing Culture: Traditional Architecture in an English Landscape* (1993) and *An Archaeology of Capitalism* (1996). He is also the author of the forthcoming *Archaeological Theory: An Introduction*. (Institutional address: Department of Archaeology, University of Durham, South Road, Durham DH1 3LE, UK.)

KRISTIAN KRISTIANSEN studied prehistoric archaeology at the universities of Aarhus and Copenhagen in Denmark, obtaining his Ph.D. in 1975 and his D.Phil, in 1998. After working as a researcher from 1977 to 1979 at the University of Aarhus, from 1979 to 1994 he was Director of the Danish Archaeological Heritage in the Ministry of Environment. Since 1994 he has been Professor of Archaeology at the University of Göteborg in Sweden. He has edited several books on archaeological theory and method, as well as the *Journal of Danish Archaeology* and the *Journal of European Archaeology*, his most recent book (1998) being *Europe before History*. Until 1998 he was President of the European Association of Archaeologists. His main research interests are the Scandinavian Bronze Age, archaeological theory and method, the history of archaeology, and archaeological heritage management. (Institutional address: Institutionen for Arkeologi, University of Göteborg, S-412 Göteborg, Sweden.)

MARK P.LEONE received his Ph.D. in 1968 through the Department of Anthropology, University of Arizona. He has published on modern material culture and the historical archaeology of the Chesapeake. In 1981 he founded the Archaeology in Annapolis project in conjunction with the Department of Anthropology of the University of Maryland at College Park, and the Historic Annapolis Foundation, the city's principal private preservation organization. He has written extensively on the historical archaeology of the US, his publications including, for example, his edited volume with P.B.Potter *The Recovery of Meaning: Historical Archaeology in the Eastern United States* (1988). He produced *Invisible America* with Neil Silberman in 1995. Mark Leone has taught in the Department of Anthropology at the University of Maryland since 1976 and currently serves as chair of that department. (Institutional address: Department of Anthropology, University of Maryland at College Park, College Park, Maryland 20742, USA.)

STEVEN MITHEN studied archaeology at Sheffield University, and then acquired an M.Sc. in Biological Computation at York University in 1984 and a Ph.D. at Cambridge University in 1987. After a period of postdoctoral research and teaching at Cambridge, he moved to the Department of Archaeology at Reading, where he is now a Reader in Early Prehistory. His major fieldwork project has been concerned with reconstructing mesolithic settlement in the Hebridean islands of Scotland. Currently he is undertaking fieldwork in southern Jordan. He is the author of *Thoughtful Foragers: a Study in Prehistoric Decision Making* (1990) and *The Prehistory of the Mind* (1996), together with numerous papers concerning upper palaeolithic art, mesolithic society and the use of computer simulation in archaeology. (Institutional address: Department of Archaeology, University of Reading, Whiteknights, Reading RG6 6AA, UK.)

JOHN MORELAND received his Ph.D. from the University of Sheffield in 1990. He has taught at the University of Kent and Wesleyan University, USA, and since 1988 has been Lecturer in Medieval Archaeology at the University of Sheffield. He is involved in field projects in central Italy, southern Albania, and Derbyshire, England, as part of his research into the transition from the Roman Empire into the early Middle Ages. He is currently writing a book on *Reconstructing Ancient Economies* with Paul Halstead, Glynis Jones and Marek Zvelebil, and another on *Visions of a Monument: The Bradbourne Cross in History*. (Institutional address: Department of Archaeology and Prehistory, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK.)

PAUL R.MULLINS received a Masters in Applied Anthropology from the University of Maryland at College Park in 1990, and was awarded a Ph.D. in anthropology from the University of Massachusetts at Amherst in 1996. He teaches historical archaeology, archaeological theory, modern material culture, and popular culture as a Visiting Assistant Professor in the Anthropology Program of George Mason University in Fairfax, Virginia. His research focuses on the relationship between racism and American consumer culture between the US Civil War and the 1930s; his fieldwork in Annapolis, Maryland, and Washington DC examines how African-Americans envisioned material consumption as a socio-political statement which critiqued anti-Black racism, yet secured the symbolic privileges of consumer citizenship. He is editor, with Paul A.Shackel and Mary S.Warner, of *Annapolis Pasts: Historical Archaeology in Annapolis, Maryland* (University of Tennessee 1998) and is the author of *Race and Affluence: an Archaeology of African America and Consumer Culture* (Plenum Press, forthcoming). (Institutional address: Anthropology Program, MSN-3G5, George Mason University, Fairfax, Virginia 22030 USA.)

ALASTAIR NORTHEDGE has been Maître de Conférences in Islamic Art and Archaeology at the Sorbonne in Paris since 1991. He trained in Islamic history at the University of Oxford, in Arabic at the University of Cambridge, and completed a Ph.D. in Islamic art and archaeology at the School of Oriental and African Studies in London. His main research interests lie in the archaeology of the eastern Islamic world, particularly in the early period. He has excavated at the Citadel of Amman in Jordan, at 'Ana and Samarra' in Iraq, at Tilbesar in Turkey, and in Kazakhstan and Turkmenistan in central Asia. His publications include *Excavations at 'Ana* (1988), *Studies on Roman and Islamic Amman I: History, Site and Architecture* (1993), and a series of articles on Samarra'. (Institutional address: UFR d'Art et d'Archéologie, Université de Paris-Sorbonne (Paris IV), 3 Rue Michelet, 75006 Paris, France.)

MARILYN PALMER is an Oxford-trained historian who developed an interest in industrial archaeology in the 1960s and has taught it at various levels ever since. She is currently Reader in Industrial Archaeology at the University of Leicester. Her fieldwork has been largely on metalliferous mining sites, but she also has a major interest in the archaeology of the textile industry. With her fellow editor of *Industrial Archaeology Review,* Peter Neaverson, she has written *Industrial Landscapes of the East Midlands* (Chichester: Phillimore 1992); *Industry in the Landscape 1700– 1900* (London: Routledge 1994) and *Industrial Archaeology: Principles and Practice* (London: Routledge 1998). She represents the interests of industrial archaeology on several national bodies and is a Commissioner with the Royal Commission on the Historical Monuments of England. She is concerned to develop a more theoretical approach to industrial archaeology and to see it fully integrated into archaeological training. (Institutional address: School of Archaeological Studies, University of Leicester, Leicester LE1 7RH, UK.)

MIKE PARKER PEARSON is a Reader in the Department of Archaeology and Prehistory at the University of Sheffield. He studied archaeology at the universities of Southampton and Cambridge. Between 1984 and 1990 he was an Inspector of

Ancient Monuments for English Heritage, involved in the drafting of the government's planning policy guidance *Archaeology and Planning* and English Heritage's research strategy document *Exploring Our Past*. His major teaching and research interests include funerary archaeology, ethnoarchaeology, archaeological theory, and archaeological heritage issues. Since 1991 he has carried out fieldwork on funerary monumentality in southern Madagascar and on bronze age to medieval settlement on South Uist in the Scottish Western Isles. He is the author of *Bronze Age Britain* and co-author of *Between Land and Sea: Excavations at Dun Vulan,* and is editor, with T.Darvill, R.Thomas and R.Smith, of *New Approaches to our Past* (1978), with C.Richards, of *Architecture and Order* (1994) and, with T.Schadla-Hall, of *Looking at the Land* (1994). His next book will be *The Archaeology of Death and Burial*. (Institutional address: Department of Archaeology and Prehistory, University of Sheffield, Northgate House, West Street, Sheffield S1 4ET, UK.)

CHARLES L.REDMAN received his BA at Harvard University and his MA and Ph.D. at the University of Chicago, and having served as Chair and Professor of Anthropology at Arizona State University is currently Director of the Center for Environmental Studies there. He has directed numerous archaeological field expeditions in the Near East, North Africa, and the American Southwest. His research interests include the origins of complex society, human impacts on the environment, and archaeological research design. His authored and co-authored books include *The Rise of Civilization* (W.H.Freeman and Co.), *Explanation in Archaeology (*Columbia University Press), *Archaeological Explanation* (Columbia University Press), *Qsar es-Seghir: an Archaeological View of Medieval Life* (Academic Press) and *People of the Tonto Rim* (Smithsonian Press). He is currently completing the manuscript for a new book, *Human Impact on Ancient Environments*. (Institutional address: Center for Environmental Studies, Arizona State University, Box 872402, Tempe AZ 85287–2402, USA.)

ALAIN SCHNAPP trained in classical archaeology, taking his *doctorate de 3° cycle* at the University of Paris I (Panthéon-Sorbonne) in 1973. He then worked as a CNRS (Centre National des Recherches Scientifiques) researcher at the Centre Gernet et Institut d'Architecture Antique and at the University of Paris I, submitting a thesis on the anthropology of hunting in the classical Greek city in 1987, and is now Professor of Classical Archaeology at the same university. He has also been a visiting scholar at the universities of Princeton (USA), Cambridge (UK) and Naples (Italy), and at the Getty Foundation in Santa Monica, California. His research has focused on the anthropology and iconography of classical Greece, on the history of archaeology, and on the historical topography of Greek cities. His publications include *L'Archéologie Aujourd'hui* (Paris: Hachette 1980), *La Cité des Images* (Paris: Nathan 1984), *La Conquête du Passé, aux Origines de l'Archéologie* (Paris: Carré

1993; Italian translation Milan: Mondadori 1984; English translation London and New York: British Museum Press 1996), *Le Chasseur et la Cité: Chasse et Érotique en Grèce Ancienne* (Paris: Albin Michel 1997), and *Préhistoire et Antiquité: Tome 1 de l'Histoire de l'Art Flammarion* (Paris: Flammarion 1997). (Institutional address: UFR d'Art et d'Archéologie, Université de Paris I [Panthéon-Sorbonne], 3 Rue Michelet, 75006 Paris, France.)

STEPHEN J.SHENNAN took his first degree in Archaeology and Anthropology at Cambridge and then completed his Ph.D. there on Bell Beakers in central Europe, supervised by David Clarke, who had a major influence on him as on many others. After moving to Southampton in 1975 to research on British prehistoric amber finds he was appointed Hampshire Archaeological Field Officer, when he carried out one of the first intensive fieldwalking projects in Britain. From 1978 to 1996 he was a member of the teaching staff of the Department of Archaeology at Southampton, becoming Professor in 1995; during this period his work was largely focused on the socio-economic prehistory of Europe and quantitative and computer methods; from 1985–89 he excavated a bronze age mining settlement in the Austrian Alps. Since 1996 he has been at the Institute of Archaeology, University College London, where he holds a Personal Chair in Theoretical Archaeology. His current interests are in the human impact of climatic change and Darwinian approaches to cultural evolution. His publications include *Quantifying Archaeology* (2nd edn, 1997), *Bronze Age Copper Producers of the Eastern Alps* (1995), *Prehistoric Europe* (co-author, 1984), *Archaeological Approaches to Cultural Identity* (editor, 1989) and *The Archaeology of Human Ancestry* (co-editor, 1996). (Institutional address: Institute of Archaeology, University College London, 31–34 Gordon Square, London WC1H 0PY, UK.)

ELIZABETH SLATER took her first degree in Natural Sciences, specializing in metallurgy and materials science, at a time when archaeologists were becoming increasingly concerned with the scientific examination of artefacts. Work on archaeological material prompted an interest in the history of metallurgy and the origins of processes and she remained in Cambridge to complete a Ph.D. on aspects of bronze age metallurgy, looking particularly at the interpretation of analytical data. In 1974 she became lecturer in Archaeological Sciences at Glasgow University and was appointed to the Chair of Archaeology at Liverpool in 1991. The use of scientific techniques in the study of artefacts has remained a prime focus of her research and she has completed extensive analytical programmes as part of major excavation projects on copper-based metals, ceramics, lithics and vitreous materials from sites in Britain, Italy, Germany, Cyprus, Egypt and Greece. Investigation of pyrotechnological processes, central to the interpretation of analytical and site data, has also been a major research interest and she has carried out detailed experimental projects from raw material through to final product. A wide-ranging book on artefact studies is in the process of publication, and a study of eastern Mediterranean and Egyptian ceramics, faience and metals, building on the Liverpool Museum collections, is in progress. (Institutional address: School of Archaeology, Classics and Oriental Studies, University of Liverpool, Liverpool L69 3BX, UK.)

NIGEL SPIVEY graduated in Classics at the University of Cambridge in 1980, subsequently studied at the British School at Rome and the University of Pisa, and then taught at St. David's University College Lampeter in Wales before taking up his present position as Lecturer in Classical Archaeology at Cambridge and Fellow of Emmanuel College. His previous publications include *The Micali Painter and his Followers* (Oxford: Oxford University Press 1987), *Etruscan Italy* (with Simon Stoddart, London: Batsford 1990), *Looking at Greek Vases* (edited with T.Rasmussen, Cambridge: Cambridge University Press 1991) and *Etruscan Art* (London: Thame and Hudson 1997). He is currently researching on the interpretation of Greek sculpture and excavating at the Etruscan city of Cerverteri. (Institutional address: Museum of Classical Archaeology, University of Cambridge, Sidgwick Avenue, Cambridge CB3 9DA, UK.)

SIMON STODDART graduated in 1980 from the University of Cambridge in Archaeology and Anthropology. He then studied in Rome and at the University of Michigan, before returning to Cambridge to write his doctoral dissertation on settlement organization and state formation in pre-Roman central Italy which he completed in 1987. After posts at the universities of York (lecturer) and Bristol (lecturer and senior lecturer), he is currently a University lecturer in the Department of Archaeology, Cambridge, and a Fellow at Magdalene College, Cambridge. He has undertaken fieldwork on state formation in the valley of Gubbio (Umbria, Italy) and at Nepi (Lazio, Italy), and on early complex society in Gozo (Malta). He is currently involved in a team engaged in the revision of the British School at Rome's South Etruria Survey north-west of Rome, originally undertaken in the 1950s to 1970s in a key area of Etruscan and Faliscan (pre-Roman) state formation. His major publications include *Etruscan Italy* (with Nigel Spivey, London: Batsford 1990) and *Territory, Time and State: the Archaeological Development of the Gubbio Basin* (co-edited with Caroline Malone, Cambridge: Cambridge University Press 1994). (Institutional address: Department of Archaeology, University of Cambridge, Downing Street, Cambridge CB2 3DZ, UK.)

JOSEPH A.TAINTER received his Ph.D. in anthropology from Northwestern University in 1975. He taught anthropology at the University of New Mexico, and is now Project Leader of Cultural Heritage Research, Rocky Mountain Research Station, Albuquerque, New Mexico. Fieldwork and documentary research in North

America, Polynesia, Europe, West Africa and the Near East have led to many journal articles, book chapters and monographs. His book *The Collapse of Complex Societies* (1988) develops a long-standing research interest in the evolution of socioeconomic complexity. This work has been recognized in several fields, and has led to invitations to lecture to organizations as diverse as the Getty Center for the History of Art and the Humanities and the International Society for Ecological Economics. He is co-editor, with Bonnie Bagley Tainter, of the 1996 book *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*. (Institutional address: Research Station, 2205 Columbia SE, Albuquerque, New Mexico 87106, USA.)

JULIAN THOMAS was educated at the universities of Bradford (B.Tech. 1981) and Sheffield (MA 1982, Ph.D. 1986). He was Lecturer in Archaeology at the University of Wales, Lampeter between 1987 and 1993, and he is now Senior Lecturer in Archaeology at the University of Southampton. His publications include *Rethinking the Neolithic* (Cambridge 1991) and *Time, Culture and Identity* (Routledge 1996). His archaeological fieldwork has included directing excavations on the neolithic to iron age ceremonial enclosure at the Pict's Knowe, Dumfries, in Scotland. He is Secretary of the World Archaeological Congress, and sits on the Council of the Royal Anthropological Institute. (Institutional address: Department of Archaeology, University of Southampton, Highfield, Southampton S17 1BJ, UK.)

PREFACE AND ACKNOWLEDGEMENTS

The *Companion Encyclopedia of Archaeology* started life, like its predecessor the *Companion Encyclopedia of Anthropology* edited by Tim Ingold, on the initiative of Jonathan Price, at that time Senior Editor for Academic Reference Books at Routledge. As then befell Tim Ingold, succumbing to Jonathan's languid charm and infectious enthusiasm has resulted in almost ten years of somewhat rueful reflection on agreeing, in the words of Jonathan's original letter, 'to mastermind such an enterprise'! It was originally planned as a joint enterprise between Annie Grant and myself, but changes in her work circumstances sadly meant that Annie had to withdraw from the co-editorship after working with me on the structure of the volume, the selection and commissioning of authors, and the drawing up of guidelines and schedules.

As I describe in the General Introduction, whereas the *Companion Encyclopedia of Anthropology* has an explicit focus on what anthropology can tell us about human societies, rather than on how it is done, the *Companion Encyclopedia of Archaeology* attempts both. It is divided, in the best archaeological tradition, into three parts, the first covering the aims of the subject, its theoretical basis and remarkably diverse methodologies, the second a series of major cross-cultural themes to illustrate the essential interdisciplinarity of archaeological theory and practice, and the third the principal themes of our 'archaeological history' from human evolution to industrialization. It has often seemed a foolhardy enterprise to try to cover all of this in a single book, and there have had to be hard editorial choices about how to structure the chapters, what to include, what topics to subsume within a wider chapter, and what to omit. I have no doubt that there are many unintentional sins of omission as well, but I hope that readers will find on reading the chapters that most topics and issues of major significance in current archaeological theory and practice are included somewhere, somehow. In this respect I would like to emphasize that the main purpose of the book is that it should be *read,* not *consulted*. Contributors were asked to write authoritative but readable chapters, rather than the 'this is a summary of everything that everybody everywhere says' review or the 'this is what I think about my particular patch, anyway' essay. Editing the results has been a mountain to climb, both in terms of paper and intellectual stamina, but whenever I stopped for breath I was enormously pleased at how contributor after contributor had (to mix my metaphors) come up trumps. I hope that every reader, whether professional, student, or interested layperson, will find the same pleasure and profit that I have had in reading the contributions, from first to last.

I would like to acknowledge first and foremost the contributors to the *Companion Encyclopedia of Archaeology* for their enthusiasm, commitment and above all patience. I am ashamed to divulge the original schedule we drew up for author commissioning, production and circulation of synopses, writing of first drafts, initial editing, author revisions, and final editing, but suffice it so say that authors and editor sometimes wondered if the other side was still in business, and in the same world! Reading Tim Ingold's Preface to the *Companion Encyclopedia of Anthropology,* though, in which he says that the project was rescued by his good fortune in securing one whole year and two subsequent terms of research leave from his university, I don't feel nearly so bad about my own desultory progress: editing the *Companion Encyclopedia of Archaeology* has had to be fitted into chairing my department throughout the time-scale of the project, with my two terms of research leave in that period being devoted to writing up field projects in Italy and Libya. All the contributors, like the editor, were typically over-committed with other deadlines, and the original smooth and synchronized progress of the charabanc we had built all too frequently broke down. Despite all the hiccups in its progress, though, the passenger list is almost entirely as originally planned: only one author succeeded in dropping off entirely (though a few others tried to!), an intended joint chapter became two, a couple of joint authors were added, and an additional chapter was kindly added late in the day by Alastair Northedge (Chapter 27) at Neil Christie's request to widen the coverage of his own chapter on the medieval world (Chapter 26). The most striking testimony to the length of the road we have travelled together are the institutional addresses of the contributors— several of the authors have moved once since the project started, and a few have moved twice or even three times! I am profoundly grateful to all the contributors for not jumping off even when the charabanc occasionally seemed to be coming to a shuddering halt.

I would also like to thank the succession of staff at Routledge who have had to take on the *Companion Encyclopedia of Archaeology* after Jonathan Price's departure, especially Seth Denbo, Samantha Parkinson, Ben Swift (who shouldered the enormous burden of chasing permissions for the illustrations), Mina Gera-Price, and Sarah Hall, as well as Alan Fidler for taking on the other huge task of copy-editing the texts and doing it with such enthusiasm and care. If it has sometimes seemed to this editor that there could be nobody left at New Fetter Lane on the list of penitents to be punished with the management of the *Companion Encyclopedia of Archaeology,* I am all too aware of where the fault lies.

At Leicester, I would particularly like to acknowledge the help of Pam Thornett, Chief Clerk in the School of Archaeological Studies, both for moral support and for indefatigable photocopying of draft and edited chapters, done out of a spirit of loyalty despite all the far more important tasks she needed to be doing for the School's administration. I would also like to thank our draughtsperson Debbie Miles-Williams, for redrawing forty of the illustrations with her typical skill and commitment even on the eve of maternity leave when she could scarcely reach the computer.

It was a very great sadness to both Annie and myself that she felt obliged to withdraw from the co-editorship of the *Companion Encyclopedia of Archaeology* because of the demands of other publication commitments on the restricted research time available to her in her present senior position in Leicester's administration. I am especially grateful to her for undertaking the onerous task of translating from French to English Alain Schnapp's original, complex—and lengthy—text of his contribution to Chapter 1, but most of all I would like to thank her for living with the *Companion Encyclopedia of Archaeology* these past years and supporting me through it. I wish she had let me put her name on the front alongside mine, given her direct contribution to the *Companion Encyclopedia's* inception, development and character, and her continual support through the over-lengthy time it has taken me to bring it to fruition.

Graeme Barker
May 1998

GENERAL INTRODUCTION

Graeme Barker

THE NATURE AND SCOPE OF ARCHAEOLOGY

Archaeology is commonly defined as the study of past societies through their material remains, and history as the study of past societies through their written records. The difficulties of recovering, analysing and interpreting archaeological evidence are profound, but the principal strength of archaeology as a historical discipline concerned with trying to understand our past is that all human societies, from our earliest ancestors to most recent generations, have created archaeology. Hunter or farmer, emperor or slave, lord or serf—everybody uses material culture, and some of it has survived for us to discover and study. Even today huge numbers of the world's population are illiterate, and write no history about themselves—in a real sense, they are denied their history. Literacy in the past was even more restricted, so most historians have to try to understand the societies they study through the perceptions and biases of the small élite that wrote about them. Furthermore, for more than 99 per cent of human history there are no historical records. Thus the practice of archaeology is not restricted to any particular period of the past, or region of the world: whether we study early humans, or ancient Egyptians, or Incas, or a nineteenth-century shipwreck, or Second World War fortifications, we are all archaeologists, using archaeological methods to try to understand past societies through their material remains.

With the totality of the human past to study, though, there are of course many different kinds of archaeologies and archaeologists. Many archaeologists study a particular period of the past, and often by definition a particular region of the world (Egyptologists, for example). Prehistoric archaeologists are concerned with the immense periods of the human past that lie between the first appearance of creatures with recognizably human characteristics three or four million years ago and the development of writing. Writing was developed or adopted by ancient societies at different times, so the interface between prehistoric and historic archaeology varies widely in different parts of the world—the first systems of writing were developed in Mesopotamia *c.* 3500 BC and Egypt *c.* 3000 BC, but in Britain written records only begin with the Roman conquest, and many societies elsewhere in the world were effectively prehistoric until European contact in recent centuries. Most prehistorians specialize in particular segments of the enormous time-scale at their disposal, such as the stone age hunters of the Ice Ages, or stone age farmers 5–10,000 years ago, or later more complex agricultural societies that were metal-using and socially differentiated.

Even when writing appeared, many societies remained 'protohistoric' and scholars studying them need to rely heavily on the methods of prehistoric archaeology. For many early 'historic' societies, writing was in fact used for very restricted purposes and by a tiny segment of society, so most of the society was effectively prehistoric. The latter point applies also to many peoples adjacent to literate societies, such as the tribes bordering the Roman empire, whose 'history' —like that of the Etruscans who were the dominant power in central Italy before Rome—is seen through a Roman glass, darkly. The same is true of the American and African peoples along the expanding frontiers of European colonialism. There are other distinct archaeological communities concerned with the ancient civilizations of Mesopotamia, Egypt, China, India, the Levant, Greece and Rome, with the pre-Columbian states and empires of South and Central America, with the emergent states of medieval Europe, the spread of Islam, European colonialism in Africa, America and Australasia, the archaeology of the Industrial Revolution, and so on.

In addition to such chronological and regional groupings within the discipline, there are other distinct archaeological communities defined by the kind of material they study and the methods they use. In the case of artefact studies, for example, some archaeologists use techniques comparable to those of the art historian to elucidate information on style, chronology, and social context, whereas a very different group of science-based archaeologists uses techniques of physical and chemical analysis to study techniques of manufacture and (from the identification of the source of the material) systems of trade. Buildings and monuments can be studied by parallel groupings of humanistic and scientific archaeologists. For many periods of the more recent past, historical archaeologists have developed distinct methodologies for the analysis and interpretation of coins, inscriptions, maps and place-names as well as archival records. Much of the archaeological record consists of biological materials such as human skeletal remains, fragments of animal bone, seeds and other plant remains, as well as the sediments in which they are found, all of which have generated distinct specialisms within what is generally termed environmental archaeology; to this group can now be added molecular biologists investigating human, animal and plant remains from their ancient DNA. Other important schools of archaeological enquiry defined by method and material rather than by period or region include landscape archaeology and underwater archaeology; air photography is another distinct specialism. The role of archaeological scientists specializing in dating the past is fundamental. Yet another group are 'ethnoarchaeologists', archaeologists-cum-anthropologists who study present-day communities to try to understand better the relationship between material culture and human behaviour so as to improve our theories and methodologies for studying past societies.

One of the principal fascinations of archaeology as a methodology, therefore, is that it spans the humanities and sciences: archaeology needs an extraordinarily broad church of expertise to try to understand the total history of humankind from its material remains. I am writing this Introduction in the middle of a field project I am directing in the Wadi Faynan in southern Jordan. The project team is an example of modern interdisciplinary archaeology. There are five environmental archaeologists reconstructing how climate, landforms, flora and fauna have changed in the study area over the past 250,000 years. An ethnoarchaeologist is studying the Bedouin people living in the area today. A team of archaeological surveyors is reconstructing the development of settlement systems from prehistoric times to the present day, by mapping collections of surface artefacts and stone structures. Other field archaeologists are investigating the different kinds of irrigation systems (stone walls for diverting and trapping rainwater) that have been developed by farmers here over the past 5,000 years, in part using an initial study by an archaeological air photographer. An hydraulic specialist is studying modern rainfall and flooding behaviour to help two archaeologists who are using computer simulations to model how the different irrigation systems would have worked. There are four finds specialists classifying and dating the artefacts being collected by the field team, and others will be involved in laboratory studies of some of these artefacts later. The effects that ancient farmers and shepherds have had on the landscape in terms of deforestation are being examined by two palaeoecologists studying fossil pollen, charcoal and snails, and geochemistry is being used on human skeletons, animal bones and plant remains to monitor the extent to which ancient miners polluted their own and even the present-day environment. A variety of archaeological laboratories is dating samples of charcoal and sediment for us. A classical historian is examining inscriptions in the field, and integrating these with other documentary sources known for the area, and similar specialists will be involved in due course to look at the pre-Roman and Islamic evidence. Major structures will be studied by architectural specialists in terms of style, chronology, and construction techniques, and another specialist will need to be brought in to study the numerous rock carvings being found by the survey teams. As the Wadi

Faynan team demonstrates, the answer to the perennial question about whether archaeology as a methodology is art or science is simply 'yes'.

APPROACHES TO UNDERSTANDING THE PAST

Methodology, though, is the means to the end, not the end itself, which is trying to understand our past. The latter, though, means different things to different archaeologists, and some of this diversity is reflected in the presentation of archaeology to the general public. One cluster of television programmes about archaeology, for example, is firmly within the tradition of 'archaeology is about finding wonderful things', the search for artistic treasures that fired the first antiquarians and archaeologists, whose discoveries form the centre-pieces of the world's great museum collections that enrich our lives today. Then there are the 'archaeology is about speculating about our mysterious ancestors' programmes, their directors automatically combining low-level camera shots of some fossil skull or standing stone or pyramid—preferably against a sunrise or sunset—with more-or-less the same soulful mood music. 'Archaeology as forensic science' is yet another strand of television archaeology with its own distinct style of test-tube and white-coat shots and computer visuals. Combining all three elements in some ways, but adding the critical component of 'archaeology is the most fun you can have with your trousers on' (to borrow the immortal if now politically incorrect phrase of the American archaeologist Kent Flannery) is a current series on British television with top viewing ratings called *Time Team*. In this, we watch a group of archaeologists sort out a specific archaeological field problem, like the layout and function of a buried building, by some frantic fieldwork over a weekend. The—highly experienced and skilful—archaeologists involved have achieved almost cult status in Britain, and their beards (sandals I am not sure about), horrible sartorial standards, wild hair and wilder enthusiasms for whatever pit, wall or bone is the subject of study have created the image of The Real Archaeologist for our aspiring first-year undergraduates against which most of their teachers fail dismally!

Curiosity about the past is of course what drives most archaeologists. Virtually none of us will ever find 'wonderful things' like Howard Carter's discovery of Tutankhamun's tomb, but I think that most archaeologists, for all their familiarity with the everyday act of discovery in fieldwork, will readily agree to suddenly finding themselves moved emotionally by the simple act of uncovering things made by people long ago, things which nobody else has seen or recognized for centuries or millennia. This engagement with 'touching our past' is surely also at the heart of popular interest in the subject, from viewing television programmes, reading popular archaeology books and attending exhibitions, to joining local archaeological societies and local archaeology classes.

The principal intellectual goal of archaeology, however, should surely be to write archaeological history, in the sense of the total history of humankind through its material remains. Just after the Second World War the French historian Fernand Braudel published a study of the Mediterranean world in the sixteenth century in which he argued that history had to be understood as the complex interplay between short-, medium-, and long-term processes. Short-term processes, *evénéments,* were the normal stuff of conventional political and military history (of the kind brilliantly caricatured for English readers in *1066 and All That*). Then there were what he termed *conjonctures,* medium-term processes that operated within a generation or an individual's lifetime, such as social, economic or demographic trends—in our own time, changes in the role of the family, in work patterns and gender roles in the industrial world over the past fifty years would be good examples. Lastly there were very long-term processes, the *longue durée,* such as the effect a particular landscape, and the technology to exploit it, could have on shaping the lives of its inhabitants over many centuries. In his Mediterranean study, for example, Braudel likened the changing relationship between lowlands and uplands, farmers and shepherds, to a 'slow-furling wave', ebbing back and forth. Another kind of long-term historical process he cited was ideology and religion, *mentalité*. With this approach Braudel and his pupils founded a school of history in France known as the Annales school, and many archaeologists argue that ultimately we, too, should be attempting to use our material to write archaeological histories from the same standpoint as the Annales historians, but over the huge time-scales we are privileged to study.

In most archaeological situations it is difficult to recognize *evénéments*—the destruction of Pompeii by the eruption of Vesuvius in AD 79 is the exception that proves the rule. Searching archaeological data for evidence of such precise events has tended to produce pseudo-history: the burnt layer in an Italian farmstead dated by the pottery contained in it to somewhere in the last three centuries BC by circular reasoning becomes evidence that Hannibal's army destroyed it because we know from the written sources that he passed through the area in 216 BC—yet it could as easily be evidence for somebody leaving the bread in the oven too long one afternoon at any time over those three centuries. On the other hand, specific short-term actions by individuals or groups of individuals can often be detected by archaeologists, such as the painting of a motif on a rock face, the preparation of a stone tool, the decoration of a pot, or the alteration to a building, even though we may not know their names. Medium-term processes such as social, economic and demographic changes are certainly amenable to study by archaeologists, and in many ways are the prime focus of most archaeological enquiry, though our time-scales may be centuries or even millennia rather than Braudel's generational changes the further back in time we go. *Longue durée* history such as the evolution of subsistence systems, technologies, or ideological structures is also pre-eminently suited to archaeological study. Braudel was criticized by fellow historians for failing to demonstrate effectively exactly how different historical processes operating at different time-scales in fact interacted, and archaeologists face exactly the same problem in the evaluation of the competing roles of structure and agency, or process and individual actions, but we do the best service to our materials and time-scales by trying to meet that challenge and writing holistic archaeological history.

That may be the ultimate goal in terms of synthesis, but whatever the scale of process we are studying, our greatest challenge is undoubtedly the interpretation of archaeological data in human terms. What exactly is the link between the material culture we dig up and the people who discarded or lost it—not just how did they make and use it, but what wider significance or meaning did it have for them? A stone axe may look to our eyes like a useful tool or an effective weapon, but did it have the same function or meaning for the people who used it 100,000 years ago? In attempting to explain their material, archaeologists can have recourse to three principal sources of information. For the historical periods there are the documentary sources, though as mentioned before these may well give a highly selective perspective on the society in question. Experimental work may also yield useful insights in some cases: some archaeologists have replicated prehistoric stone tools, for example, then used individual tools on different materials such as wood, bone, meat, leather, and vegetable foods, and then compared the various microscopic abrasions and scratches produced on the replica tools with those on prehistoric tools to infer how the latter were used. The third, and most important, source of information is provided by anthropology, the study of present-day societies: studying modern San hunter-gatherers in the Kalahari desert, for example, should show not only how stone tools or rock carvings similar to the ancient ones found by archaeologists were made, but also their role in San social interactions; studying Masai cattle herders should show not just how cattle herding systems like theirs may produce the kinds of faunal samples we find on many British late prehistoric sites, for example, but also the central role of cattle on the hoof for Masai societies in terms of wealth accumulation, gift exchange, bridewealth, client relations and the like.

The obvious problem for archaeologists, though, is that whereas geographers can interpret ancient fluvial sediments in terms of what a river does today, Kalahari San are not Ice Age hunters, and Masai are not ancient Britons, and we have no modern Neanderthals or Etruscans to use as models for past Neanderthals and Etruscans. Archaeologists thus recognize both the central role of anthropology for the development of theories about the significance of their data—in the United States, archaeology is commonly taught as ‘ancient anthropology’ within an anthropology department—and also the problems of using the present as a straightforward guide to the past. It is in this context that ethnoarchaeologists are playing an increasingly vital role in their studies of present-day societies to establish the linkages between different kinds of activity today and the different kinds of residues that these activities will create. The most useful work has generally been on societies in more-or-less similar environments to the ancient societies under study: studies of Inuit hunting systems in Alaska, for example, have stimulated critical insights into how prehistoric hunters may have operated in glacial environments in Europe, and ethnoarchaeological studies of Mediterranean shepherds and Near Eastern Bedouin are providing similar help in studying the archaeology of pastoralist societies in these regions. We always have to remember, though, that simply to impose the present onto the past is to diminish the importance of the latter in terms of understanding the development of our own humanity.

In our theoretical approaches to explaining our data, therefore, just as in our methodologies, archaeologists generally admit that they have to combine humanistic and scientific approaches. In the classic procedure of scientific enquiry, the scientist makes observations about the natural world, formulates an hypothesis to explain them, and then devises a laboratory experiment to test independently whether or not the predictions of the hypothesis are verified. It may sometimes work like this in archaeology, as in the example of the stone tool experiments mentioned earlier, but in most cases our 'independent verification' has to be our understanding of the role of material culture in present-day societies, and in using anthropology to explain archaeology we always have to be aware of the oft-quoted phrase of L.P.Hartley that 'the past is a foreign country: they do things differently there' and not try to replicate it comfortably but simplistically in our own image.

The interaction between the discovery of our archaeological history and archaeologists' theorizing about its meaning is a central theme in the history of the subject, as the opening two chapters in this *Companion Encyclopedia* describe. Until recent decades most of this theorizing characterized prehistoric archaeology, historical archaeology developing very much in the shadow of history. (Happily neither of these 'subservient' relationships, either between prehistoric and historic archaeology, or between historic archaeology and history, exists any more.) In the nineteenth century the dominant theory was that the human past could best be viewed as an evolutionary sequence from primitive savagery eventually to civilization—a ladder of progress culminating implicitly if not explicitly in the Victorian age. In the first half of the twentieth century, the goal of much prehistoric research was to recognize what Gordon Childe defined as 'archaeological cultures', similar sets of material culture (settlement types, artefacts and so on) at a particular time and in a particular region that, it was assumed, probably related to some kind of present-day social unit such as a tribe. In Europe, the result was a 'chest-of-drawers' of archaeological cultures (Fig. 12.1), most of it only dated relatively, and with the overall structure tenuously bracketed by cross-dating to historically dated cultures in the eastern Mediterranean and Near East (Chapter 5). The inevitable effect of such linkages was that the main stimulus of culture change appeared to be contact with the Near East—neolithic farmers from there must have introduced agriculture to Europe, bronze age smiths from there must have introduced metallurgy, and so on. It is easy now to criticize the kind of archaeology that produced successive maps of prehistoric Europe akin to those of the eastern front in the Second World War, but we have to remember that most prehistorians in the first half of the twentieth century had to put their main effort into trying to work out when things were (very many Ph.D. dissertations were on 'the chronology of the X culture'), not how and why things changed—as Mortimer Wheeler once remarked, the focus had to be on the timetables rather than the trains.

From the 1950s onwards, the development of radio-carbon dating and many other branches of archaeological science had a devastating impact on this kind of cultural archaeology. Together, they provided examples of different people living in different ways at the same time—hunters alongside farmers, for example, or metal-using peoples alongside stone-using peoples—and of episodes of rapid change contrasting with periods of great stability, raising serious questions about successive phases of invasion or cultural diffusion as explanations of cultural change. Through the 1960s and 1970s there were profound changes in archaeological theorizing generally referred to as the New Archaeology or processual archaeology, as archaeologists focused increasingly on trying to document processes of cultural change and to propose explanations for them. Many archaeologists felt that their discipline needed to be far more scientific than hitherto, not just in methodologies but in the theoretical procedures of theory-testing and model-building, as described earlier. Processual archaeology was concerned especially with explaining change in social and economic systems, frequently with a materialist and functionalist perspective such as in terms of adaptations to particular environmental, technological, or demographic circumstances. Its theoretical focus was therefore especially on long-term or diachronic change. (This focus had a significant impact on field methodologies, providing the stimulus for many regional studies of settlement that employed survey techniques to map settlement systems and trends.) At its most extreme, processual archaeology hoped to extract general laws of human behaviour from the archaeological record, though those that emerged were so general and unhelpful ('Mickey Mouse laws') that the expectation was short-lived.

Through the 1980s, also, many archaeologists became disillusioned with the focus of processual archaeology, arguing that it was de-humanizing the past, ignoring the role of the individual and concentrating on function at the expense of meaning. The British prehistorian Christopher Hawkes had once proposed that prehistorians were attempting to scale a 'ladder of inference' —in terms of increasing difficulty, they could study technology, then subsistence, then social organization, and only with the greatest difficulty ideology. In some ways processual archaeology worked to the same agenda, but many post-processual archaeologists argued from ethnoarchaeological studies of present-day societies that ideology commonly structured just about everything else, and that archaeological research should focus primarily on the broader meaning of their material culture for past societies. Most post-processualists have focused on detailed studies of individual societies, on statics rather than dynamics, and have invariably favoured idealist over functionalist explanations of what they observe. Whereas the theoretical basis of processual archaeology borrowed heavily from the natural sciences, post-processual archaeology has borrowed heavily from sociology and post-modernist philosophy, emphasizing for example the importance of understanding the role of the individual archaeologist's perception of the material under study in moulding the interpretation proposed. Probably the most striking example of the relationship between archaeologist and archaeology has been the dominant role of male archaeologists in writing most archaeological histories, in which women have often been all but invisible unless minding the children and weaving.

Reading undergraduate examination papers on archaeological theory these days gives a strong impression that processual archaeology is thoroughly bad and post-processual archaeology thoroughly good. However, rather than characterizing—or caricaturing—these approaches as mutually incompatible ways of thinking about the past, it is more helpful to see them as different ways of questioning the past, both of which have validity. Processual studies of long-term processes of change have been inclined to underestimate the importance of ideological structures and the significance of people's interpretation of the meaning of their own material culture for the reproduction or maintenance of society. Post-processual studies are inclined to forget that social reproduction must also function in relationship to environment, technology, demography and so on. Understanding the history of our species is at heart understanding the changing relationship between nature and culture, and neither processualist archaeologists nor post-processualist archaeologists can do that on their own: archaeology as long-term Annales history needs both.

So yes, archaeology should certainly lift the human spirit with its discoveries of the cultural and artistic achievements of past peoples; it should feed our curiosities with their mysteries; and it is certainly enormous fun to do—the principal thing I remember from my first ever archaeological supervision at Cambridge was the comment from the tutor—one of the contributors to this volume who probably prefers not to be identified! —that the most important side of archaeology was the social side. But at the same time I believe passionately that archaeology should also have important things to say about our past to help us understand ourselves and our place in the world which we now inhabit so uneasily. My own research interests have been primarily in relations between people and landscape over time, an interest I have pursued through interdisciplinary field projects especially in Italy, Libya and, currently, Jordan, an 'archaeology of sustainability' if you like, but our archaeological history is replete with big questions that remain entirely unresolved. How did the human species first evolve, and why? How did the scavengers and hunters of the Ice Ages manage eventually to people the globe—what, for example, were the respective roles of our peculiarly human mix of aggression and cooperation in that process? How can we explain the first appearance of artistic endeavour in the extraordinary cave paintings that were produced by the late glacial hunters who occupied Europe 20–30,000 years ago (especially now we know that the same species had been living elsewhere in the globe for tens of thousands of years previously sometimes producing rather similar things)? What factors caused many societies around the world to change from hunting to farming 10–5,000 years ago? How did stratification, and ultimately our state system of organization and city-life, develop in human societies? How, when and why have gender roles changed? To what extent has the growth of empire been characterized by cultural resistance or acceptance, and the collapse of empire by internal disintegration or external pressure? What can we learn from material culture about changing concepts of 'social belonging', of people's sense of identity and ethnicity? And so on. We do an enormous disservice to the archaeological record if all that archaeologists have to say—and expensively, compared with the historical disciplines—is that once upon a time people made houses, ate meat, sometimes decorated pots, and had a variety of relationships with molluscs or megaliths.

As Chapter 10 discusses, professional archaeologists share their subject with many other groups of people, and there has to be a lively debate about the ownership of the past: it belongs to all of us, not particular political or intellectual groups. The popular fascination with the subject has already been mentioned. Amateur or community involvement is a source of great research vitality in many countries, and a source of great irritation for those national archaeological authorities that try to deny or exclude it. The appropriation of a country's archaeology, and its rewriting to fit modern political agendas, is frequently most apparent in newly developing states, such as white-ruled Rhodesia's attempts in the 1960s to explain Great Zimbabwe as anything other than an indigenous black African achievement. Nazi Germany's misuse of its prehistory in support of its claims of racial superiority is also commonly cited in this respect. Yet there are related if much more subtle issues to be faced in the presentation of archaeology by national and regional archaeological authorities everywhere. Closest to home, English Heritage has the complex task of presenting the archaeology of England to a modern multi-cultural society, many members of which (the majority of people in my own university city, for example) look as much to Britain's ex-colonies as to Britain for their cultural roots. The numerous industrial archaeology 'heritage sites' springing up everywhere in Britain—including coal mines in regions devastated by politically contested mine closures only a decade or so ago—present an uneasy mix of political perspectives on the social and economic effects of modern capitalism. The movement to 'engender' archaeological interpretations for the public is also particularly active in the developed world.

The extreme position of the New Archaeology was that it could seek to understand the past, and extract general laws of human behaviour about it, with the detachment of the scientific observer. The extreme position of post-modern archaeology is that the past is unknowable, an intellectual game (mostly with tax-payers' money, it has to be said!): the individual archaeologist is engaged in his or her individual discourse with it, and will extract whatever individual meaning suits them best. In his introduction to the *Companion Encyclopedia of Anthropology,* Tim Ingold pointed to exactly the same tensions between detachment and engagement in anthropological theory, and the necessity to accept the challenge of both. We must, he writes, 'drop the pretence of our belonging to a select association of Westerners, uniquely privileged to look in upon the inhabitants of "other cultures", and recognize that...we are all fellow travellers in the same world'. Archaeologists face even harder challenges in seeking to understand the countless 'other cultures' that have journeyed the earth since humans first evolved three or four million years ago, but together with anthropologists, to adapt Tim Ingold's words, 'by comparing experience...can reach a better understanding of what such journeying entails, where we have come from, and where we are going'.

THE *COMPANION ENCYCLOPEDIA OF ARCHAEOLOGY*

Like most things in archaeology, the *Companion Encyclopedia* is divided into three parts: in essence, methods, approaches, and results. In his Introduction to the *Companion Encyclopedia of Anthropology,* Tim Ingold emphasizes that it is *of* the subject, not *about* it, in the sense that the focus throughout is on what anthropology can tell us about human societies, rather than on how it is done, but the *Companion Encyclopedia of Archaeology* attempts both. In drawing up the structure of the book, Annie Grant and I were clear that archaeological methodologies are so remarkably diverse, and that this diversity would not be readily apparent to many readers new to the subject, that methodologies needed to be addressed first, as well as research achievements later. Chapter 1 describes how modern archaeology has developed from what the British antiquarian William Camden famously called a 'backward-looking curiosity', and Chapter 2 builds on this to discuss the development of archaeological theory and the critical relationship there has always been and will always be, between discovering the past and trying to explain it, between the questions we ask and the kind of evidence we look for. Chapter 3 addresses the peculiar nature of archaeological evidence, and Chapter 4 the field techniques developed to investigate it, and each of the following chapters in the rest of the first section has a focus on major clusters of methodologies and Chapter 10 considers the ethical and political as well as practical issues in presenting the past to the public.

Whilst one of the fascinations of archaeology is that it is an extraordinarily broad church with a place for just about every kind of specialism, there is an inevitable danger of over-specialization amongst its practitioners, yet we are most effective as an *inter*disciplinary rather than simply a *multi*disciplinary subject. Hence the middle section of the volume addresses a series of general issues of common interest in archaeology to illustrate how very different kinds of archaeologies and archaeologists have to work together in their study, from reconstructing social systems, to lifeways, to population histories, to what people thought. The third section then addresses the principal themes of our 'archaeological history' from human evolution through the 'age of hunting' (or not, as Chapter 20 discusses) and the beginnings of farming to the emergence of increasingly complex societies, states, and empires, ending with the archaeology of European colonialism and industrialization.

To attempt to encapsulate in a single book the full gamut of archaeological techniques and approaches, and the full sweep of the archaeological history of humankind, is clearly impossible, and I am all too aware of gaps and omissions. There are certainly some specialisms or issues that some readers might have preferred to see as a separate chapter—as a landscape archaeologist myself, I am still rather bemused about how and why that ended up being subsumed into several chapters, and I have no doubt that reviewers will point out their own favourites that have ended up as similar casualties. However, I think that most significant topics get discussed in one chapter or another, or from different perspectives in more than one, but hard decisions had to be taken about the chapter structure to try to keep everything between two covers (and in the event, I failed!). The most important aspect of the book, as I have stated, is that it is designed to be *read,* not *consulted*. I asked the contributors to cover their individual topics treading a middle road between the detailed and dull literature review and the off-the-cuff polemical essay, to produce chapters that were both authoritative and readable. I must say that the contributors responded to the task splendidly. It has been a Herculean task editing the chapters, sometimes making savage cuts in length, building in linkages between chapters in different parts of the book, and so on; but in the process I have enormously enjoyed reading every chapter, finding each authoritative but still with the personal stamp of the author or authors, and highly readable. I have also learned an enormous amount, though I wish I could remember it all!

The *Companion Encyclopedia of Archaeology* is designed to be read by students, teachers and academics working within archaeology or related disciplines such as anthropology, history and geography, who are looking for an authoritative but accessible overview of current thought and practice and developing trends to supplement their existing specialist knowledge. However, I also hope that the book will enthuse and excite the general reader wanting to understand the nature of archaeology and what archaeology has to say about the totality of the human past.

For this reason each chapter is fully referenced in the 'Harvard style' for the specialist reader wanting to check or follow up specific sources, with references to author and publication date in the text and the full list of references in alphabetical order at the end, but the chapter also concludes with a select bibliography to guide the more general reader to the key literature on the subject if they want to explore it further.

Whatever your background and interests, I hope that you will have the same pleasure that I have had, sitting down to read any chapter in its entirety with pleasure as well as profit. Archaeology is fun, and it is a hugely companiable subject, a team subject *par excellence,* but it also has serious things to say about our past and thus about ourselves. We should study the past to learn from it, not treat it as an escapist refuge—I find nothing more depressing than the succession of brown tourist signs down our motorways proclaiming post-industrial Britain as one enormous heritage site, or great houses filled with period furniture they never actually contained and then preserved in aspic, or historic towns blighted by mediocre and faint-hearted supermarket architecture aping the 'local heritage' in ways that the architects of those same medieval buildings would have thought completely daft. The past is more important than that. Whatever gaps and omissions it may have, the *Companion Encyclopedia of Archaeology* unashamedly proclaims not just the fascination and excitement of archaeology, but also its importance in helping us understand where we have come from and who we are.

Part I

ORIGINS, AIMS AND METHODS

1

DISCOVERING THE PAST

Alain Schnapp and Kristian Kristiansen

THE ANCIENT FOUNDATIONS OF A SCIENCE OF THE PAST

One of the oldest references to archaeological practice appears on the base of a statue found at Memphis in Egypt, of Ka Wab, one of the sons of the pharaoh Keops (*c.* 2700 BC): *c.* 1300 BC Khaemois, the son of the pharaoh Rameses II, had added an inscription in which he explained that, during work in the estate of Memphis of which he was in charge, the statue of a prince, precisely identified, had been found and honoured with cult status (Gomaà 1973). Another example comes from Mesopotamia, where German archaeologists found in one of the sixth-century BC levels of the palace of Babylon a group of statues including some that dated to the third millennium BC, and where Nabonid, the last king of Babylon, has left an extraordinary account of the excavation of the great sanctuary, the Ebabbar, carried out in order to recover traces of the constructions of his predecessors (Schnapp 1996:13–17). These included the famous Hammourabi, to whom he attributed, probably correctly, a foundation tablet found during the work. In China, we have evidence from as early as the fifth century BC for the interest of scribes and emperors in collecting and identifying bronze age cult tripods.

Though latecomers to the world of writing, the Greeks knew that their modest alphabetical letters had a quality that no hieroglyph, no cuneiform inscription, nor ideogram possessed: they had an apprenticeship so easy that everyone could become master. In contrast to the writing systems of the ancient empires, the Phoenician discovery of alphabetical writing, completed by the Greek invention of the use of vowels, revealed a powerful tool for the preservation of memory, giving voice to those who dared to say 'I' where scribes for the reckoning of kings wrote 'we'. The birth of history—investigative history—is inseparable from that of the historian who began to speak, name himself, and assert his autonomy against the anonymity of the scribes: with the alphabet, writing is no longer servant. Thus, together with the sciences and philosophy, historical enquiry—*historié*—was born in classical Greece. Herodotus did not entrust to stone or mud-brick the recounting of a conquest or a victory: he set out for his readers the result of a personal enquiry, a confrontation of evidence, and offered his reader a text which transformed the arts of memory into history.

In order to create this new literary genre, it was necessary to use sources other than those of imperial chancelleries, to refer to models other than those of the rhetoric of the sovereign. It was necessary, like Herodotus, to combine seeing and hearing, to enquire about the mores, origins and customs of very diverse peoples. The sophist Hippias explains in Plato's *Hippias Major* (285) the reasons for his success, the fact that he mastered a new discipline which dealt with 'the genealogies …with the science of the past *(archaiologia)*'. For sure, this *archaiologia* is very different from what we now call 'archaeology', but the idea of a science of the past showed that monuments have their place beside documents. Ever since then, the observation of ruins and the collection of ancient objects became an integrating part of a vision of the past which claimed history as a knowable totality. *Archaiologia* in Greek and *antiquitates* in Latin designated a category of objects and of facts that a particular type of scholar sought to collect and interpret, as a way to systematize the evidence of the past.

A well-known text of Xenophon shows that the ancient philosophers had an intuition about the existence of fossils. On the origins of Egypt, Herodotus wrote, in support of arguments that Egypt had originally been a submerged gulf, 'I have seen shells on the hills and noticed how salt exudes from the soil…the soil is black and friable as one would expect of an alluvial soil formed of a silt brought down by the river from Ethiopia' (Herodotus *The Histories* II.10, 1954 Penguin translation by A.de Sélincourt). *Archaiologia* as a systematic observation of the traces of the past led naturally to the description of the varied marks of history on the earth. In the first century AD, when Pausanias visited the ruins of Tiryns and Mycenae, he was intrigued by the extraordinary architecture of the two sites and attempted to interpret them by establishing a chronology compatible with the myths of archaic history: 'there are parts of the ring-wall left', he wrote, 'including the Gate-with-Lions standing on it. They say that this is the work of Kyklopes, who built the wall of Tiryns for Proitos. In the ruins of Mycenae is a water source called Perseia, and the underground chambers of Atreus and his sons where they kept the treasurehouses of their wealth. There is the grave of Atreus and the graves of those who came home from Troy, to be cut down by Aigisthos at his supper party' (Pausanias *Guide to Greece* II.XVI.6, 1971 Penguin translation by P.Levi). His efforts to explain and interpret these remains distinguish him from the Assyrian and Egyptian scribes: he did not try to force a continuity, but to explain the reasons for a break between what we now term the Mycenaean Bronze Age and Archaic and classical Greece. The weapons of Homer's heroes were still visible amongst the treasures of the temple; verification of the tradition was possible by inspection of their manufacture and material. It does not matter much that Pausanias gives us no information about the way in which the temples were able to make a collection of such weapons: what is important is that he established a relationship between tradition and material facts.

The philosophers and antiquarians of the Graeco-Roman world were able to establish the antiquity of man and a chronology which, even if it was not absolute, suggested a considerable time difference between men of these unknown times and those of mythical times. They sensed that natural phenomena, such as the evolution of plants and animals, could unite to lay the foundations of a human prehistory. By elaborating a theory of stages—hunting, pastoralism, agriculture—they introduced for the first time a rationality in the development of ways of life and technology. They did not hesitate, as the Roman poet Lucretius suggested in the first century BC (*De Rerum Natura* V, 1283–7), to affirm that the progress of mankind was a progress in technology which, from stone to bronze and then to iron, was linked to the capacity of man to extract nature's minerals. However, we must not consider that this vision of the past was generally accepted: primitivist ideas of the decadence of man since the golden age, cyclical theories, of myth as explanation, all struggled against the rationalist explanations that our vision of the history of human science has confirmed. In its flashes of intuitive enlightenment, however, as in its original observations, the vision of the past that we have been bequeathed by Graeco-Roman antiquity constitutes for historians—and in particular for archaeologists—an appeal to humility, to doubt, and to the examination of the evidence.

What differentiated the Greeks and Romans from the Egyptians or Assyrians, therefore, was not their concern for the past but their way of being interested in it and of writing history. Within this newly established intellectual sphere, several types of history emerged. This diversity explains how it was possible for a descriptive history which sought to classify societies, institutions, and objects to blossom alongside a political history. The work of a historian such as Varro cannot be dissociated from the work of philosophers who, in trying to define the uniqueness of the human species, laid the foundations for a history of evolution in which mankind was the biological and social subject.

THE COLLAPSE OF THE GRAECO-ROMAN MODEL OF HISTORY

With the progressive break-up of the Roman empire, not only did institutions and social practices disappear, but also the framework of intellectual reference (Rodocanachi 1914). Even though, in the West, culture was going to merge with the Graeco-Roman tradition for hundreds of years still, the intellectuals of the Middle Ages never exercised the liberty, time, or facilities of their classical predecessors in classical antiquity. The difficulties of these times, the wars, the consequences of multiple invasions, do not explain everything, however; the loss of the influence of the model of ancient education, together with the affirmation of a Christian culture which was suspicious of the idolatry manifested in the ancient texts, monuments, and objects, also had something to do with it. In the great disorder which ravaged the West, bishops and monks became the devoted guardians and the defenders of Letters. Clerics had to eradicate from the countryside the numerous traces of paganism, because the type of history that the new reigning dynasties reclaimed had to justify their rapid fortune and assert their affiliation with a prestigious past. Scholars writing saintly hagiographies not only undertook to expunge the ancient literature from the works which could threaten the sacred writing, but they scarcely sustained any interest in digressions on the origins of their species—they had enough to do to establish that the Franks, like the Romans, were the descendants of the Trojans and to reconcile the Revelation with Graeco-Roman history, the only history available (Beaune 1985; Kendrick 1950).

Everywhere were the remains of fortifications, works of art, gigantic monuments such as baths and aqueducts, but they did not arouse admiration or astonishment because people in the sixth and seventh centuries AD had neither the time nor the inclination to muse on their long history. What concerned them was to live with them by converting them, modifying them or (most frequently) destroying them: a ruin was not only a vestige of a vanished past, it was, according to circumstances, an object to be made useful or removed. For the people of the early Middle Ages, the rapport with the past became one of continuity: there was no sign of a rupture between the Roman empire and their own daily lives, so why should they make one? German chiefs set themselves up in the palaces of Roman governors; peasants took over abandoned villas; princes took the marble from great villas to cover the walls of their own residences; bishops salvaged columns, statues and sarcophagi to decorate their churches and tombs; and clerics in the unstable calm of their libraries hunted out quotations of ancient authors (Adhémar 1996; see also Mennung 1925 and Wright 1844). For all of them, their interest in the past was primarily utilitarian.

THE RECONSTRUCTION AND RECUPERATION OF THE PAST

In laying claim to the Western Empire, Charlemagne was better placed than his predecessors to inherit the grandeur of Rome, and his claim was not without cultural consequences, for Antiquity became again an inspirational source and model. With the reading of ancient texts, the taste for discovery of the sources of the Graeco-Roman culture spread. The great abbots of the eleventh and twelfth centuries, such as those of Saint Benoît sur Loire, Cluny and Saint-Denis, made pilgrimages to Rome and experienced for themselves the monuments of antiquity (Adhémar 1996). The first accounts of journeys to Italy appeared at this time, and in Rome itself an interest in protecting its buildings emerged. In northern Europe, too, there is the first evidence for observations of the monuments of the past: thus in AD 1009 a Carthusian monk of Quimperlé tells us that Rudalt and Orscand, sons of the bishop of Vannes, gave a gift of land to the monastery of Saint Cado, land on which there were many heaps of stones, the first mention of the prehistoric megaliths of Brittany (Mortet 1911). These were mentioned as topographical markers, though, not as a potential source of history—for the objects found in the earth to become historical signs it was essential that the vision of the observer should itself be a historical vision, a condition that was rarely fulfilled in the Middle Ages or in Antiquity.

It was in Italy that a new feeling for Antiquity emerged: at Modena, Pisa and soon in all the peninsula, people were no longer content just to recover remains but made use of them in architecture and the plastic arts. The emperor Frederick II embodied to perfection those princes of the Middle Ages who sought to use all means to establish the continuity between the ancient and medieval worlds (Weiss 1988). Elsewhere, however, the interest of other European nations in the Graeco-Roman past seemed to diminish. The eleventh and twelfth centuries witnessed the integration of barbarian invaders and Classical history: the English and French, for example, both laid claim to their Trojan origins, whilst some scholars spiced their accounts still further with a dash of Jewish history and *chansons de geste* (Adhémar 1996). Over time, the Romans became confused with Charlemagne, the Graeco-Roman divinities with the Islamic demons of the *chansons de geste:* theatres, amphitheatres, temples became the towers of Roland, the palace of Pepin the Bref, the gates of Ganelon. In the middle of the thirteenth century all ruins were essentially Saracen, and the crusades replaced the German invasions in the popular imagination. With urban expansion, the destruction of Roman monuments reached a scale never before known—the chronicles record massive demolition of the amphitheatre of Trêves, the murals of Poitiers and the arenas of Nîmes and Le Mans, for example (Adhémar 1996). The rural and urban landscape was profoundly changing, and with it regional history.

In the cities of northern Italy at this time, scholars such as Petrarch, the most celebrated editor of Livy and Cicero, embarked on writing treatises on Roman history; his taste for the ruins of Rome marked the rediscovery of the town. The work of such scholars established the break between the present and the past and dictated that Antiquity should be treated as a historical object, investigated by visits, descriptions, and studies of objects such as inscriptions and coins. The Italian scholars of the fourteenth and fifteenth centuries laid out the path of humanism by preparing a return to Antiquity which was not merely a purely literary experience, or even the rediscovery of certain plastic forms, but the systematic comparison between the monument and the text (Weiss 1988). The fifteenth-century antiquarian Cyriaque of Ancona was one of the first people since Varro to tackle the question of the truth of the written sources: monuments, coins and inscriptions were now *sigilla historiarum,* 'seals of history'.

RENAISSANCE ROME, THE CAPITAL OF HISTORY

If the intellectual movement that was to overturn history (and the sciences!) in Europe was Italian, it was because the Italians found themselves at the confluence of two movements which were like the poles of the Renaissance: they were the best placed to supply themselves with Latin and Greek manuscripts, and to discover in their towns and countryside the clear presence of Antiquity (Weiss 1988). The description and study of antiquities in fifteenth-century Rome was not only a speculative and disinterested activity: it was necessary for the development of the town, with possibilities for profit, for the ancient monuments provided cheap material for the construction of residences for princes or cardinals—some building contracts specified the reuse of materials found on site. Surveys and excavations had an economic function devolved to a particular type of builder, the *cavatore,* who exploited the soil of Rome on such a scale that the Popes tried to limit the destruction and to reserve for Papal finances at least a part of the profits. In 1515, Leo X entrusted the construction of St Peter's to Raphael, expressly commanding him to control the antiquities which were to be used to decorate or build the monument and to avoid any destruction that was not decided by himself.

The Italian antiquarian of the Renaissance thus took after Archimedes as much as Herodotus, because he was essential to every architectural project—in Italy at this time there was no architecture without archaeology. The very rapid changes that affected the treatment of ancient monuments, with the development of techniques of excavation, survey, and the critical evaluation of monuments and written texts, paralleled the revolution which overturned the knowledge and editing of ancient texts. The antiquarians, through the ties which they maintained with the scholarly world because of the necessity of interpreting coinage and restoring and interpreting inscriptions, became familiar with the methods of textual criticism, of *emendatio,* correction and *recensio,* and the verification and comparison of manuscripts. The clerks of the Roman court coexisted with the artists and builders responsible for the construction of the new Rome.

EARLY ANTIQUARIANISM NORTH OF THE ALPS

Nicholas Fabri of Peiresc, who was born in 1580 at Beaugensier in Provence and died at Aix in 1637, was unanimously acknowledged both by his contemporaries and by tradition for being the greatest antiquarian of France, at least until Montfaucon (Gassendi 1641). He published nothing, and is known for a correspondence which radiated across the whole of Europe. He collected books and rare and exotic objects, but he brought to his collection a preoccupation with knowledge and the desire to explain and to know, in pursuit of which he sought the help of Rubens, Galileo, Camden and many others. He showed to the scientific world that, if there had been a country of choice for all the antiquarians, antiquity was found everywhere where men of curiosity wished to discover it. The lesson was heard, far from Roman palaces, but in close communion with the most ardent humanism: from the fjords of Norway to the banks of the Thames, from the plains of Moravia to the canals of Holland, people began to scrutinize the earth and the countryside, trying, like Peiresc, to understand them (Sklenar 1983).

Amongst those that he knew well was William Camden, author in 1586 of a historical and geographic description of the British Isles called *Britannia* (Daniel 1964, 1967; Daniel and Renfrew 1986). Its original character and the quality of its observations (Fig. 1.1) quickly made this book the bible of British archaeology, repeatedly republished, added to, and enriched from the time of his death to the present day. Camden was not the first British antiquarian, but because his work was easily accessible he became, even more than Peiresc, an example and a model for others. His technique was topographic, departing from Roman geography to construct a local history of each English town, but his aim was not limited to high Antiquity: the ancient geography had to be the foundation for a history that considered the Saxon and medieval periods as a part of the history of a kingdom which asserted its place in the world of letters. Camden's two imperatives were precision of time and of place, and for these he invented the rules of historical cartography: the linguistic study of place-names to distinguish between Roman, Gaulish, and Saxon contributions; and reconstruction of historical territories through tradition and the study of coinage. He was the first to establish the existence of indigenous coinage in Roman Britain and to decipher the inscriptions on the coins to identify the towns from which they originated. In the face of the Trojan legends and Roman tradition, he emphasized the Anglo-Saxon character of the British population.

As far as we can tell from the sources, Nicolaus Marschalk (1460/70–1525) of Thuringia was the first scholar to use excavation to try to resolve a historical question (Stemmermann 1934; see also Abramowicz 1983). He asked himself about the difference between megalithic alignments and tumuli and, as a good reader of the Latin writers on the Germans, he attributed one to the 'Heruli' and the other to the 'Obétrites'. Not content to study the monuments, he remarked that nearby

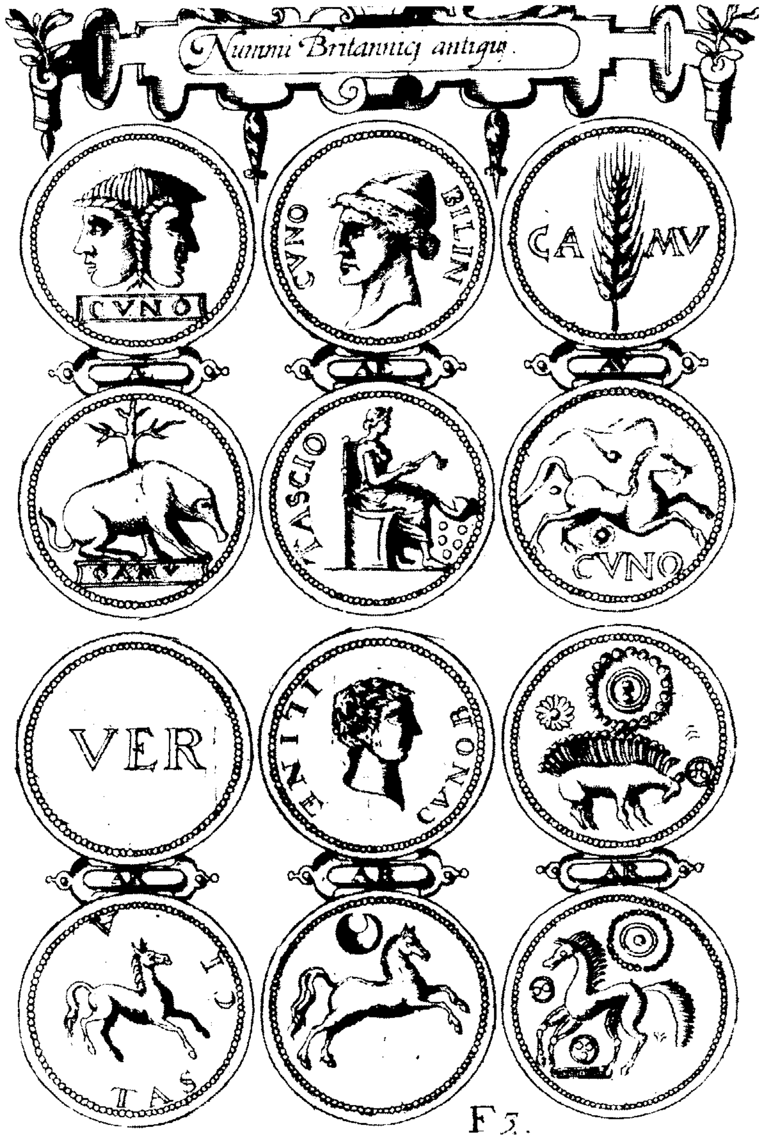

Figure 1.1 Drawings of ancient British coins from William Camden's *Britannia* (1600). Reproduced with permission of Curtis Brown Ltd, London on behalf of Copyright © Glyn Daniel 1967, Glyn Daniel and Colin Renfrew 1988.

vessels with cremations had been found which he considered to be the graves of servants of the chiefs buried in the funerary monuments. Like 'thunderstones' (which we now know as palaeolithic handaxes—Figure 1.6), megaliths and tumuli, prehistoric cremation cemeteries formed an element of the 'archaeological landscape' of medieval and modern Europe, but the presence of immense 'urnfields' on the plains of central Europe was now an additional element of curiosity. Not everyone accepted this view, however: the 'cosmography' of Sébastian Münster which appeared a few years later took up again the myth of vases 'spontaneously born in the ground' (Schnapp 1996) —like the thunder-stones, the urns (which we know as vessels of the late bronze age Lausitz culture) were considered as objects of curiosity which it was appropriate to place in royal cabinets of rare objects *(Wunderkammer)*.

Though the mythological identification of thunder-stones was traced back to ancient authors such as Pliny and Varro, the tradition was maintained right up to the eighteenth century and beyond. However, Michael Mercati (1541–93), the director of the Vatican's botanical garden, had already in the sixteenth century presented an alternative to the majority view that claimed them as manufactured by lightning (Mercati 1719). He saw the similarities between the objects being found in the countryside by Italian peasants and the Vatican's growing collection of American Indian and Asiatic artefacts being brought back by Italian and other voyagers. Professional historians, he wrote (*Metallotheca* XII), believed that before the use of iron, blades were detached from hard flint for use as knives.

What is striking in the history of these interpretations of flint, pottery, megaliths and tumuli is the perfect parallelism of the interpretations: in contrast with the mythological traditions, a small number of scholars produced convincing theories, but they were never completely accepted by the scientific world. This duality between knowledge and tradition was the basis of the archaeology of the sixteenth century. Certainly there were differences between one country and another: Britain was notable for archaeological cartography, in the tradition of Camden; the antiquarians of central Europe were more active in excavation, and in attempts at ethnic interpretation following the writings of Tacitus; the French, with the notable exception of Peiresc, were more concerned with collecting and cataloguing thunder-stones, coins and inscriptions than travelling the countryside. Meanwhile, in Scandinavia, a new way of practising archaeology was born where, for the first time in European history, the states were not only concerned with legislating on the preservation of the past but with the creation of archaeological institutions.

SCANDINAVIA: THE ARCHAEOLOGICAL SCIENCE OF THE NATION

At the end of the twelfth century Saxo Grammaticus had already pointed out the presence of strange monuments in the Scandinavian countryside, enormous artificial hills or blocks of stone that he attributed to the giants of the past, but systematic collection of Nordic antiquities did not begin until the end of the sixteenth century

(Klindt-Jensen 1975). Johannes Bureus, the son of a pastor of Uppsala, was educated in the strict humanist discipline, knowing Latin and Greek, but also Hebrew, which he taught himself. In the passionately intellectual and nationalist climate of the Swedish court, his interest soon turned towards the decipherment of rune stones. He established an accurate alphabet, suggested rules for transcription and proposed a dating system, and above all undertook a systematic survey of all the inscriptions in Sweden. Accompanied by two assistants, from 1599 onwards he organized regular archaeological and topographical expeditions. In comparison with Camden's, his method was not an original one, but it was distinguished by the care taken over drawings and the attention devoted to the epigraphic material, whose collection was the principal objective of his excursions: in a few years, his team collected a quarter of the inscriptions known today from Sweden. The kingdom of Sweden was thus the first state to have an archaeological service, whose work anticipated many of the features of our modern antiquities services. The achievement of Johannes Bureus has also to be understood in the context of the political and diplomatic rivalry between Swedes and Danes at this time: the two double monarchies (Denmark-Norway and Sweden-Finland) intended to create an image of their past that matched their political and diplomatic role in a Europe torn apart by wars. History thus constituted a formidable ideological stake between the two kingdoms, and in Scandinavia archaeology was from its inception a critical part of history.

The exploration of the earth is a voyage in time; in order to undertake it, there is no need for Latin and Greek sources, but one must have at one's disposal an inclination to be curious, an eye always on the lookout, and a taste for the countryside and for drawing. Johannes Bureus and Ole Worm (1588–1654) were the founders of an archaeology of the landscape which is the ancestor of our modern surveys: their innovation did not only consist of the inspection, cataloguing and surveying of sites, but in their topographic approach and their interest in accurate recording and publication. From site to publication, Worm (who was antiquarian to the king of Denmark) controlled a sequence of complementary operations which could no longer be undertaken by an isolated individual, but which demanded collaboration to facilitate his knowledge, functions and international relations. Worm's researches (Worm 1643) also showed the way to those such as Olaf Rudbeck (1630–1702), who moved from observation to excavation (see pp. 13–14). The Scandinavian antiquarians, perhaps because they were more in a hurry than others to find new historical sources, were the first to attempt the synthesis of collection and interpretation.

'COMPARATIVE ANTIQUITY': JOHN AUBREY

Peiresc, Camden and Worm opened the way for the epigraphists, numismatists and all those who were engulfed in the vast movement of curiosity that came from the Renaissance and its consequences on the intellectual life of Europe. However, in order for the study of antiquities to progress, it needed the addition of fieldwork to the knowledge not only of literary sources but also of local customs, place-names and regional linguistics. It was a Briton, John Aubrey (1626–97), who was to succeed in this synthesis (Daniel 1964, 1967; Legg and Fowles 1980; Powell 1963). An admirer of Francis Bacon and Descartes, Aubrey was an active member of the Royal Society of London, a friend of Thomas Hobbes and William Harvey, a colleague of Newton and Locke, in short a man at the centre of British intellectual life, a physician and naturalist as well as a folklorist and antiquarian. His major antiquarian work *Monumenta Britannica* remains unpublished in Oxford's Bodleian Library, but the manuscript was circulated, read, and admired as one of the most important treatises on archaeology in the seventeenth century.

Aubrey's method consisted of combining observation of the present and the past, ethnology with textual tradition, the analysis of the landscape and the anatomy of its monuments. He is distinguishable from Worm by the larger scope of his interests and methods, but also by his rejection of description for its own sake and by his willingness to establish rules of interpretation which governed observation. In order to restore these antiquities 'of an age so long ago that no book can reach them', he invented a method of 'comparative antiquity': he was certainly not the first to envisage the comparison of monuments with each other as a way of identifying them, but he can be regarded as the inventor of the typo-chronological method, the systematical classification of archaeological types, as is shown in his *Miscellanea*. To arrange objects and monuments according to a chronological order, to identify the variables which decided their order, and to compare the types that emerged one with the other—this was the method proposed by Aubrey, and it seemed like the programme of a new science. Aubrey did not confine himself to a palaeontological restitution of the past, he suggested to the antiquarian that his final goal should be to recover the form of life, the behaviour, even the psychology of vanished populations. 'Comparative antiquity' is a speculative method which attempts to elucidate the language of the monuments.

THE GERMAN AND SCANDINAVIAN SEARCH FOR THEIR ORIGINS

In Scandinavia, Olaf Rudbeck (1630–1702), doctor, philologist and student of myths, was the most active and the most visionary of seventeenth-century archaeologists, bringing not only topographic survey to excavation but also, in his excavation of the tumuli of Uppsala, the stratigraphic section (Klindt-Jensen 1975). A curiosity for local antiquities was also as strong in a troubled Germany, constantly seeking its origins: here too, doctors and pastors were the first actors of a new history that was as attentive to the countryside as to texts. Christian Detlev Rhode and Andreas Albert Rhode personified this new generation of antiquarians who dared to descend from the saddle to excavate the soil with their hands. Both ministers, both from the region of Hamburg, C.D.Rhode (the father, 1653–1717) and A. A.Rhode (the son, 1682–1724) combined a solid classical education with a taste for the earth, much like the contemporary British antiquarians, but they owed to German erudition an experience of excavation that was scarcely found anywhere in Europe.

The goal of A.A.Rhode, who took on the collections and excavations of his father in 1717, was the more ambitious: he wished to share with the curious the concrete experience of contact with the past, using the results of excavations as a way of understanding local history. In order to achieve this he published a weekly magazine, *Cimbrisch-Holsteinische Antiquitäten Remarques,* which is one of the most entertaining publications in the history of archaeology (Rhode 1720). Rhode brought to his discoveries a freshness of first amazement and a naïvety—but also the precision—of a man of the soil. Excavation was not considered as a manual task for a subordinate, but as a technique of exploration which obeyed a set of rules. J.D. Major had already proposed several techniques for excavating tumuli to avoid the destruction of the funerary structures within them. Like the other pioneer excavators Rudbeck and Major, Rhode was a meticulous observer of detail. This curiosity was not limited to observation, but also led to interpretation: he asked himself about the functions of flint in the daily life of the ancient peoples of Germany, himself working on modern flints in order to reconstruct the techniques of the ancients. Rhode did not possess the extraordinary intuition of an Aubrey in matters of typology, nor did he give the same attention to topographical survey of his excavations as Rudbeck, but more than either of these he typified, in his many interests, the field archaeologist of the Age of Enlightenment. For these men, the knowledge of the past was inextricably linked to their religious convictions. The thirst for knowledge of the pastors of northern Germany was inseparable from their desire to apply their reason to religion, and in this they are similar to those in Britain who went out to find the Druids in order to rescue a new type of Anglicanism.

DRUIDS AT THE SOURCE OF HISTORY: WILLIAM STUKELEY

Everything began, however, under the auspices of a serene positivism. William Stukeley (1687–1765) was born in Lincolnshire and began his studies of medicine at Cambridge at a very young age. There, and afterwards at St Thomas's Hospital in London, he formed connections with everyone in England who was respected as a scientist at the time, including Isaac Newton, the astronomer Edmond Halley, and Richard Mead, the director of the hospital and one of the most brilliant doctors of his time. In this scientific milieu, where a taste for antiquities was linked with a passion for botany, astronomy and mathematics, Stukeley—aided by his gift as an artist—showed himself as an outstanding observer (Daniel 1975, 1981; Kendrick 1950). He was not the first to discover Stonehenge, but his description and surveys were momentous, and his visit to the neolithic site of Avebury was to enter into the annals of British archaeology. He combined the description of the landscape with excavation, and his vision was that of a modern archaeologist, paying attention to the layers in the earth. Because he complemented his discoveries with precise survey (Fig. 1.2), Stukeley is without doubt one of those who made the greatest contribution to the foundation of field archaeology (Piggott 1976, 1985, 1990).

His contribution, though, was not limited to the development of topographical analysis or to the inclusion of excavation within the range of tools of scientific verification available to the antiquarian. His researches led to a chronological analysis of the past which threw to the winds the interpretation of megalithic structures as Roman or Saxon in favour of a Celtic origin. However, without the means of establishing a chronology which showed the existence of a history before history, Stukeley came to consider all pre-Roman monuments as Celtic. The consequences would not have been so dramatic for science if Stukeley had not linked enigmatic sites such as Stonehenge and Avebury with the Druids, whom he considered as Phoenician colonists and as the civilizers of Britain—a kind of silent Christianity which well before the Revelation had tried to introduce to Europe the early symptoms of civilization. For this was the central question. If the scholars of the Rennaisance had succeeded in expelling the fable of Trojan origins from the scientific history of Europe, the theologians of the seventeenth century were not emancipated from biblical chronology. In consequence, the beginnings of history in Europe had to be mixed with holy history. It is not, then, surprising to find that Stukeley built his druidic revelation on such sources. It is a strange irony that this admirable scientist who began his enquiry with excavations should have ended it with the maddest reveries!

QUESTIONS OF BIBLICAL REVELATION

Why did not the most passionate and curious of the antiquarians of the seventeenth and early eighteenth centuries try to relate what they observed in the ground to a chronology that was longer than commonly accepted? Part of the answer lies in the emblematic history of Isaac Lapeyrère (1594–1676), a scholar who, if not the

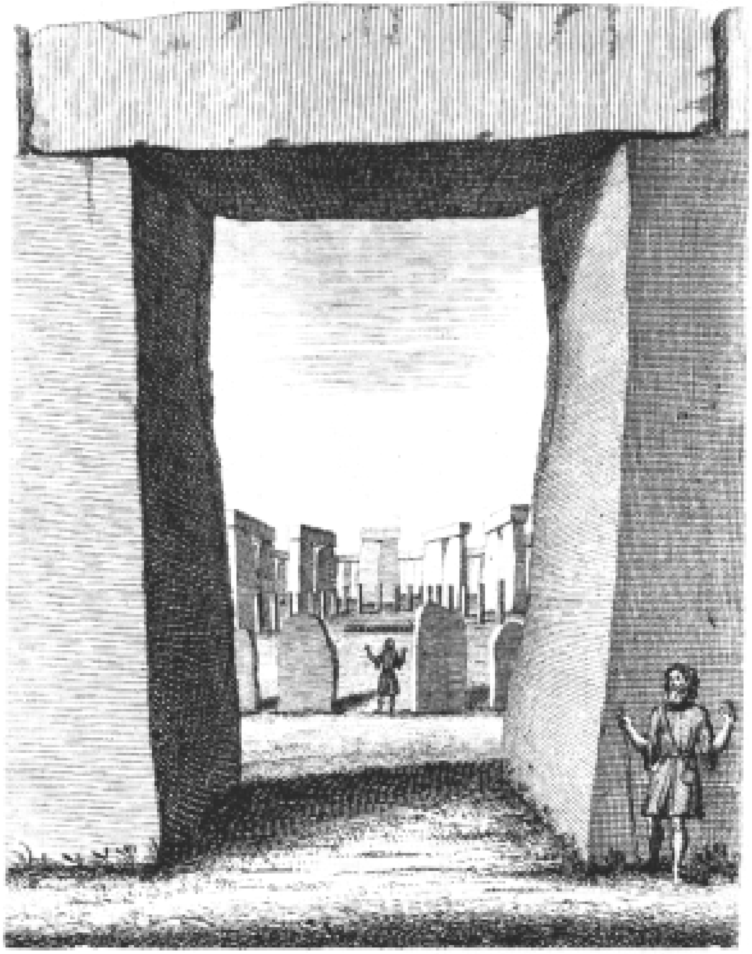

Figure 1.2 William Stukeley's illustration of Stonehenge from his *Stonehenge, a Temple Restored to the British Druids* (1740). Reproduced with permission of Curtis Brown Ltd, London on behalf of Copyright © Glyn Daniel 1967, Glyn Daniel and Colin Renfrew 1988.

most learned of his generation, was certainly the most obstinate defender of a long human history, 'du noir abîme du temps' to use the poetic definition of Buffon (1776). Lapeyrère was the author of a work published secretly in 1655: *Preadamitae, sive exercitatio super versibus duodecimo, decimotertio et decimoquarto, capitiis quinti epistolae D.Pauli ad Romanos* ('The Préadamites, or an essay on verses twelve, thirteen and fourteen…of the epistles of Paul to the Romans'). This book was not a surprise to the scientific world (Popkin 1987). The notoriety of its author and the passionate character of its subject made it a sought-after and awaited manuscript, published in five editions simultaneously, three by a single publisher, Elsevier, in Amsterdam.

At the edge of Protestantism and Catholicism (indeed also of Judaism, as some authors saw him as a Christianized Jew), Lapeyrère appeared literally obsessed by the narrowness of the historical and geographical boundaries imposed by the Jewish Revelation. Contrary to the accusations of his innumerable (and fascinated) critics, Lapeyrère did not attempt to undermine the basis of the holy scriptures, but sought more modestly—but just as dangerously—to distinguish in biblical text that which was human from that which was divine. Doing this, he resumed an ancient tradition that allowed for mankind a history that was much longer than that authorized by the biblical Revelation. That humanity had a long history of tens of millennia was an idea common to the Greeks, and before them to the Egyptians and to the Assyro-Babylonians, but the reading of the Bible, from the moment when it became accessible to the Greeks and Romans through the translation of Septantes, offered a much shorter chronology and a story of the creation of the world which was to become an essential point of Christian orthodoxy.

From the time of St Augustine in the fifth century AD, all reference to a history of the world which was longer than the few millennia of biblical history became suspect and heretical. The discovery of America, however, came to disturb these certainties because, first, it posed to scholars the question of the origin of the American people and, second, because much evidence attested that these peoples used a chronology much longer than the biblical tradition (von Hohenheim 1929). Even if Christopher Columbus had never considered that the Americans could be different from the Indians that it was normal to encounter on the journey to Asia, his immediate successors soon confronted the problem of the ethnic and racial nature of the Amerindians. It took some effort for the missionaries and conquistadors to admit that it was men and therefore souls that they conquered. Once the human identity of the Amerindians was admitted, speculation over their origins was wide: lost tribes of Israel, Phoenicians, Arabs and even Norwegians were invoked to explain the peopling of America (Popkin 1987).

Lapeyrère had to wait a long time before the scientific world would accept the evidence of men before Adam. The reason for this was undoubtedly the fact that the antiquarians of the period regarded the proposition of the existence of pre-Adamite man only as a philosophical suggestion. However, in his *Relation de l'Islande,* Lapeyrère showed that, although he was not an antiquarian by profession, he knew well how to develop a geographical and historical argument. Did he not at the time of his stay in Copenhagen debate with the master of Scandinavian antiquities, Ole Worm, and visit his museum? It was Worm himself who told him about the first inhabitants of Greenland and Iceland, and it was due to him that he was able to contest Grotius's theory that the Americans were the descendants of Vikings that had established themselves on the American coast from Greenland. To the Scandinavian and British surveyors, the German excavators, and the Italian and French collectors, Lapeyrère made a gift of the long antiquity of man, but they were hardly inclined to accept it, because, in displacing the question of the origin of man from a descriptive to an interpretive sphere, he had transformed a chronological question into a philosophical one.

Certainly others before him such as Fracastoro, Leonardo da Vinci and Bernard Palissy had suggested that the world was very much older than it appeared and that fossils were not the result of some spontaneous phenomenon by which the mineral imitated the animal, but were once living creatures petrified and buried deep in the earth. Furthermore, G.Owen, and after him N.Steno, suggested a stratigraphic theory of the formation of the earth that also required a long time-scale (Rossi 1984); but none of them addressed the crucial dogma of Adamism. Even if some, such as Robert Hooke in his *Micrographia* (1665) and his *Lectures and Discourses on Earthquakes* (1669), had discrete doubts about the necessity of the biblical Universal Flood, it was better to separate the history of mankind from the history of the world. For the naturalists, the history of the world paralleled that of humankind, but the different lines of evolution never intersected. Natural history should have everything to gain by borrowing its methods from the secular history of the antiquarians. Shells and fossils were the

> medals, the urns and the monuments of nature, they are the biggest and the most durable monuments of history which in all probability are distant precedents of the most ancient monuments of the world, more than the authentic pyramids, mummies, hieroglyphics and coins and they offer more information on natural history than all the latter put together on civil history.
>
> (Hooke 1705:355)

These comments by Robert Hooke illustrate well the paradox of the era—the naturalists agreed with their colleagues to construct a history of the natural world on the model of antiquarian history, but did not ask the opposite question: whether antiquarian history could benefit from natural history. For sure, the idea of the vastness of natural history and of its relationship with the history of humankind was in the air, but precisely because he made a manifesto of this idea, Lapeyrère created about him a vast halo of distrust. He had to wait two centuries before his theories found an echo amongst antiquarians, with the discovery of the immensity of prehistoric time in the mid-nineteenth century. Thus the men of the Enlightenment provided the tools necessary for archaeological observation: numismatism, epigraphy, field observation, topography, and, in some cases, as we have seen, a sense of the landscape, and an interest in the relationship between what appeared on the surface of the earth and the layers that formed it. With this, there were also regional and national traditions. The taste for ruins and for exploration of the Scandinavians, the taphonomic passion of the central European antiquarians, the British attachment to the description of local antiquities, the more traditional preoccupation of the French and Italians with the collection of Roman and Greek antiquities, together painted an archaeological landscape that had very little in common with that of the Renaissance. It was necessary next to provide some order for all this.

TOWARDS A SCIENCE OF MATERIAL CULTURE: THE ENLIGHTENMENT

Bernard de Montfaucon (1655–1741) represented the great tradition of the Benedictines of Saint-Maur: like Mabillon, he was both a palaeographer and a philologist, but he had the idea, during a visit to Italy (1698–1701), of devoting a part of his religious texts to antiquities (de Broglie 1891). Montfaucon's project, as is revealed explicitly in its title *L'Antiquité Expliquée* (Montfaucon 1719–24), was to attempt to explain the monuments of Antiquity by illustrating them with as full documentation as possible—and he suggested to the reader to devote two years to the systematic study of his manual. The work was structured functionally (and here again we find the Varronian plan): first there are the gods, then cults, then the customs of life (the private mores) to which correspond the public mores—'wars, vehicles, roads, bridges, aqueducts, navigation' —with the last part devoted to funerals, tombs and mausolea. Rather than by simple curiosity, Montfaucon was driven by a historical ambition to reconstruct the past from a global perspective: to the antiquarian, texts suggested ideas, notions, the functioning of institutions, whereas objects and monuments offered knowledge of another kind, their analysis subject to the eye of the expert and the hand of the artist. The ancient Platonic distinction between the world of ideas and the world of the senses led him to consider that archaeology was the image and history the text. *L'Antiquité Expliquée* was a methodological effort to assign to each object a text which gave it meaning; in this way Montfaucon theorized the reciprocal movement between text and image that underpins historical archaeology today.

In opposition to the classic *descriptio* and *interpretatio*, the Count of Caylus proposed the replacement of the philological model by an experimental paradigm, making the antiquarian a sort of physicist of the past. Born in 1692, he accompanied the ambassador of France to Constantinople and visited the coast of Asia Minor, before beginning, from 1718, the life of a dilettante and friend of the arts. An excellent engraver himself, he was interested in the techniques of drawing and painting, past and present. His fortune allowed him to be the patron of Parisian artists, and also to acquire antiquities from a network of devoted correspondents which spread as far as Alexandra or even Syria (Rocheblave 1889). However, he was not a collector in the narrow sense: once the boxes of antiquities had been unpacked, he thought of nothing but letting the scientific world know about them. His contribution to archaeology stands in a number of memoirs published by the Académie des Inscriptions, but his masterpiece remains his *Recueil d'Antiquities Egyptiennes, Erusques, Grecques, Romaines et Gauloise,* published in seven volumes in Paris between 1752 and 1768.

No one before him (and very few after him) explicitly criticized the philological interpretation that the scholars of the Renaissance had applied to monuments: if the study of antiquities had something to do with an experimental method, the paradigm of textual interpretation would no longer suffice, and the diagnosis of the archaeologist, like the reasoning of the physician, was open to proof. As much as it was possible, it was necessary to establish laws: if every object could be assigned to a place and a period by virtue of a cultural determinism that was observable and quantifiable, the antiquarian thus had a logical instrument capable of ordering series of objects. Caylus's double principle of evolution and cultural distinction laid the foundations of the descriptive typology which is at the heart of modern archaeology.

In 1711, at the same time that Montfaucon completed the writing of *Antiquité Expliquée,* a colonel in the Austrian army, the Prince of Elbeuf, who owned a small property near Portici in southern Italy, discovered there at the bottom of a well statues and inscriptions of an exceptional quality (Zevi 1987). In 1738 the King of Naples ordered the resumption of these explorations under the direction of a Spanish engineer, Rocco Joachim Alcubierre. Beginning from the wells and the galleries of the Prince of Elbeuf (happily situated in the centre of the theatre of Herculaneum), the excavators found a treasure house of inscriptions, bronze and marble statues, and above all—unique in the history of the Graeco-Roman world—paintings which the disaster which struck the town had rapidly buried and thus protected. Ten years later, under the direction of the same Alcubierre, the king ordered similarly spectacular excavations to begin on the site of Pompeii (Fig. 1.3). It is difficult for us today to imagine the passions and the interest that these excavations released at a time when they constituted practically the only royal archaeological site in the whole of Europe.

These discoveries impacted on the collection of antiquities in the Kingdom of France. First, the great construction programmes of roads and fortifications of the age of Louis XIV revealed numerous buried monuments. The fortifications constructed by Vauban led to the discoveries at Metz and Besançon of Roman amphi-theatres. The bridge builders encouraged by Trudaine, director of 'Ponts et Chaussées' (Bridges and Roads), sent Caylus wonderful surveys of their discoveries, which provided a number of illustrations and commentaries for *Recueil d'Antiquités* —the idea of a survey of French antiquities was born. There was even systematic excavation, subsidized by the royal government. In 1750 the bridge engineer Legendre had identified at the site of Châtelet, between Saint-Dizier and Joinville

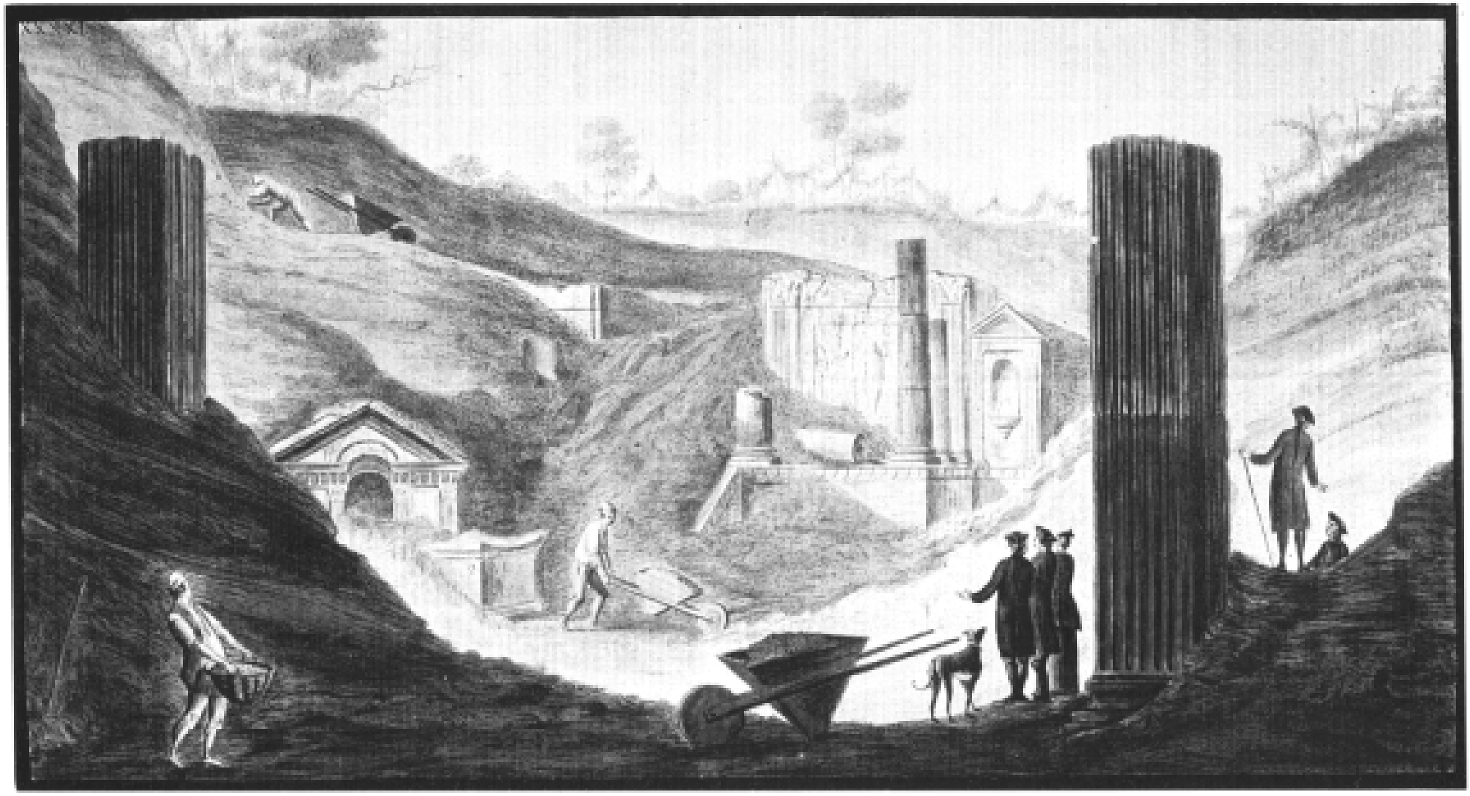

Figure 1.3 Early excavations at Pompeii. Reproduced with permission of Michael Holford Photographs.

in Champagne, an important Gallo-Roman site, and in 1772 Grignon, a master blacksmith of the neighbouring village of Bayard, decided to undertake excavations there with the support of the Académie des Inscriptions et Belle-Lettres and of the king. He published his discoveries in 1774 in two volumes of the *Bulletin des Fouilles Faites par Ordre du Roi d'une Ville Romain, sur la Petite Montagne du Châtelet*. Grignon was one of those practical minds that contributed to archaeology the techniques of a man of the land: survey and topographical analysis, drawing and description of the finds, attention to the variations in the ground and the conditions of discovery.

Throughout the eighteenth century, intellectuals attempted to make intelligible the mass of discoveries which kept accumulating, but it was Johann Winckelmann (1717–68), the son of an obscure shoemender of Stendal in Prussia, who completely renewed Western awareness of the works of the Graeco-Roman world (Fig. 1.4). There were indeed already many scholarly works on ancient art, but in his *Histoire de l'Art de l'Antiquité* (1781) Winckelmann proposed an order in the learned jumble of knowledge, daring to establish a stylistic chronology where his predecessors had contented themselves with iconographic commentary. From his perspective, Greek art was not the bearer of a particular awareness, determined historically, but the ideal of a perfect and absolute beauty, embodied in the works of Phidias; stylistic analysis was not, as with Caylus, a technical instrument, but the key to the knowledge of an aesthetic. He gave to the social world of dilettanti, writers, artists, and antiquarians a framework of reference and a philosophy of art, with both practical and intellectual consequences.

From the middle of the eighteenth century, the Grand Tour (first to Italy, and soon to Greece and Turkey) became a mode of social distinction and cultural exploration. The travellers of the eighteenth century, like the antiquarians who preceded them, were collectors, but they showed a technical curiosity and a willingness to imitate that was new. Ambassadors put their resources at the service of the collectors. Richard Worsley, British ambassador to Venice, Choiseul-Gouffier, French ambassador to Constantinople, Lord Elgin, British ambassador in the same town, Sir William Hamilton in Naples: all these had their 'antiquarians', their draughtsmen and their mould-makers. In London, the Society of 'Dilettanti' founded in 1733 was the soul of these undertakings, the place to meet for English gentlemen, the most resolute and numerous of the travellers. Their curiosity combined with the necessity to finance their journeys to make looting economic sense (Constantine 1984; Pomian 1987).

The incredible and unsurpassed success of Winckelmann can be explained within the context of the Enlightenment, when a taste for, and a knowledge of, Graeco-Roman antiquities was at the heart of European culture (Gaetghens 1986). Where Europe only knew taste, however, Winckelmann offered an aesthetic of Greek art: his *History of the Art of Antiquity* is not a series of comments on art, but a well-

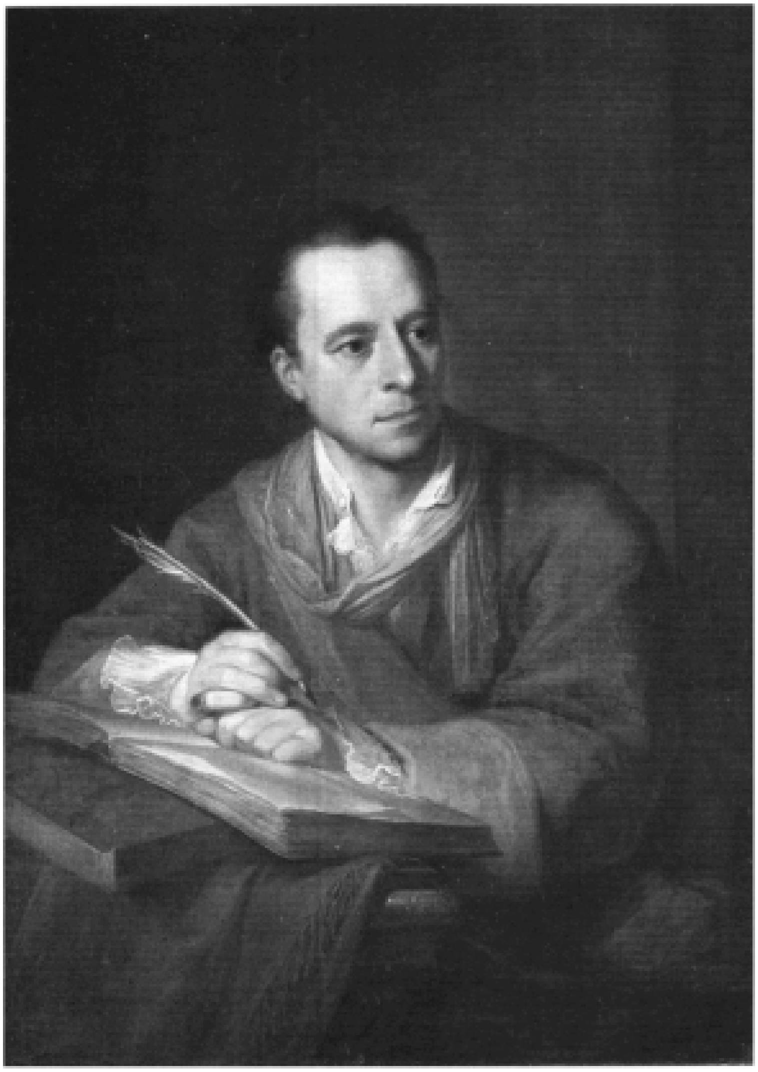

Figure 1.4 Johann Joachim Winckelmann (portrait by Angelika Kauffmann, 1764) whose *History of Art* (1763–68) renewed Western awareness of the works of the Graeco-Roman world. Reproduced with permission of Kunsthaus Zurich.

ordered account which laid out, in his inimitable style, the works in their historical context. Generations of antiquarians had sought to explain objects, but Winckelmann claimed to explain culture through objects, a formidable change of perspective that appealed to scientists as much as to artists. Even better, he was not content only to talk to the princes of Germany, the scholars of Holland and the cardinals of Italy in revealing the charms of the sublime: he addressed the men of the Enlightenment to tell them that if Greek art had attained such a degree of perfection (as he put it: 'by no people has beauty been so highly esteemed as by the Greeks') it was because it developed in the most liberal society that humanity was to have known: beauty was the sister of liberty. To the gifts of his pen Winckelmann added those of the connoisseur, travelling from one collection to another, from Rome to Paestum via Herculaneum, on the lookout for all the new archaeological discoveries of his time. Winckelmann imposed on the society of his time a new image of Greece, an aesthetic which was to be considered for decades as the key to the understanding of ancient art. The sublime and freedom were the two poles of Winckelmann's view of Greek art, though later writers did not always interpret it thus: for some—Herder, Lessing, Humboldt and of course Goethe (Franz 1945) — the mystery of Greek art constituted the heart of Winckelmann's heritage, whereas for others, particularly for the revolutionaries, the Ancients' message of freedom found in Winckelmann its modern incarnation.

BETWEEN THE MIST AND THE FLOOD

The discovery in 1685 in Normandy of the tomb of Cocherel provides a good example of the difficulties which the antiquarians of the eighteenth century confronted when they tried to interpret monuments outside the classical tradition. This megalithic tomb, carefully described by the gentleman who excavated it, comprised a burial chamber in which around twenty corpses were buried with unusual objects: flint axes, worked bone, arrow heads: 'it seems that these barbarians had no use of either iron, copper or any other metal' (Montfaucon 1719: vol. 2). This first burial was associated 'on ground raised eight inches above' with a cremation burial. Montfaucon favoured an ethnic interpretation of these different means of burial: 'without doubt these are the burials of two nations of the most distant Antiquity'. However, he was wary of chronological interpretation, contenting himself with joining to his description a letter of an antiquarian from Bâle, Jacques Christophe Iselin, which gave full details of similar burials found in Germany and the Nordic countries. In this letter, Iselin suggested a simple classification of these types of burial according to the weapons and tools discovered in the excavations, a succession from stone to copper and thence iron. It was a fundamental paradigm inherited from the Greek and Latin authors, but which hitherto no antiquarian had explicitly used to classify archaeological finds.

Other antiquarians had already experienced the malaise of discovering, or at least intimating, a time longer than biblical history. In *Les Epoques de la Nature*, for example, Buffon (1779) argued that there was no solution of continuity between the history of humankind and the history of nature:

> as in secular history, one consults the titles, one pursues the medals, one deciphers the ancient inscriptions, in order to determine the period of human revolutions, and notes the dates of events; just as in the history of nature, one must search through the archives of the world, draw from the entrails of the earth the ancient monuments, gather their fragments and reassemble in a body of evidence all the indices of the physical changes that can reconstruct the different ages of nature. It is the only way to fix some points in the immensity of space and to place a certain number of valuable stones on the eternal road of time [our translation].

With the prudence of someone who knew he was treading on dangerous theological ground, Buffon suggests throughout this essay that what he had proposed for the history of the world and of animal species, others might undertake for human history.

Pierre Legrand d'Aussy (1737–1800) was another antiquarian who found himself contemplating a 'deep antiquity' beyond the classical and biblical chronologies (Laming-Emperaire 1964). Typological reasoning suggested that megaliths could not be monuments built by the Gauls, constructed a few centuries before Caesar, but 'tombs of the first times of the nation', which went back to an 'immeasurable succession of years'. However, although he had an intuition of the long duration of history, he did not understand the existence of prehistoric times because, like his contemporaries in France, his approach remained purely theoretical: during the early decades of the nineteenth century, French antiquarians, in contrast to those of Germany and Britain, hardly ever excavated. In Britain, on the other hand, an interest in the observation of the soil and excavation had continued since Stukeley: men such as the Reverend Brian Fausset (1720–76) and the officer-engineer James Douglas (1753–1819) were the pioneers of a primarily funerary field archaeology (Marsden 1983). They were early examples of the English nobility's romantic passion for opening tombs (Fig. 1.5).

Two characters linked by such a passion embody this new British archaeology: William Cunnington (1754–1810) and Sir Richard Colt Hoare (1758–1838). For them, barrow digging was a collective exercise, a professional undertaking supported by documents, plans and sections (Daniel 1967). Their curiosity was not confined to funerary archaeology: it was the beginnings of landscape archaeology as well. The work on the ground was prepared by preliminary prospection, the excavation then supervised by Cunnington and his team. In 1808 Colt Hoare undertook the editing of a comprehensive monograph, *A History of Ancient Wiltshire,* which was published from 1810 to 1812. Colt Hoare wanted to be a real historian—as he commented, 'we speak from facts not theory. I shall not seek among the fanciful regions of Romance an origin of our Wiltshire barrows.' However, for all their passionate endeavours, antiquarians such as Legrand d'Aussy, Colt Hoare, and Cunnington could not make the logical relationship between their material and the layers of the earth because of the short chronology of biblical history—the accepted

Figure 1.5 The English nobility's romantic passion for barrow-digging, as illustrated by the *Gentleman's Magazine* (1852). Reproduced with permission of Curtis Brown Ltd, London on behalf of Copyright © Glyn Daniel 1967, Glyn Daniel and Colin Renfrew 1988.

chronology calculated by Bishop Ussher dated the beginning of the world in the first book of Genesis to 4004 BC. As the Danish antiquarian Rasmus Nyerup commented in 1806, 'everything which has come down to us from heathendom is wrapped in a thick fog: it belongs to a space of time which we cannot measure. We know that it is older than Christendom, but whether by a couple of years or a couple of centuries, or even by more than a millennium, we can do no more than guess.' Where did the border which separated the ancient from the very ancient begin?

Already by the seventeenth century, the pioneers of fossil research Nicolaus Steno and Agostino Scilla had shown that the history of the earth was made up of a long process of geological formation. The most curious antiquarians could not fail to note the discoveries which, like Cocherel, demonstrated the existence of a worked stone industry associated with the evidence of the great antiquity of man. In 1715, a librarian from London, John Bagford, described a flint point discovered in a gravel pit in London as like a Breton weapon made from a point of flint driven into a long handle (Daniel 1975). In 1797, John Frere, high sheriff of Suffolk and later Member of Parliament, discovered a series of worked flints (Fig. 1.6) associated with animal remains several feet below the ground in undisturbed deposits in a brick quarry in Suffolk; he wrote to the Society of Antiquaries (in a letter published in their journal *Archaeologia* for 1800) that 'they are, I think, evidently weapons of war, fabricated and used by people who had not the use of metals…the situation in which these weapons were found may

Figure 1.6 The 'weapons of war, fabricated and used by a people…even beyond that of the present world', illustrated by John Frere in *Archaeologia* (1800). Reproduced with permission of Curtis Brown Ltd, London on behalf of Copyright © Glyn Daniel 1967, Glyn Daniel and Colin Renfrew 1988.

tempt us to refer them to a very remote period indeed, even before that of the present world'. However, his spectacular discoveries did not at the time provoke any particular debate—the Society recorded that 'thanks were returned to our worthy member Mr Frere for this curious and most interesting communication'. After all, without directly questioning the biblical chronology, scholars had long been trying to identify men contemporary with the Great Flood or Universal Deluge of the Bible. Thus in 1774, a pastor of Erlangen, Johan Friedrich Esper, discovering fossil animals, worked flints and human remains in the caves of Bayreuth, claimed that he had found in the earth physical traces of the Flood (Esper 1774).

Such debates characterized the first half of the nineteenth century. In France, Cuvier (1787–1832) collected and described as many animal fossils as possible, assigning them to well-defined strata and thus laying the foundations for a general stratigraphy of extinct species and associated geological features (Cuvier 1801). In Britain, the geologist and theologian Dean Buckland (1784–1856) made extensive studies of cave stratigraphies (Daniel 1967). Paradoxically, however, though their researches opened the way to a rigorous study of the association between human remains and fossil animals, both Cuvier and Buckland challenged the idea of contemporaneity between man and extinct mammals, explaining their discoveries in terms of biblical floods, as the sub-title of Buckland's *Reliquiae Diluvianae* (1823) indicates: *Observations on the Organic Remains Contained in Caves, Fissures and Diluvial Gravels and in Other Geological Phenomena Attesting the Actions of an Universal Deluge*. In contrast, Marcel de Serres, a pupil of Cuvier and a friend of Buckland, in collaboration with the naturalist Jules de Christol and pharmacist Paul Tournal, discovered and published remains of fossil animals associated with stone tools in central France, and argued for their great antiquity (Grayson 1983). Doctor Schmerling (1791–1836) of Liège published documents with similar findings, as did Boucher de Perthes (1788–1868) on his discoveries in the Somme gravels (Cohen and Hublin 1989). However, such conclusions went against the opinions of most geologists, naturalists, and antiquarians. It was only after geologists accepted uniformitarianism, the basis of modern geology advocated by Charles Lyell in his *Principles of Geology* (1830–33), that occurrences of stone tools associated with extinct animals could be recognized as indisputable evidence for the antiquity of man (Daniel and Renfrew 1986). As John Evans reported to the Society of Antiquaries in his lecture of 2 June 1859, 'this much appears to be established beyond doubt, that in a period of antiquity remote beyond any of which we have hitherto found traces, this portion of the globe was peopled by man'.

THE RISE OF MUSEUMS AND OF COMPARATIVE ARCHAEOLOGY

A number of factors distinguish the pre-modern from the modern development of archaeology. While some of them were already present in the period prior to 1850, as we have seen, it was their contribution to a new organizational and ideological framework, spurred by a remarkable quantitative increase in archaeological finds, which made possible the development of archaeology as a scientific and public discipline.

The formation of numerous museum collections during the first half of the nineteenth century in Europe, closely paralleled in America, was in the context of three major processes (Kristiansen 1985): as described in the previous section, history and natural science, including archaeology, replaced popular myth and religion as the dominant expressions of human origins; the landscape was transformed as the western world changed from static mercantile—agrarian societies to dynamic industrialized societies; and nationalism rose to dominance as a political and historical framework (Trigger 1989). In this ideological climate, the first museum collections appeared as exhibitions of the origin of nations.

The formation of museum collections and the destruction of the archaeological heritage were interrelated phenomena, not as cause and effect but as alternative responses to social and economic developments (Kristiansen 1985, 1996a, 1996b). The rapid destruction of archaeological monuments in the late eighteenth and early nineteenth centuries led to the uncovering of thousands of burial finds and hoards and a growing desire to preserve the archaeological heritage. As has been demonstrated in many studies, a graph of museum acquisitions over time, divided into ten-year intervals, reveals a recurring trend: all over Europe finds from non-professional contexts (levelling of barrows, drainage and so on) boom during the nineteenth century, while professionally excavated finds start to increase only during the latter part of the century. During the twentieth century, non-professionally uncovered finds decline, while professional excavations become the main source (Fig. 1.7). This pattern can be explained by the effects of agrarian intensification, land reclamation and so on, which brought forth thousands of finds as well as destroying a similar number of monuments in the process. Museums arose in part as a response to this development, in order to save at least the movable part of the archaeological heritage. Only the increased archaeological activity in the latter part of the nineteenth century, in combination with increased pressure to protect the surviving monuments in the landscape, changed the picture.

During the early nineteenth century, museums were mainly passive receivers of finds, whereas later they became increasingly involved in classification and excavation, and in developing conservation policies for the non-movable part of the archaeological heritage. The critical change came with the development of comparative archaeology as a framework for classifying objects. For over a century, above all since Aubrey and Caylus, scholars had seen that it was possible to classify the remains of the past by using their intrinsic characteristics to arrange them chronologically. This method, as common to antiquarians as to geologists, had not only overturned geology at the beginning of the nineteenth century but had also led to considerable progress in historical, classical, and then oriental archaeology.

In the early nineteenth century, archaeological curiosity not only affected geologists and palaeontologists, it spread throughout the eastern Mediterranean. The fight for independence in Greece mobilized European opinion, enflamed by the ideas of Winckelmann, the poems of Goethe, Hölderlin and Byron, and the public's enthusiasm for antiquities such as the Parthenon frieze purchased by Lord Elgin

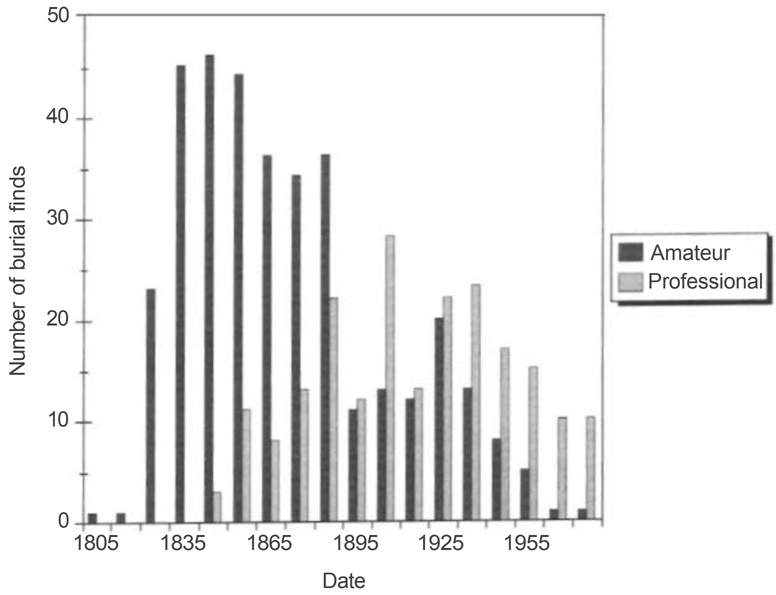

Figure 1.7 Number of amateur and professional burial finds of the Early Bronze Age on Zealand, Denmark; in most cases, barrows levelled for cultivation yielded the finds. © Kristian Kristiansen.

and displayed in the British Museum (Fig. 1.8). The taste for Greece was matched by that for Egypt, in part stimulated by Bonaparte's expedition to Egypt (1798–99), on which he was accompanied by many scientists. The many resultant publications, in particular Edme Jomard's lavish *Expedition to Egypt* (1809–22), were the originators of the 'Egyptian style' which affected both architecture and the plastic arts. The decipherment of the Egyptian hieroglyphic script on the Rosetta Stone by Champollion (1790–1832) further stimulated the taste for Egypt, and the parallel deciphering of the cuneiform inscriptions of Assyria by Rawlinson (1810–95) produced similar interest in the ancient civilizations of the Near East (Larsen 1997).

However, it was in northern Europe where the model emerged that was to revolutionize archaeology. Christan Jürgensen Thomsen (1788–1865), Curator of the National Museum in Copenhagen, was the first archaeologist to construct a museum on the succession of stone, bronze and iron (*Aarbøger Nordisk Oldkyndighed* 1988; Hildebrandt 1937; Jensen 1992). He argued for the necessity of comparing the technologies of archaeological and ethnographic objects (Thomsen 1836): 'experience shows that similar conditions and in particular an equivalent cultural level lead to equivalent tools'. In giving such concise expression to the law

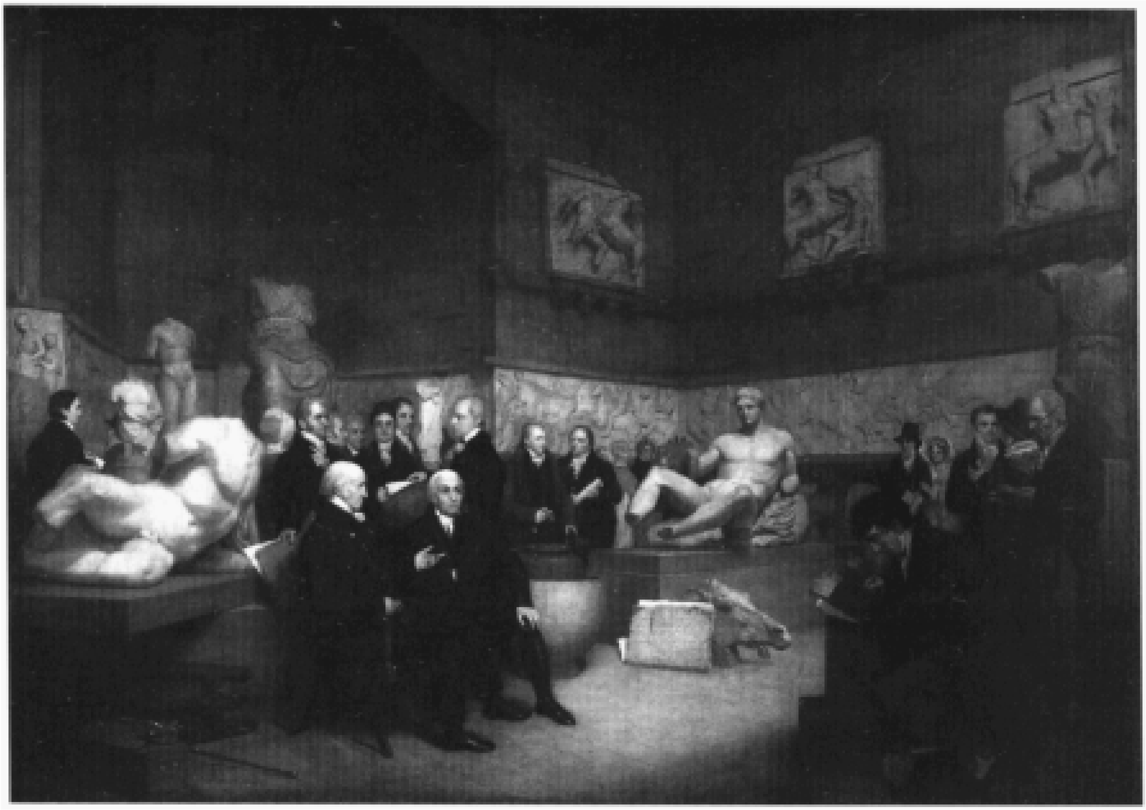

Figure 1.8 The Elgin Marbles displayed in the British Museum in 1819. © The British Museum.

of cultural similarity, Thomsen added to the typological rules of Caylus a way of analysing objects that was not only descriptive but also technical. He laid the foundations for a prehistory that was no longer dependent on texts. Also, he was able to construct a picture of prehistoric Europe before writing that coincided with the revelation of the prehistory of humanity. The originality of Thomsen was not only in the justification of the old model of the Three Ages of Stone, Bronze and Iron which had inspired philosophers, historians and antiquarians ever since classical Antiquity: it was also in the practical consequences that it brought with it—the establishment of a chronology which could be the basis of an explanation that was accessible to everyone. Thomsen published his guide to Nordic antiquities in 1836, but his system had already been elaborated and applied when he used it to organize his collections. In fact, Thomsen's museum methodology is perhaps his most important contribution to archaeology (*Aarbøger Nordisk Oldkyndighed* 1988; Jensen 1992).

The many museums that swiftly followed his lead differed from the earlier 'cabinets of antiquities' in two important aspects: they were all based upon systematic classifications and recordings of objects in their original find context, and they had as their main objective the presentation of this new evidence to the public in an orderly manner, according to period, find context, and type. Museums were thus anchored both in a new scientific tradition of recording and classification and in a new tradition of public display, based upon the history of the nation-state and its cultural origins. In the expanding industrial and colonial states of the United States, France, Germany and England, this inevitably included the cultural heritage of the Near East (Larsen 1997) and the eastern Mediterranean and Greece, whereas in central and northern Europe, and in Latin America, the focus was on the national archaeology (Trigger 1984). By the mid-nineteenth century, therefore, the new concept of public, national, museums—later to expand to regional and local museums—had become formalized, with the aim of collecting, recording and presenting the movable past, including archaeology, to the public.

CONTEXT, EXCAVATION AND STRATIGRAPHY

Alongside the development of his classification system, C.J.Thomsen had laid down the principles for recording museum collections according to find circumstances, finder, the context of the find, and descriptions of individual objects that were numbered. He established the methodological principle of the 'closed find', the context of objects found in association being the starting point for analysis and interpretation. He also established the basic methods of museum registration, as expressed, for example, in a letter to a colleague in 1822: 'no less important is that the antiquarian should observe which objects are found together—we have been neglectful in this respect. I hope that the careful inventory we keep on everything that comes into our Museum will be of some help' (Kristiansen 1985:21).

J.J.A.Worsaae (1821–85), Thomsen's brilliant successor, consolidated and expanded his mentor's work by adding a new methodological practice to archaeology, that of systematic excavation according to the principles of stratigraphy—what the American archaeologist Rowe called 'Worsaae's Law' (Fig. 1.9). He established a more precise chronology for Danish prehistory, a particularly important contribution being his study of shell middens first discovered on the coast of Jutland in 1848: aided by the zoologist Steenstrup and the geologist Forchammer, he demonstrated that they were the food refuse of stone age hunter-gatherers—what we now know as the Ertebølle Mesolithic (Fischer and Kristiansen in press). He also published his results in a readable and accessible way, beginning with *Danmarks Oldtid oplyst ved Olsager og Gravhoje* in 1843 (when he was only 22), published in English in 1849 as *The Primeval Antiquities of Denmark*. Other Scandinavian pre-historians followed his lead, integrating acute observation of the evidence from the ground with the application of evolutionary theory, producing important syntheses of their prehistory such as Sven Nillson's *Skandinaviska Nordens Urinvånare* (1837), published in English in 1868 as *The Primitive Inhabitants of Scandinavia*.

The second half of the nineteenth century witnessed the gradual emergence of archaeology as a discipline with its own philosophy and field methodology (Daniel 1975; Trigger 1989). In America this period has been called the Classificatory-

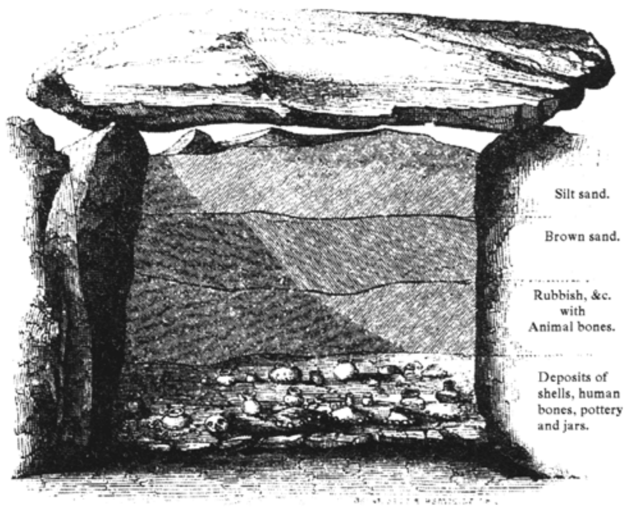

Figure 1.9 An illustration by J.J.A.Worsaae of a section through a megalithic tomb. Reproduced with permission of Curtis Brown Ltd, London on behalf of Copyright © Glyn Daniel 1967, Glyn Daniel and Colin Renfrew 1988.

Descriptive period by Willey and Sabloff (1974). In both Europe, America, and the Near East, it was the great period of explorations and early excavations of prime sites: in North America the great Mississippian mounds; in Central and South America the great Maya and Inca ruins; in the Near East, Troy, Nimrud, Nineveh and Babylon. In Europe, excavations of stone age caves, for example of the Dordogne in central France by Edouard Lartet and Henry Christy, of the lake dwellings of Switzerland, 'kitchen middens' of Denmark, and of thousands of prehistoric barrows and cemeteries all over Europe, uncovered a hitherto unknown rich pre-historic past. To these researches must be added the work described earlier by archaeologists such as Boucher de Perthes and the geologists and zoologists who collaborated with them to establish a new scientific understanding of the antiquity of man.

The decade 1855–65 in particular revolutionized the classical, biblical, perceptions of the antiquity of man, and laid the foundations for not only the modern world-view, but also for its science-based foundations in geology, zoology, and archaeology. The pioneering works published by Darwin and Lyell in England, Lartet and de Perthes in France, and Worsaae and Steenstrup in Denmark, all had several things in common: they were all based upon field investigations and carefully documented observations, including principles of stratigraphy, find context, and typological change, establishing a new scientific practice that in time eclipsed the initial scepticism that usually greeted their publication. They were also based upon interdisciplinary work, which was to remain a dominant feature in archaeological practice until this day. These ground-breaking works established the basic methodological principles of archaeological excavation and observation, and the use of natural science.

As described in Grayson's (1983) study of this pioneering phase, the results were immediately applied and discussed on both sides of the Atlantic, but the scientific network that linked the main actors is no less interesting. Both Lartet and Boucher de Perthes refer in their works to the first results of the Danish Kitchen Midden Commission from 1851 as supporting evidence. Worsaae visited Boucher de Perthes in Abbeville, and refers to both the French and English results in an 1859 article in which he noted that 'entirely independent observations have been made in England and France, which are in almost verbatim agreement with the reasons given here for my proposed distinction between an early and a late Stone Age' (Worsaae 1859, our translation). The small band of early archaeologists was well connected, and travelled widely with the new modern means of transport, steam boats and trains. From the 1860s onwards, the network of this new international archaeological research community found its formal forum in international archaeological congresses that helped to speed up the distribution of new results, as well as the development of archaeological methods and principles of interpretation (Fig. 1.10). The formation of archaeological societies throughout Europe during this period helps

Figure 1.10 Participants in the international archaeological congress in Copenhagen 1869, posing for the photograph at a shell midden under excavation at Sölager, northern Zealand. Reproduced with permission of the National Museum, Copenhagen.

to explain the great similarity of excavation methods and reports that were published during the later half of the nineteenth century by some of the pioneering figures in archaeological excavation, such as Schliemann in Germany, Pitt-Rivers in England, Sophus Müller in Denmark, and Max Uhle in America. However, though by 1870 archaeology had been established as a discipline in its own right, it still lacked its own interpretative methodology, beyond that of find context and stratigraphy. This was to follow in the decades at the end of the nineteenth and beginning of the twentieth centuries.

CHRONOLOGICAL SYSTEMS AND EARLY INTERPRETATIVE FRAMEWORKS

The late nineteenth century and the early twentieth saw the development of chronological systems based upon the principles of typology. A major figure behind this was the Swede Oscar Montelius (Gräslund 1987), and the French Gabriel de Mortillet (for the early Stone Age: de Mortillet 1872). During the 1870s, at work in the National Museum in Stockholm, where all new finds were brought in, Montelius observed how objects changed gradually. By ordering the artefacts in so-called typological series, he was able to demonstrate in great detail the direction of typological change (Figs 1.11 and 5.2). By adding the evidence of closed find association and the stratigraphy of barrows, he could then prove his typological series to be chronological. A new method had been born, by combining existing methods with a new principle of typological change.

On this basis, Montelius was able in 1885 to subdivide the Nordic Bronze Age into six periods instead of the previous simple division between an Early and Late Bronze Age, a scheme further developed in his later publications (Montelius 1895a, 1895b, 1900, 1904). An important aspect of the new method was the plotting of all finds on a distribution map, to distinguish between spatial and chronological change. These maps established the first documentation of archaeological cultures that could be relatively dated against each other. Montelius also developed absolute dating by cross-dating down into the safe chronological harbours of the ancient civilizations in the East Mediterranean (Eggers 1959; and see Chapter 5). Later he applied his method to the bronze and early iron age cultures of Europe and the Near East (Montelius 1903—which includes a description of the principles of typology that still reads as a methodological masterpiece). We should note, however, the practical background to these early methodological developments in Scandinavian archaeology and their later international spread. The National Museums in Copenhagen and Stockholm were the first to acquire a large representative sample of finds from the main periods that could be subjected to comparative and typological analyses. This explains the validity of many of the old chronological systems:

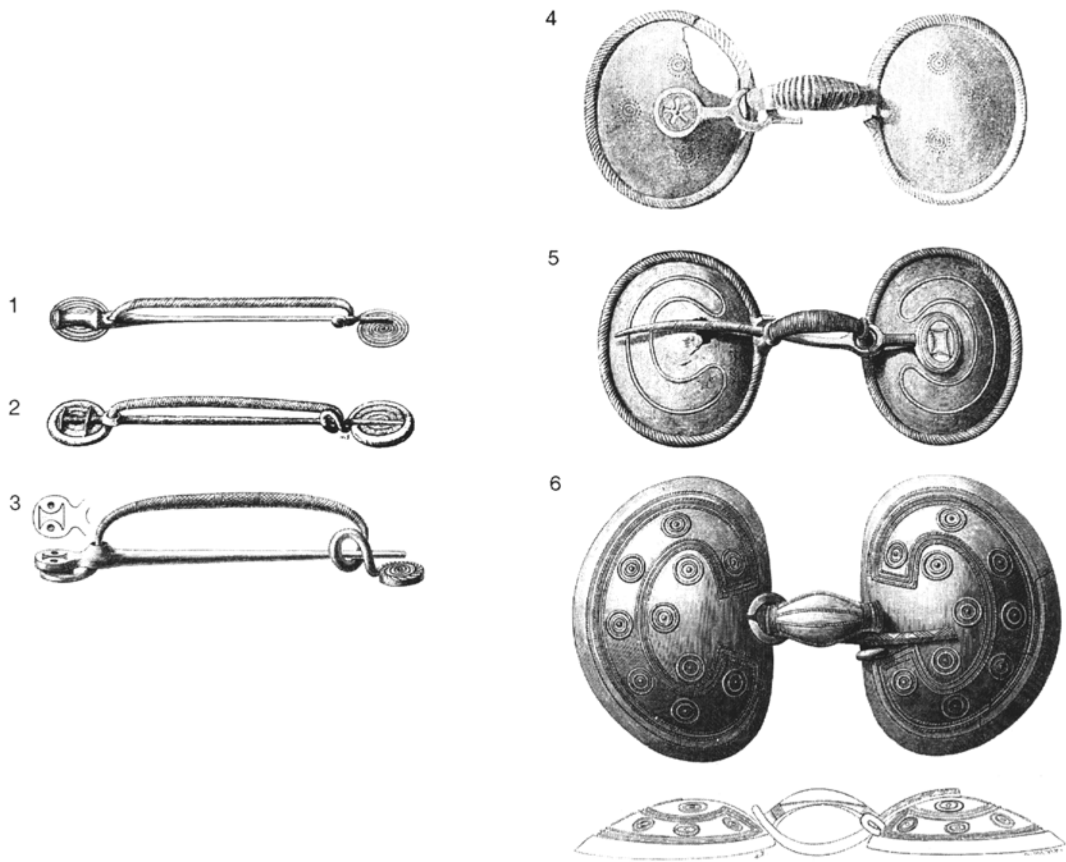

Figure 1.11 The typological method: the development sequence of bronze fibulae (safety-pins) postulated by Oscar Montelius for the Scandinavian Bronze Age. Reproduced from O.Montelius, *Die typologische Methode,* 1903. (See also Fig 5.2.)

chronological and cultural systems of comparable detail could not be established in many parts of Europe until the regional collections reached a similar level of find representativity during the first half of the twentieth century. We may, however, distinguish between an early phase lasting until the Second World War, and a later phase lasting into the 1960s. The latter was characterized by a more developed use of combination statistics and other quantitative methods, linked to demands for objectivity formulated by researchers such as Mats Malmer in Sweden, François Bordes in France and Waterbolk in the Netherlands, and culminating in David Clarke's *Analytical Archaeology* (1968).

Similar developments took place in America, although slightly delayed compared with Europe, and with a stronger emphasis on stratigraphy and the definition of culture areas (Willey and Phillips 1958; Willey and Sabloff 1974). This approach was applied systematically from 1915 onwards. The early classification period up to 1940 was mainly concerned with developing seriation, a quantitative typology that could be employed at the many settlement sites without good stratigraphies. Alfred Kroeber formulated elegantly the principle of order in civilization as exemplified by changes in fashion (Kroeber 1919), and archaeologists such as Irwin Rouse, Alex Krieger and James Ford refined and formalized the method during the 1930s and 1940s (summarized by Ford 1962; see also Meltzer *et al.* 1986). The culmination of the methodological framework of the culture area tradition was the publication in 1958 of the standard work by Willey and Phillips, *Method and Theory in American Archaeology*. With its complex mixture of methodological principles and principles of interpretation, it also represented the termination of this tradition.

Thus in the decades after 1900, the progressive application of the typological method meant that the archaeology of Europe and America came to be peopled with cultures and culture areas, horizons and traditions of all periods, which formed the background to the first interpretative endeavours (see Chapter 2). The increasing sophistication of the cultural prehistory that could be established in Europe by the typological method is well illustrated in the successive editions of Vere Gordon Childe's *Dawn of European Civilization* between 1925 and 1961. (Childe's profound contribution to the development of European prehistory through the twentieth century is explored in detail in Chapters 2, 5, 11 and 12.) In America, Julian Steward's *Handbook of South American Indians,* issued in six volumes between 1946 and 1950, is similarly illuminative.

Although the reconstruction of the past always had its place in archaeology since the early settlement excavations, the many new cultures represented an interpretative challenge that had to be met. In Europe this was most clearly seen by Gustav Kossina, who in a series of papers in the years shortly before 1900 formulated theoretical principles for the interpretation of cultures and cultural traditions (see Chapters 11 and 12). They were summarized in two interlinked propositions: 'clearly demarcated cultural provinces always correspond to specific peoples or tribes' (translated after Eggers 1959:211). This was followed by another proposition, that continuity in archaeological cultures over time also implied ethnic continuity of a specific people or tribal group. These propositions were probably inspired by the European tradition in ethnography, which in similar ways defined 'cultural areas' and linked them to population movements, and to the diffusion of specific cultural traits. Such interpretative principles were widely applied in European archaeology to trace the history of historically known peoples such as Germans, Celts and Illyrians, although not without critical discussions (Jacob-Friesen 1928). When no names existed, in the case of the people of earlier prehistory, they were named by the archaeologists. In America a related interpretative practice developed, under the influence of the so-called Boas school in ethnography, which had many similarities to the European *Kulturkreislehre* (cultural area tradition). Culture was defined as ideas which were transmitted through generations and which might spread through diffusion. Society was perceived as consisting of multiple layers that were the result of the spread and acculturation of new cultural traits and ideas over time, which led to increasing cultural and social complexity (see also Chapters 11 and 12).

Thus in the period after 1900 archaeology developed a descriptive chronological-culture historical basis, with historical interpretations of cultural distributions, diffusions and traditions as the theoretical superstructure rooted in the theoretical framework of the Boas school in America and the *Kulturkreislehre* in Europe, but applied to a historical-philological tradition in Europe. After the Second World War disillusion and dissatisfaction with this theoretical framework led to its abandonment.

The development and refinement of the methods of typology represented the final step in the development of archaeology as an independent and scientific discipline. A new theoretical framework was not to emerge until after 1960, stimulated in the 1940s and 1950s, especially by Gordon Childe and Grahame Clark in Europe and Julian Steward and Leslie White in America. These developments were accompanied from the early 1960s by a series of methodological battles which drew up the borderline between good and bad archaeology, between history and archaeology, and between amateurs and professionals (see Chapter 2). Alongside these changes in interpretation and method, however, the period between the 1930s and 1960s was also characterized by a stronger emphasis on the importance of the cultural heritage, and of the role of settlement archaeology in it.

FROM NATIONAL SURVEYS TO NATIONAL HERITAGE

During the latter part of the nineteenth century, the global destruction of monuments led to a growing recognition among archaeologists and nation-states that new measures needed to be taken to preserve the archaeological heritage *in situ*. Museums had preserved the movable heritage, while at the same time the unmovable heritage—monuments and sites in the landscape—were being destroyed at an accelerating pace. Although large-scale campaigns of barrow excavation were initiated all over Europe, it soon became clear that this only accounted for a fragment of the lost knowledge. More extensive and systematic methods of documentation had to be applied in order to preserve a record of the full range of archaeological monuments and sites before it was too late.

Thus the decades around the turn of the century were characterized by systematic efforts to make inventories of archaeological monuments and sites, and to restore and protect (either by voluntary action or through legislation) a portion of the remaining monuments, mostly the more visible ones such as, in northern Europe, barrows, hill-forts, and standing ruins. In Denmark, work started as early as 1873, whilst in England the Royal Commission on Historical Monuments was founded in 1911. By the beginning of the twentieth century, regional and national registers were emerging in many countries, corresponding to the national and regional museums. The new registers were recorded on the modern topographical maps that were being produced in the second half of the nineteenth century, often at scales as detailed as 1:20,000 (Larsen 1992).

From the turn of the century onwards, the mapping of this vast material formed the basis for the first archaeological analyses of settlement patterns. In Denmark, for example, the mapping of more than 60,000 barrows and several thousand megaliths allowed Sophus Müller to document the basic layout of neolithic and bronze age settlement structures (Müller 1904), and there were similar studies in many other countries. This new emphasis on settlement patterns based on the visible monuments naturally led on to a new emphasis on settlement sites, their discovery, and excavation. New excavation methods were developed to uncover large settlement sites, such as by Mortimer Wheeler at Maiden Castle in England and Mohenjo-Daro in India (Wheeler 1954), and by Gudmund Hatt on the early iron age villages in Denmark (Hansen 1984), but it was only after 1960 that the potential of settlement excavations was realized with the use of machines for open-area excavation and the application of the techniques of natural science (see Chapter 4). By the 1960s in both Europe and America, regional settlement projects based on the concept of systematic field surveying were setting new standards for archaeological work, expanding the principal focus of fieldwork from the archaeology of the dead to the archaeology of the living (see Chapter 13). Major contributors to this movement were, in northern Europe, Therkel Mathiassen's Northwestern Jutland project (Mathiassen 1948), and in America, Gordon Willey's Viru Valley project (Willey 1953). In Germany, Kossina's approach was replaced after the Second World War by a new *Siedlungsarchäologie,* explicitly formulated in the new journal *Archaeologica Geographica,* with leading figures such as Herbert Jahnkuhn, Georg Kossack and Rolf Hackmann. However, it reflected a general trend that was paralleled in England by J.G.D.Clark (for example: Clark 1952), in Czechoslovakia by B.Soudsky (Audouze and Leroi-Gourhan 1981) and in Holland by A.E.van Giffen (Waterbolk 1981).

The fact that these theoretical and methodological developments only became dominant in the second half of the twentieth century was due to several factors. One of them was the development of new protective legislation (see Chapter 10), which formed the basis for the expansion of rescue archaeology. In fact, from the late nineteenth century, strategies for conservation had stimulated developments in the compilation of monument inventories and in field surveying that had gradually opened up new avenues of archaeological information and interpretation. Another contributing factor were developments in the natural sciences, for example in pollen analysis, with the possibilities this opened up for reconstructing vegetational and environmental history, and in the study of bones and seeds, with similar importance for the investigation of subsistence (see Chapters 6 and 14). Major questions such as the introduction of farming could now be addressed from an ecological perspective, as exemplified in the influential work of Johannes Iversen using pollen analysis to identify the *landnam* or land colonization of early farmers (Iversen 1941) and the interdisciplinary excavations of the early farming village of Jarmo in Iraq directed by Robert Braidwood during the 1950s (Braidwood and Howe 1960), as well as Grahame Clark's classic investigation of a mesolithic hunter-fisher-gatherer site at Star Carr in northern England (Clark 1954). The rapid development of such techniques in the second half of the twentieth century, and over the same period of all the other techniques of archaeological science for analysing artefacts (Chapter 9) as well as organic remains, and to date them (Chapter 5), revolutionized the practice of archaeology—a comparison of the range and content of the papers in the 1963 and 1969 editions of *Science and Archaeology* (Brothwell and Higgs 1963, 1969) exemplifies how archaeological science was being transformed in the 1960s. These developments were also intimately associated with the profound impacts on the discipline of the successive theoretical frameworks described in the next chapter.

However, along with these dramatic transformations in methods and theories there have been developments as powerful in the whole organizational framework of archaeology and in its role in society (Cleere 1984, 1989; Kristiansen 1996b). It is paradoxical that it is only during the last decade that archaeology is beginning critically to examine and understand the deep historical connections between national heritage, national ideology, and archaeological practice (Atkinson *et al.* 1996; Diaz-Andreu and Champion 1996; Kohl and Fawcett 1995; Schnirelman 1996). It suggests that archaeology still has a long way to go before it is able to interpret and understand not only the past but also its own foundations in the present (Graves-Brown *et al.* 1996; Pinsky and Wylie 1989; Vargas and Sanoja 1993; see also Chapter 10). The development of archaeology as a historical discipline has been determined by its role at the interface between science and the humanities, history and prehistory, knowledge and interest, past and present, nationalism and internationalism, management and research. Each of these relationships deserves to be studied from a historical perspective; only then will a more complete understanding of archaeology's own history emerge.

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A general survey of the beginnings of antiquarianism and the history of archaeology is given in Schnapp (1996), though the best comprehensive history is still by Daniel (1975). There are useful introductory pieces in Greene (1996) and Renfrew and Bahn (1996), and Berghaus (1983) is valuable for its iconography. For classical archaeology the sources are collected in Stark (1880) and Thomson de Grummond (1996), for medieval archaeology by Adhémar (1996) and Wright (1844), and for the Renaissance by Weiss (1988). Regional syntheses are given for America by Meltzer *et al.* (1986) and Willey and Sabloff (1974), for Britain by Piggott (1976, 1990), for China by Chang (1986), for central Europe by Sklenar (1983), for France by Pinon (1991), for Germany by Gummel (1938) and Stemmermann (1934), for Greece by Etienne and Etienne (1990), for Italy by Settis (1984), for Poland by Abramovicz (1983), for Scandinavia by Gräslund (1987) and Klindt-Jensen (1975), and for Spain by Arce and Olmos (1991) and Mora and Diaz-Andreu (1997). Detailed discussions include those by Christenson (1989), Daniel (1964, 1967, 1981), Eggers (1959), Grayson (1983), Guidi (1988), Kühn (1976), Malina and Vasicek (1990), Svestad (1995) and Trigger (1989); of these, Eggers provides a classical introduction to archaeology organized as a history of the discipline up to 1955, Kühn gives a detailed descriptive account, Guidi and Malina and Vasicek present the background to modern archaeology, and Trigger presents a more philosophical and theoretical overview. There is still a notable lack of books on the history and philosophy of the archaeological heritage.

2

THE DEVELOPMENT OF ARCHAEOLOGICAL THEORY

Explaining the past

Charles L.Redman

INTRODUCTION

As long as people have sought to know more about themselves, they have tried to understand and explain the past. In various cultures this enquiry has taken idealist forms, such as myth, religion, or tradition, while in other contexts the pursuit has been more empirical as exemplified by the study of history and archaeology. As is outlined in the previous chapter on the history of archaeology, the Western approach to knowing the past has taken many forms, but in a general sense has become increasingly empirical.

In trying to assess the approaches used to know the past, it is impossible to separate the study itself from the individuals pursuing the study and the social context within which these studies are undertaken. The critical awareness of the active role of the researcher into the past has led to a necessary evaluation of biases influencing attempts to know the past, while at the same time leading some scholars to be cynical of our ability to know the past in an objective sense. Recognizing full well the potential biases that personal and societal values may introduce into the study of the past, this chapter takes the optimistic position that the past can satisfactorily be known through archaeology and that it has been achieved with varying degrees of success by researchers of many persuasions.

The first half of this chapter will organize its review according to four major interpretive approaches that have dominated the work of most modern archaeologists: evolutionary; reconstruction of cultural histories; economic—ecological; and social-ideological (see also Trigger 1989; Willey and Sabloff 1980). While it is useful to examine each of these approaches separately, it will quickly become evident that most researchers adopt only one or the other but work with aspects of more than one.

The second half of this chapter reviews the development of archaeological theory from cross-cutting perspectives: that throughout its history, archaeologists have sought to become increasingly empirical (sometimes within a scientific framework), as well as the fact that our discipline is strongly influenced by the political and social context within which the research is conducted. The historical trends for these developments were largely covered in the previous chapter, so this chapter will briefly review the history of thinking and focus on the situation as it has evolved since 1960. Many of the following chapters expand on the issues dealt with here, for example the discussion of how archaeologists have approached the establishment of chronologies (Chapter 5), the study of culture (Chapter 11) and of forms of social organization (Chapter 12).

THE EVOLUTIONARY APPROACH

Three major intellectual currents reached fruition in the middle of the nineteenth century, setting the conceptual basis for archaeological interpretation. First, in his *Principles of Geology* (1836) the geologist Charles Lyell proposed his principle of superimposition, or uniformitarianism, that provided the framework for a scientific understanding of stratigraphy and a rational means to ascertaining the relative age of archaeological objects already being discovered. Second, Thomsen and Worsaae proposed the three-age system (Stone, Bronze and Iron Ages) as a chronological framework for classifying and displaying archaeological discoveries from northern Europe (see Daniel 1962). Third, Charles Darwin published his *Origin of Species,* outlining the evolution of living species and suggesting possible mechanisms for change. These conceptual innovations allowed a rational context to be formulated to explain the increasing number of archaeological discoveries, such as those of extinct fauna associated with tools of obvious human manufacture.

Contrary to the religious doctrine of the time, this revolution in thinking and the archaeological discoveries of the era were indicating a very long period of human and cultural development. Moreover, this record of the past included an unexpected diversity of societies awaiting fuller explanation. Many scholars of the late nineteenth century and the early twentieth therefore adopted an evolutionary perspective to explain the development of these many cultures over what was now appearing to be very long spans of time. This clearly was initially thought of as a parallel to biological evolution, where societies changed and evolved into new forms over time according to rational, but yet to be discovered, rules. As biological evolution could be interpreted as leading through a welter of lower life forms towards more complex forms, and eventually the human species, so cultural evolution could be taken to indicate that simpler societies eventually evolve into more complex societies or become extinct. Hence, the many societies of the past, and seemingly simpler societies of the ethnographic present, could be organized along an evolutionary trajectory leading to what was seen as the pinnacle of the evolutionary tree: modern western civilization.

Scholars from many countries adopted an evolutionary perspective, but it was in the United States that it gained greatest popularity. Archaeology there had grown with the expansion west and its academic marriage to the anthropology of American Indians. Because US archaeologists saw no historical connection between their society and that of the Indians they were studying, an evolutionary perspective gave value to what they were doing more than relying on normal social concerns with one's origins. In addition, by assuming an evolutionary perspective, there is an implicit notion that a society's position along this evolutionary trajectory related to how advanced or backward it was, with the expanding western civilizations being perceived as far above indigenous Indian cultures.

Best known of the early American evolutionists was Lewis Henry Morgan, who wrote *Ancient Society* in 1877. Based primarily on ethnographic information and what was then known archaeologically of house forms, community size, and technology in use, Morgan posited a three-stage sequence of Savagery, Barbarism, and Civilization. Although this was a very general framework, it provided a conceptual approach to the diverse American Indian evidence as well as being used in many other parts of the world. The implication was that people in many, if not all, parts of the world had been and were still moving through a uniform sequence of cultural development. This sequence had evolved through its full trajectory in parts of the Old World, while European discovery of the Americas and elsewhere had revealed societies at various positions along this trajectory. This perspective gave scientific value to studying the 'simpler' societies of the Americas, because they in some ways represented what may have happened during earlier epochs on the trajectory to western civilization.

Vere Gordon Childe can be credited with integrating more than one perspective into his monumental works on prehistory, but it is clear that evolutionism was of special interest to him. In his book *Social Evolution* (1951), he adopts Morgan's three stages and adds his own strongly materialistic ideas, which clearly were influenced by Marxist writings. Childe sees parallels in the beginnings and ends of the developmental sequences he examines, but divergences in the paths taken to civilization. He also suggested that the differences in the sequences of social institutions were greater than those observed in the economic systems. He concluded that his empirical observations of the evidence of archaeology 'vindicated' the use of cultural evolution as an interpretive framework for the past.

Cultural evolution was to find opponents as well as advocates and went out of fashion in the period between the two world wars. However, evolutionary ideas were to re-emerge in American archaeology and their renaissance can be traced to the works of Julian Steward and Leslie White (for example: Steward 1955; White 1959). Steward's overall objective was to discover regularities among cultures. His approach focused originally on seeking similar adaptations to similar environments and then observing whether regularities existed in other aspects of the society. This led Steward to combine evolutionism with the observation that there were similar cultural responses to similar environments in widely separated geographical situations. He identified the most important elements of these cultures with respect to their adaptations as being their technology, economic system, and the social institutions that comprised their 'culture core'. Seeing parallel, historically distinct, trajectories towards complex society he posited a multilinear evolutionary scheme as at the heart of culture change.

At roughly the same time, Leslie White was promoting the use of an evolutionary perspective for anthropologists. Unlike Steward, who based his work on observed regularities, White's focus was on causation of development and, in particular, on a society's use of energy. He saw that the trajectory from what had been identified as simple to complex societies was paralleled by its increasing per capita consumption of energy. This was a strongly materialist perspective that focused on changing technology and the operation of integrated cultural systems rather than individuals. A new generation of American archaeologists emerged who had been influenced by the ideas of Steward and White: they believed that the evolutionary perspective would allow them to attack the general issue of culture change from an empirical perspective. Betty Meggars, for example, actively defended evolutionary theory in her writings (1954), suggesting that archaeologists could accomplish more if they adopted this perspective than if they worked with competing paradigms. Robert Braidwood was not as outspoken an advocate of evolutionism, but organized much of his influential research and writing according to an implicit acceptance of this perspective. His most explicit article, 'Levels in prehistory' (1960), sought to order our knowledge of different regional sequences as the results of the combined influence of evolutionary and diffusionary forces. However, throughout his writings on the cultural stages that led from hunting and gathering through agricultural villages to urban societies, there is a clear, but seldom enunciated, reliance on cultural evolutionism.

More outspoken advocates of the neo-evolutionary perspective were Marshall Sahlins and Elman Service whose book *Evolution and Culture* (1960) redefined the contemporary Americanist approach to the subject. Drawing heavily on ethnographic evidence, the authors suggested that developments could be best understood if we separated concepts about culture change into 'General' and 'Specific' evolutionary processes. This biologically based model suggests that at a very broad level (hence the term 'General'), societies throughout the world seem to experience similar changes and to develop in a basically parallel form. However, the familiarity with both the ethnographic and archaeological record demonstrated that the actual trajectories of culture change in each region often were significantly different in response to environmental, social, or historical factors. Looking at the survival and failure of numerous societies, Sahlins and Service proposed that two 'laws' could be used to predict the behaviour of societies. First, the Law of Cultural Dominance indicates that societies with more effective adaptive systems spread geographically. Second, the Law of Evolutionary Potential suggests that those societies that retain a greater range of adaptive alternatives within their cultural inventory have a greater chance of survival, while conversely those who become very specialized are more likely to fail over time.

Service went on to define what he perceived as the four basic forms of community organization in his book *Primitive Social Organization* (1962; see also Service 1975). Although the evolutionary mechanisms that would lead one form to evolve into the next were not the subject of the book, this typology of community forms has formed the basis of many subsequent studies from an evolutionary perspective, such as Colin Renfrew's treatment of chiefdoms in Britain (1974) and Sanders and Price's book *Mesoamerican: The Evolution of a Civilization* (1968).

An evolutionary perspective was one of the fundamental elements in Lewis Binford's early reformulations of archaeological theory that has come to be known as New Archaeology (Binford 1962, 1964, 1965). He referred directly to Leslie White and made a strong point about how archaeologists should seek to understand the evolutionary processes 'behind' culture change and not simply the regularities in the products these processes produced. Kent Flannery (1972a) and Fred Plog (1974) put forward two compelling examples of evolutionary formulations within the New Archaeology paradigm, although they adopt quite distinct positions.

Flannery conceptualizes the rise of the state as a process of increased segregation and centralization within a society. Segregation is the internal differentiation and specialization of sub-systems of the society, while centralization is the linkage between the sub-systems and the highest-order controlling apparatus in the society (1972a:409). Flannery outlines where he sees many archaeological and ethnographic societies belong on an evolutionary trajectory according to these measures. He then points out that an adequate explanation of the rise of the state would carefully distinguish between the *processes* of segregation and centralization, the *mechanisms* by which they take place, and the *socio-environmental stresses* that select for those mechanisms. Flannery adopts two evolutionary mechanisms from systems theorists to explain many of the changes that took place during the rise of the state, particularly in Mesoamerica. The first is promotion, by which a low-level special-purpose institution becomes a higher-level institution serving a more general purpose, often during a time of stress. The second mechanism is linearization, by which low-level controls are permanently by-passed by higher-level controls.

Plog formulates what he calls a 'dimensional model of change' by isolating the critical elements of change and describing their interrelationships (1974). He believes that 'certain variables critical to individual instances of change are also important to change in general' (Plog 1974:10). Plog focuses on the Basketmaker to Pueblo transition in the American Southwest, that he suggests exemplifies the world-wide cultural transition called the Neolithic. He identifies 'growth' as the process at issue and empirically examines four dimensions: population, differentiation, integration, and energy. By seeking archaeologically observable measures of each of these dimensions and then evaluating their interrelationships statistically, Plog was able to posit which factors were associated with this major cultural change.

In order to explain the causes of changes such as these, Plog (1973) suggests that we should examine how cultures deal with variations. Following more basic evolutionary theory, he points out that variety is continually being generated in every human population: in fact, if left on its own, the natural trend would be toward greater and greater variety in the world. However, processes of selection are also acting within every population to limit the generation of variety and to produce a modal pattern of behaviour. Some selective pressures are related to the environment, others emanate from our biology, while many are culturally created. For Plog, an explanation of an evolutionary culture change would be based on an understanding of the special forces that govern variety generation and selection within a particular culture and how they operate, particularly in the face of a changing environment.

Robert Dunnel is a strong advocate of an evolutionary perspective, but he urges archaeologists to abandon the tenets of cultural evolutionism and return to a more directly biological version (Dunnel 1971, 1980). He believes that within each society there is a great store of variability with respect to key issues facing that society and that some equivalent of natural selection acts to select among that variability. Implicit in this approach is a minimization of the role of conscious choice and an avoidance of dealing with symbolic systems as important to our understanding. An example of this approach is David Rindos's theory on the origin of domestication, where the process is seen as mutualistic wherein the plants and animals are equally responsible as the humans (1984). The advocacy of biological evolutionary principles is an important movement, but has not attracted the majority of archaeologists who adhere to an evolutionary perspective away from the cultural evolutionary framework.

THE CULTURE-HISTORY APPROACH

Archaeology was born out of an attempt to extend our knowledge of the past beyond the frontier of history. This is especially true for the Mediterranean world, where biblical and classical writings provided an awareness of the precursors of western civilization, but few details of those societies. Hence, European and American scholars set off on a quest for their 'origins' on European soil and in the classical and biblical lands of the Mediterranean and Near East. Austin Layard sought the Assyrians of the Old Testament, Heinrich Schliemann searched for a historical basis for the Homeric poems, and Flinders Petrie was one of many who contributed to uncovering the origins of Egyptian greatness. More than anything, these early archaeologists can be thought of as explorers who found sites, objects, and sometimes written documents that informed directly about episodes of the past.

This newly found source of evidence on the distant past resulted in some trial syntheses of the prehistoric sequences of regions, but probably the most notable cultural historian of his era was V.Gordon Childe. Although a field archaeologist himself, Childe's greatest accomplishments came through a series of books and articles in which he synthesized what was known of world prehistory, with particular emphasis on the rise of civilization in the Near East (1934) and the growth of European societies (1925). The key to Childe's success was his ability to bring together the variety of archaeological evidence available with a powerful logic based on an understanding of human history and behaviour. He wrote with a broad brushstroke, treating broad areas and vast spans of time, while pointing to particularly crucial episodes in the human career, such as the 'agricultural' and 'urban' revolutions—terms he coined (Childe 1936, 1942, 1951; see also Chapters 21 and 23). His works were logical and interesting, although sometimes short on empirical underpinnings. However, many of his reconstructions, speculative at the time, still appear to be reasonable even in the face of a half century or more of additional research.

Many other European scholars focused on the prehistory of their own continent, a subject with a huge audience, both lay and scholarly. Some, like Stuart Piggott (1965), sought to explain history from a technological/economic basis, while others like Colin Renfrew (1973) have defended Europe's independent development from those who saw all innovations coming from the Near East. Others, like David Clarke (1972), who are best known for their theoretical writing, spent most of their energies on historical studies and reconstructions.

The rationale for archaeology as a means of reconstructing history has always been strongest among European scholars, but it attracted many adherents in America as well. The origin of interest in the prehistory of the United States may have involved a bit of antiquarianism and perhaps even some racial ideas; but as the amount of information on local sequences mounted, scholars developed an intrinsic interest in knowing the past better. The key discoveries that stimulated greater interest in a systematic approach to the pre-European history of North America came from evidence of a very long Indian presence there, the fact that there were geographically delimitable cultural manifestations, and that the archaeological record could not be simply explained by one group replacing another.

As early as the 1890s, the anthropologist Franz Boas argued for more detailed ethnographic studies at the local and regional level as part of what he was defining as the historical method (Boas 1896). Particularistic studies that eschewed evolutionism or any other integrating theory came to dominate American anthropology during the early twentieth century. In the absence of any theory that would explain the extant variability in the ethnographic record or how societies developed greater complexity, observed geographic differences were assumed to represent different positions on a developmental trajectory. This had a major impact on archaeological interpretation in that, following this approach, ethnographic examples of 'simpler' societies were taken as models for prehistoric predecessors of known historic societies.

A.V.Kidder (1924) and others had been conducting extensive fieldwork in the American Southwest, combining excavation evidence with interpretive insights gained from observations of contemporary Indian groups. Kidder proposed a regional synthesis identifying local cultural traditions and developmental periods that eventually was codified by regional archaeologists at a meeting held at Pecos pueblo. Scores of subsequent researchers have applied themselves to refining our understanding of these cultures, their accomplishments, and their chronology.

In the midwestern United States, a parallel approach to classifying the rapidly growing amount of archaeological material was taken under the leadership of McKern (1939). It was based on the straightforward assumption that differences in collections of objects from the same region should be attributed to different time periods. Furthermore, the system was hierarchical, allowing that differences through time and across space could exhibit differing degrees of similarity. With a methodological basis for handling diverse information from across broad regions, archaeologists set about reconstructing local histories in earnest.

Probably the culmination of historical reconstruction is reflected in Gordon Willey and Philip Phillips's *Method and Theory in American Archaeology* (1958). The authors suggested that historical reconstructions were an essential element of American archaeology, but as a stepping stone to the recognition of cross-cultural regularities and the eventual explanation of culture change. Focusing on the eastern half of the country, Willey and Phillips proposed five basic stages of development. They saw periodic influences entering these regions from Mesoamerica to the south, but they also credited the local societies with much of the impetus behind observed culture changes.

As with most Americanist archaeologists, Willey and Phillips emphasized historical reconstruction, not as an end in itself but rather as a stepping stone toward broader generalizations about human behaviour. To others, especially in Europe, historical reconstruction was the ultimate objective of archaeology. The subjects often were seen as direct ancestors and, hence, of unique interest to scholars and lay-people alike. In fact, most European scholars were trained in historiography and recognized the false dichotomy that American archaeologists had constructed between history and science. David Clarke in particular represented a British archaeologist who was concerned both with generalizing from archaeological data and with the explanation of complex historical situations (Clarke 1968, 1978).

The focus on the value of historical reconstructions based on archaeology has also led to two developments treated later in this chapter: post-processualism and national archaeologies. Post-processualism involves many elements, but key among them is a concern for the specific historical context of archaeological materials and the social context of the investigators. With the explosion of new nations from former colonies, there has been a parallel growth in interest in their indigenous heritages. This often involves cultures and periods that were not emphasized by the colonial archaeologists and have opened new domains of inquiry (as discussed in particular in Chapter 10).

ECONOMIC AND ECOLOGICAL APPROACHES

Economic and ecological approaches to explaining the past were direct responses to the nature of archaeological data and expectations about the lifeways of the past. Tools, containers for food, and food itself, were the most common items found by archaeologists. In addition, techniques were developing quickly to monitor the ways food resources were utilized and the nature of the ancient environment. Identifying different human adaptations to their environment became the central objective of many scholars, which led to a largely functionalist approach to explanation. For some, functionalism had proved too limiting and they sought to interpret their findings through the perspective of ecological systems.

Although intertwined with the two previous approaches, this perspective attained an identity of its own from its focus on subsistence strategies, human-land relationships, and exchange systems. The name most closely associated with bringing this perspective to modern archaeology is Grahame Clark. His basic premisses were that archaeological findings should be studied in their environmental context and that reconstructing economic activities was a first step in studying the broader society. Clark assembled his views in his influential book *Archaeology and Society* (1939). In it, he argued that the primary function of a culture was to ensure the survival of a society; hence, virtually all aspects of a society would have some adaptive value that might be discovered by the archaeologist. Clark was also a field archaeologist and sought new methods for improving archaeological data recovery. He is best known for his excavations at the waterlogged mesolithic site of Star Carr (England), where he actively sought out organic material as well as stone artefacts; his work there is often cited as the paradigm for environmental archaeology. At roughly the same time, Clark published *Prehistoric Europe: the Economic Basis* (1952), in which he summarized existing archaeological data on the economic development of Europe. The result of these studies and of Clark's efforts at training many talented students was that laboratory study and interpretation of biological remains from archaeological sites became a focus of activity. This was part of his larger effort to get archaeologists to broaden their focus beyond typologies and artefacts to the broader economic and social aspects of society.

Clark's pioneering work encouraged many others to focus their efforts on discovering prehistoric subsistence patterns and information on the broader economic realm. At Cambridge, this developed directly into a major project to explain the early history of agriculture, as well as the formulation of a 'site catchment' approach to interpretation (Higgs 1972, 1975; Vita-Finzi and Higgs, 1970; see also Chapter 13). The agriculture project emphasized the improved recovery and study of the residues of plant and animal foods as the key to understanding. Site catchment analysis involved the careful study of the micro-environments surrounding a site and the resources that would be available from each.

Among American archaeologists, the focus on environment and economy took many forms. In 1948 Walter Taylor had called for a conjunctive approach to archaeological interpretation that highlighted the functional relationship between many aspects of a society. This approach did not attract many adherents immediately, but was fundamental in the initial formulations of New Archaeology twenty years later. Building on Steward's and Childe's emphasis on the importance of irrigation agriculture for the rise of urban societies, Robert McC.Adams (1966) and William Sanders (1968) proposed new multi-variable theories. Sanders' idea rested on the productive advantage afforded by irrigation agriculture and the tendency for producers in different localities to specialize in the crops they produced, leading to an intra-regional exchange system. Adams saw the same factors at work, but also believed that irrigation agriculture would exacerbate the differentials in wealth and power among landholding groups and that control of long-distance trade would reinforce the emerging economic differences.

Control of trade and the establishment of artificially high values for particular goods was seen by some scholars as a key element in establishing the surplus value to support élites within a society. Flannery had pointed to the possibility that the exchange of élite goods to less developed groups in return for access to valuable raw materials might be a powerful factor in the growth of hierarchy among Central Mexican groups (Flannery 1972b, 1976). Some scholars adopted this idea of the importance of élite exchange, while others pointed to trade in more basic subsistence goods as the prime mover (Rathje 1971). Various combinations of local and long-distance trade, as well as movement of élite goods or basic commodities, have come to form the basis of many ideas on the operation of advanced societies in prehistory (Earle and Ericson 1977; Peacock 1977; see also Chapter 15).

Other environmental perspectives used by scholars in America include what Karl Butzer has called ‘contextual archaeology’ (1980) and David Thomas’s simulation of Great Basin subsistence strategies (1972). Butzer’s approach focuses on the environmental context of a society and the ecological relationships it establishes. Availability of resources, possible climatic changes, and human impact on their surroundings all become central forces in understanding the growth and decline of particular societies. Thomas relied heavily on ethnographic observations of a historical situation to set up a very detailed model of a series of procurement strategies that prehistoric hunters and gatherers in the Great Basin may have utilized. These are defined in terms of the micro-environmental locale and the impact one has on the conduct of the other. The implications of this model were then compared to the actual archaeological data to provide insight into its validity.

THE SOCIAL ORGANIZATIONAL APPROACH

A fourth perspective includes those studies whose primary objective has been the reconstruction of prehistoric social organization. The close association of pre-historic archaeology with social anthropology in the United States has made that a logical objective for Americanists, but it also gained popularity with some Europeans as an effort to move beyond largely technological and economic explanations (see, for example, Bender 1978; James 1993; Renfrew 1984; and Chapter 12).

A focus on social organization can be seen as early as Lewis Henry Morgan’s attempt at correlating changes in social organization with changes in house forms as the key markers in the overall evolution of society (1881). The rough equation of successive social forms (that is, kinship, residence practices, and community organization) with the evolution of prehistoric and early historic societies can be seen in the works of many of those adhering to an evolutionary perspective (Fried 1967; Service 1975; Steward 1955; White 1959).

The social organizational perspective took a new turn when it became adopted by a number of young archaeologists who would soon be called New Archaeologists. Their initial concerns were with explicit testing of ideas about prehistoric behaviour primarily by using what were interpreted as stylistic differences in ceramics. The origin for this school of ‘ceramic sociology’, as I have named it, probably can be most directly traced to the work of Constance Cronin (1962) in the American Southwest. An art historian and social anthropologist by training, she was employed to study the designs found on prehistoric ceramics from a variety of sites in Arizona. Her inference was that there were uniformities in design that were associated with each site, even over periods of time. This contrasted sharply with the idea that ceramic designs changed uniformly with the passage of time, and it led to the possibility that there might have been identifiable ceramic traditions that were very localized and passed on even within single sites.

This insight was picked up by various students at the University of Chicago, who under the influence of Lewis Binford were attempting to be more explicit about testing ideas in the archaeological record and utilizing statistics to test these ideas. Freeman and Brown (1964) demonstrated the statistical differences between ceramic assemblages from different rooms and room floors and fills. William Longacre, in his 1963 dissertation, attempted to show a correlation between ceramic design elements and possible social organizational patterns at a pueblo in east-central Arizona (1963, 1970). His fellow student James Hill further systematized this approach by using sampling procedures to select rooms to be excavated, multivariate statistics to examine ceramic distributions, and a more detailed testing procedure (Hill 1965, 1970).

Archaeologists studying regions outside of the American Southwest also began to look at ceramic evidence as potentially revealing aspects of prehistoric social organization. James Deetz (1965) argued that the increasing diversity of ceramic designs among neighbouring villages could be traced to a breakdown in traditional social relations due to the entry of Europeans into the middle Missouri River region. Similar changes were observed among upstate New York villages by Robert Whallon (1968).

These social organizational studies were built upon by some young scholars (Graves 1982; Leone 1968), praised by others (Aberle 1968; Watson *et al.* 1971), and criticized by some ethnographers (Allen and Richardson 1971; Friedrich 1970; Stanislawski 1969) and archaeologists (Dumond 1977; Muller 1973; Plog 1980; Schiffer 1976). The criticisms ranged from pointing out the problems with defining social residence rules, to questioning the statistics being used, to suggesting that the context of discovery of the ceramics may not represent meaningful prehistoric units. The overall impact was to discourage further efforts to discover prehistoric social organization, at least in so far as it meant kinship types and residence rules, particularly as they operated at individual sites.

The social organizational perspective survived the criticisms, but largely by taking somewhat different approaches. Studies of inter-community organization and interaction have thrived in the American Southwest (Hantmann and Plog 1982; Watson *et al.* 1980), as well as in Mesoamerica (Flannery 1976; Haviland 1970), and the Near East (Johnson 1972; LeBlanc and Watson 1973). Other scholars have productively focused on the nature of households and household production within communities as a key to understanding the past (Binford 1978; Kent 1984; Yellen 1977). Another perspective that is attracting widespread interest is the attempt by certain scholars to discern gender relations and gender-based activities within prehistoric communities as a way to improve our insight into major processes in the prehistoric record (Bender 1978; Conkey and Spector 1984; Gero and Conkey 1991; Wylie 1992; also see Chapter 12).

For others, the criticisms of the early residence studies did not dissuade a broad approach to examining social organization at all levels (see authors in Redman *et al.* 1978). Colin Renfrew publishing a collection of his own works gives it an overall title of *Approaches to Social Archaeology* (1984). To Renfrew and others who now pursue this approach, it has come to mean a broad concern with issues beyond technology, economics, and chronology in isolation; rather, the social forms that have governed societies and driven culture change are the ultimate objective of study.

THE NEW ARCHAEOLOGY AND ITS AFTERMATH

In the 1960s what was to become known as the New Archaeology emerged in the United States under the leadership of Lewis Binford. Related developments occurred in Britain and elsewhere and the discussion of archaeological theory was elevated to centre stage in almost every forum. From its localized beginnings, people appearing to be 'new archaeologists' were doing and claiming many things during the 1970s. By the 1980s, much of the theoretical literature of archaeology is devoted to bashing the 1970s and the target often turns out to be the so-called New or Processual Archaeology. While many of the attacks come from recent theorists who are attempting to replace it with post-processual archaeology (Hodder 1982b, Shanks and Tilley 1987), some criticism comes from within what was New Archaeology, even from the hand of its original champion, Lewis Binford (1983). If scholars from both outside and inside the theoretical developments of the 1970s are rejecting the New Archaeology, why do I focus the remainder of this chapter on it? The answer is very simple: for better or worse, it is *us*!

As Alison Wylie has said (1989), the New Archaeology of the 1960s quickly became everybody's archaeology in the 1970s. Most of today's faculty members and senior archaeologists were the people who, in one way or another, adopted the teachings of New Archaeology. Although most archaeologists did not claim to agree with all aspects of New Archaeology, nor could more than two or three people agree on what it was, virtually no one rejected it outright. Typically, each one presented her or his version, often using a New Archaeology text as a starting point for pedagogical purposes. Few wanted to be left out of the exciting new theoretical movement of those years, and New Archaeology was passed on to the succeeding generation of students who reached maturity in the 1980s and who are today's young professionals.

Criticisms now levelled against the New Archaeology of the 1970s do have merit, but by discounting that era as misguided, critics have overlooked its crucial importance. New Archaeology had an important historical role in the development of the field we have today, and it has continuing importance because it is still guiding archaeology's trajectory into the future. Equally troubling is that some critics ask us to reject the basic tenets of New Archaeology and to replace them with a system often called *Post-Processualist Archaeology*. I believe this is rhetoric which not only misrepresents the achievements of the New Archaeology of the 1970s, but also does not successfully articulate the potential contributions of its own position.

To put the New Archaeology into perspective, it is important to review the social context of the decades leading up to its development (something post-processualists would certainly advocate). In the first years following the Second World War, archaeology was still a small field, but by the 1950s and 1960s it was expanding rapidly and taking itself quite seriously. With the launching of Sputnik in 1957 there emerged a frenzy in the United States and western Europe to make all disciplines more 'scientific'. Great strides were made in bringing science into archaeology through new dating techniques, a multidisciplinary approach, early experiments with the use of statistics, and devoting substantial attention to increasing the precision of artefact classification. The 1960s provided the United States with both the optimistic Kennedy years, with an emphasis on science and the conviction that we were capable of accomplishing wondrous things, and the cynical Vietnam era. Coming on the heels of a decade of civil rights unrest, the widespread dissatisfaction with the Vietnam conflict in the late 1960s moulded a generation of young Americans who were distrustful of established authority. In academic life, there was an increasing emphasis on the environment, other cultures, and people-orientated disciplines. Anthropology and archaeology grew markedly because of these trends. Archaeologists were urged to become concerned with sociological issues: the people behind the artefacts.

It was during these decades of rapid change that many of the core concepts of the New Archaeology entered the literature. However, they were not, at first, assembled into a programme for action that attracted a solid following. Walter Taylor (1948) advocated the conjunctive approach with little effect, while Leslie White's evolutionism (1959) and Julian Steward's cultural ecology (1955) attracted some attention, though largely among cultural anthropologists. Albert Spaulding led a one-man campaign to bring science and statistics into archaeology (1953, 1960). But the individual whose work catalysed the New Archaeology movement was Lewis Binford, who incorporated these earlier lines of thinking, together with an explicit concern for scientific methods and field research designs. Much of Binford's thinking probably crystallized while he was at the University of Michigan, but it was during his relatively few years at the University of Chicago that he changed the direction of modern archaeology (see Binford 1972).

Among the keys to Binford's success was that he attracted a talented group of students who, under his direction, carried out innovative research projects. Binford himself wrote a series of powerful methodological articles setting the guidelines for the New Archaeology (1962, 1964, 1965, 1968), and his students filled in with substantive examples (Hill 1965; Longacre 1963; Whallon 1966). The publication in 1968 of the book *New Perspectives in Archaeology* (Binford and Binford 1968) marked the crossing of a threshold. New Archaeology was discussed and debated by an ever-increasing proportion of the field. Binford's New Archaeology caught on because its advocation of a scientific approach was timely and because it represented a major advance over the way things had previously been done. It should be noted, however, that the political climate of the late 1960s and early 1970s was important in fostering its widespread acceptance as well. There were three important 'political' elements to the New Archaeology that were right for the times: first, it was explicitly scientific; second, it demanded social relevance; and third, it rejected arguments based on authority alone, thereby providing a means for junior people to assail the establishment on an equal footing.

The advocates of the New Archaeology created their own momentum. Binford's writing became clearer, making his message accessible to more readers. Binford's students wrote compelling articles and got teaching positions at important universities, where they could directly influence a second generation of New Archaeologists. The attractiveness of an explicitly scientific approach and the teaching of New Archaeology by this cohort led new scholars to conduct further research reexamining the results of earlier investigations. In this way early studies laid the intellectual groundwork for later studies. This cumulative aspect to several lines of enquiry followed by New Archaeologists gave the field a special momentum that made it appear as if real interpretive progress was being made. Nowhere was this more clear than in studies of decorated ceramics, the 'Ceramic Sociology' that I referred to earlier (Cronin 1962; Deetz 1965; Graves 1981; Hill 1965, 1970; Leone 1968; Longacre 1963, 1970; Tuggle 1979).

If New Archaeology had all this going for it, why was it not universally accepted and why is it now out of style? There were, unquestionably, useful innovations in New Archaeology, but it was not entirely clear how a researcher operationalized it to achieve the desired results. The early emphasis in New Archaeology on seeking general laws of cross-cultural applicability set our sights high, considering the relatively mundane set of substantive accomplishments. This grand goal led to cynicism from outsiders and active debate among New Archaeologists themselves about how realistic their objectives were (Clarke 1973; Flannery 1973a; Isaac 1971). Exacerbating these reservations about the New Archaeology was the aggressive manner in which it was promoted, leading to a defensive reaction from many established scholars. Because of this, in its early years the New Archaeology was not taught, and I doubt if it was even discussed, at many of the most prestigious universities.

Despite doubts and opposition, there were relatively few articles opposing New Archaeology during its heyday, and those that did offered an olive branch by acknowledging some of its contributions (Trigger 1973). Especially among younger archaeologists, there were few who were not attracted to the New Archaeology. Most criticized a few aspects of it and claimed to be following their own version.

In this way, they could adopt many of the convincing tenets of the new programme, yet they did not have to claim to be following Binford, who may have offended their senior faculty members.

In America one of the central tenets of New Archaeology was a rejection of culture history as the primary goal of the field; history was pejoratively associated with idiosyncratic details and regional chronology building. These activities were still valued, but only as means to a greater end—processual explanations. In Britain, however, those who appeared to accept many of the 'scientific' principles of New Archaeology did not reject history as their primary objective. This is probably due to the fact that archaeologists in Britain were trained in a modern historical approach based in the social sciences, and the connection of their prehistory to their history was quite obvious. David Clarke published *Analytical Archaeology* (1968) in the same year as Binford's *New Perspectives in Archaeology,* and it was taken by many as the outline of a sort of British new archaeology. Clarke himself clearly recognized the differences and in his own work kept to a strong trajectory of historical reconstruction. What he did emphasize in this masterwork was that up to this point archaeologists had failed to assemble a real body of method and theory that would allow their discipline to advance. He looked to sister disciplines for methods and associated theories that might set archaeology on the right path. Cultural geographer Peter Haggett (1965), numerical taxonomists Sokal and Sneath (1963), and system theorist Ross Ashby (1956) were repeatedly cited in Clarke's work and formed the methodological basis for his strongly functionalist approach. Although extremely influential through his writing and mentorship, Clarke died at a tragically early age in 1976 before he was able to react fully to the rapid theoretical developments of the era. His substantially revised second edition to *Analytical Archaeology* was published posthumously.

Few scholars today would still call themselves New Archaeologists, but much of the New Archaeology's programme has survived and has become the mainstream conduct of our field. Perhaps above any other influence, the New Archaeology's demand for rigorous archaeological methodology, both in formulating research designs for the field and analytical strategies for interpretation of results, has been fully accepted by almost all practitioners today. Which philosophical model is most appropriate is either ignored or a matter of quiet controversy, but it is without argument that researchers must be able to explain and support the methods chosen. There is now a universal expectation that explicit questions are to be formulated and a research design established before archaeological work is carried out. Also attributable to the New Archaeology is the recognition of the diversity of material needed to support an interpretive proposition and the resultant use of sampling in many aspects of field and laboratory work. Another enduring outcome of the increasing scope and precision desired for our observations has been the growing reliance on statistical procedures.

Related to the methodological changes brought by New Archaeology was the emphasis on the systemic view that culture is a series of interrelated sub-systems and on the importance of ecological relationships. This dovetailed nicely with the diverse datasets defined and sampled through extensive research designs. Emphasis on examining variability among datasets led many scholars to supplement traditional artefact typologies with attribute-based analytical systems, experimentation with artefact classes, data from allied sciences, and an understanding of the operation of material culture in a systemic context, which has, in turn, encouraged the pursuit of 'middle range theory' (see below, p. 65) and ethnoarchaeology.

I believe that New Archaeology also had an important impact on the professional structure of our discipline. New Archaeology's emergence coincided with a period of great growth in numbers of practitioners and university departments offering anthropology graduate degrees in America. Earlier, archaeological training was available in a limited number of universities where senior professors comprised the acknowledged establishment. Access to the establishment required training and apprenticeship under a senior scholar with an established reputation. This system, which is still dominant in many European countries, restricts access to professional positions and in some situations may inhibit intellectual innovations. The New Archaeology position, that new knowledge is validated through explicit testing rather than reference to authority, opened the doors for young unknown scholars to make significant contributions to the field. Such contributions became the major means of attaining credibility for young scholars and for programmes at universities without an established tradition in graduate anthropology.

Twenty-five years have passed since the heyday of the New Archaeology debates. Despite the shake-up that the new programme caused, New Archaeologists who were the *outsiders* of the 1970s now make up much of the establishment. Few people today are beating the drums of New Archaeology, but where have they all gone and what are they pursuing? Many of the people who matured professionally in the 1970s during the New Archaeology era are now involved in public archaeology, either through positions with government agencies or in conducting fieldwork for these units. Their methodological and philosophical focus has been on developing data recovery strategies and management principles. The New Archaeological emphasis on research design and hypothesis testing is fundamental in much of public archaeology today.

There also has been an expansion in the substantive domains pursued by anthropologically trained archaeologists. For some of us, it has meant carrying out fieldwork in countries that heretofore had not received much attention (McIntosh and McIntosh 1984; Redman 1986), or by expanding the study of complex societies where other disciplines have focused on only the élites to a more balanced, holistic treatment (Cowgill 1983; Fritz 1986; Marcus 1973; Wright 1969). Further developments have involved ethnoarchaeology, experimental studies, and other ways to gain insight into the meaning of the archaeological record, a series of approaches often called 'middle range theory' (Binford 1978; Raab and Goodyear 1984; Schiffer 1976). There has also been a renewed interest in the material of the archaeological record. Chemical and physical studies of ceramics are once again common after receiving little attention in the United States for forty years since their introduction by Anna Shepard (1955). These supplemental sources of information, combined with the objective of discovering differing sub-systems of behaviour, have prompted a re-evaluation of how artefacts and other information are analysed. The typological approach that yielded easily interpreted nominal sets of units is being supplemented by integrated, attribute-based systems that allow for multiple, overlapping sets of interpretive results. This is also true of distribution studies, in which models and mathematical techniques are being borrowed from geography and ecology to allow for a richer description of the patterns that we discover.

If so much of modern archaeology is peopled with graduates of the 1970s, each with her or his own brand of New Archaeology, why is there so much commotion about Post-Processual Archaeology? And why do these theorists identify what they are doing as *replacing* 'processual' or New Archaeology? Who are these post-processualists?

POST-PROCESSUALISM

In America, for the most part, the post-processualists come from the ranks of the New Archaeologists of the 1960s and 1970s. There have always been members of the New Archaeology cadre who felt that the rejection of psychological and symbolic factors was too strong and that the workings of the mind and the style of the way people do things were inadequately treated in most New Archaeological works. James Deetz (1977), John Fritz (1978), Mark Leone (1982), and Margaret Conkey (1982), among others, believed that the New Archaeology agenda, as most often portrayed, did not do justice to the archaeological record and often misrepresented what could be accomplished. These scholars often derived their concern from having backgrounds in history, art, or belief systems. With their additional insights, these post-processualists saw how non-material domains of societies, downgraded by many New Archaeologists, were crucial in deciphering the past.

The birthplace of post-processualism, as well as the area of its greatest intensity today, is Britain. Just as Binford crystallized and led New Archaeology, Ian Hodder at Cambridge has been the central figure in post-processual studies (Hodder 1982b, 1986). Interestingly, Hodder's early contributions to archaeology were in the domain of quantitative methods and locational analysis (Hodder and Orton 1976). Hodder himself has said that he was led to the new way of thinking out of a frustration with the accomplishments of archaeology as it was practised (by which he meant the version of New Archaeology defined by David Clarke). He found himself able to devise sophisticated quantitative methods to describe the distribution of archaeological artefacts or phenomena accurately, but he still did not have a solid idea about what those phenomena represented. This led Hodder in two directions: first, to investigate generalities about human existence; and second, to embark upon ethnoarchaeological studies in order to put the objects being investigated into a richer context.

Hodder soon attracted a substantial number of young British archaeologists to his way of thinking, as well as some Americans. There has been some ambiguity about who might acknowledge being a post-processualist, but for at least some time this programme appealed to some among those who were concerned with such diverse topics as Marxist archaeology, world systems approaches, critical theory, gender studies, and ethnoarchaeology. Each of these domains has found some support in Hodder's approach, but I believe that for the most part, each of them has maintained themselves as separate, although sometimes overlapping, pursuits. What one must recognize then is that the term 'post-processualism' does not represent a monolithic approach, but has come to signify a wide range of practices and that even the views of its primary advocate have evolved over time (Hodder 1987b).

The post-processual approach to archaeology has attracted a growing and very credible following. As much as I like New Archaeology, I concede that it has some significant shortcomings and that the post-processualists offer some worthwhile alternatives. I prefer to use the more descriptive title of Contextual Archaeology, as does Hodder (with due respect to Karl Butzer [1980], who previously used this term to refer to an environmental approach). Critical, symbolic, or structural archaeology are also useful terms to identify other varieties of what have more often been tied together under the single title of post-processual archaeology. I do not think processualism deserves a *post*, and I agree with Colin Renfrew (1989) who suggests that, if taken at their word, some would more properly be called *anti*-processualists.

Some of the more vocal adherents to this new movement disagree with archaeologists who view interpretation as a rational and objective method. They perceive New Archaeologists as focusing on objectivity and validation of things in the past, while practising their profession in the present. Hence, they argue, there is no objective archaeological record. Facts can be observed only via living individuals; therefore, facts about the past cannot be separated from the biases of the presentday observers. This relativistic position leads to historical pluralism in archaeological reconstructions and asserts that politics will inevitably enter archaeological interpretations (Shanks and Tilley 1987).

The essential point of these writers who emphasize the relativistic nature of data is that we must recognize the importance and the inseparability of the present-past dialectic that can also be seen as a subject-object dialectic. Their goal is to establish a *situated discourse* which, with appropriate respect for the gulf between the archaeologist and the past, attempts to consider the objects and events of the past in their full context. The most successful examples of these 'situated discourses' are with historical societies where many social and ethical linkages to the present can be brought to bear on evidence of the past (Hodder 1987a; Leone and Potter 1988). These relativists believe that the possibility for interpretive richness and the control of subjective intrusions offered by their approach are unobtainable via New Archaeology.

Having highlighted the importance of the perspective of the investigator, the more relativistically minded among the contextual archaeologists view the way that archaeologists interact with the archaeological record as an active interplay that is often manipulated and hence must be understood in order to be controlled. In this way, archaeological method can be seen as a 'style' that may involve politics, power, rhetoric, and perhaps even aesthetics. At its most extreme, these contextualists maintain that we are so bound up by our own perspective and style that we cannot know the past at all, but merely present our own views of the present as if they were an interpretation of the past (Miller and Tilley 1984).

There are numerous articles by contextualists that reinterpret an already-collected dataset from their perspective (Hodder 1982a, 1982b, 1986). They often begin by seeking a recognizable structural patterning in the archaeological data. In early studies, this often took the form of demonstrating spatial or typological 'polarities' in the dataset. The second step would be to relate these patterns to causes that are not normally cited by New Archaeologists. The source for these explanations often, but not necessarily, was from anthropological literature or ethnoarchaeological studies that the contextualist had been doing among nearby peoples. The final step might be to draw on information derived from the historical context and various general anthropological ideas that would enrich the original explanation and give it more plausibility. The principles and procedures of post-processualism should not be seen as an isolated phenomenon. It has parallels with approaches advocated by social anthropologists who focus on meaning or 'thick description' (Geertz 1973; Rabinow and Sullivan 1979; Sahlins 1981).

Contextualists are, despite their condemnation of it, descendants of the New Archaeology of the 1970s. Their own political agenda requires them to claim they are *post*-processualist, but their programme is in fact a logical offshoot of processualism. Moreover, many developments happening at about the same time within New Archaeology, including middle range theory as advocated by Binford and others, show how some of our trajectories are at least parallel (Watson 1986). The post-processualists' continuity with New Archaeology can be demonstrated in numerous areas.

First, post-processualists call for a *reflexive archaeology*, in which archaeologists must be concerned with how their *style* affects their conclusions. The New

Archaeology's first rule, however, was to have an explicit concern with methods and how conclusions were reached because data collection and interpretation were recognized to include subjective elements. Ironically, many of the original critiques of New Archaeology accused it of being over-reflexive (Clarke 1973).

Second, post-processualists say that it is essential to put the archaeological object in its context of ancient meaning. New Archaeologists could not agree more, but were less certain how to best achieve this. Contextualists have made some interesting new contributions in this area by seeking contextual relations more broadly, but their ideas are not different in kind, or in the intensity of their application, from the New Archaeology. Primary among the efforts of the New Archaeology was to see objects, features, and sites within their systemic and ecological contexts. Unfortunately, many examples of New Archaeology models reflected a rather simple, materialist-functional viewpoint. The key contribution of the contextualists is to expand their definition of systemic context to include broader symbolic and social domains, while attempting to avoid the pitfalls of a naïve application of functionalism.

Third, post-processualists say that knowledge comes from a dialogue between subject (us) and object (the archaeological record). Some see this as a dialectic involving an unbridgeable gap, whilst others see the subject and object as being inseparable. Both views do not believe that an objective interpretation of the past can exist. In the place of objective interpretations are politically or rhetorically motivated 'critiques' that reflect the investigator more than the object. For many years, some New Archaeologists have also been concerned about the use of archaeological data for political agendas (Ford 1973; Leone 1981). It is something to be sensitive to and to be made explicit in one's writings, but not something to inhibit moving forward.

Belief in the lack of objective reality is often diminished once an archaeologist spends substantial time doing fieldwork: archaeological objects are a lot more real out there in the dirt than they are when thought about from an armchair! However, as the contextualists rightly observe, fieldwork sometimes can lead to delusions in the other direction, fostering the belief that the work is extremely objective just because precise measures are used during fieldwork or laboratory analysis.

Fourth, an acceptance of the contextualist position that archaeologists cannot attain objectivity in their interpretations undermines the very basis of our research. At the extreme, some contextualists believe there is little chance of obtaining an objective view of the past with available approaches (see Miller and Tilley 1984). Because archaeological excavation is necessarily destructive of contextual relationships, if we do not have an effective method for understanding these relationships, it could be argued that all excavations should stop. Despite these relativist claims, the generation of systematically collected and carefully reported data has mushroomed in recent decades. The consistency of much of this material has led most scholars to accept it as a sufficiently objective set of data to serve as the basis for interpretations and further research.

Fifth, and probably the most important divergence between the approaches, is that some contextualists believe the New Archaeology's primary failing is its overemphasis on validation and efforts to be objective (Shanks and Tilley 1989). Even if not espoused by all contextualists, I believe that this is a useful point for current New Archaeologists to ponder. In the early years of the New Archaeology, major concern with idea generation was explicitly rejected: the focus was on confirmation as the method of science. Ironically, in the same book about the New Archaeology in which Patty Jo Watson, Steven LeBlanc, and I (1971) heralded Carl Hempel's (1966) positivist focus on confirmation, we lauded Norwood Hanson's (1958) and Thomas Kuhn's realist (1962) treatments of the complexities of idea generation in the history of science. By presenting both, we overtly recognized the distinction between context of discovery and context of validation, without providing a means for integrating the first with the second. More energy should be devoted by scientific archaeologists to generating ideas and perceiving contextual relationships, but we should not reject efforts at validation and a systematic approach to being objective, replacing them with uncontrolled story-telling, as has been said of some extreme examples of contextual archaeology.

THEORETICAL PERSPECTIVES AND PROSPECTS

I would prefer to transfer this debate to the well-worn format of Science versus Humanities. What troubles me most about the current argument, as well as many earlier ones on this theme, is that it is not really a conflict; I believe the best possible solution would be integration, but the more likely resolution is coexistence (see Spaulding 1988). These approaches, each encompassing great diversity, are essentially complementary aspects of the study of the human condition. One of these approaches does not have to replace the other: I see them as *alternative systems of knowing,* each with its own contributions.

Among the reasons that New Archaeology emerged was to dispel a widespread belief that archaeology could advance as a science solely by achieving more precise measurement and not revising its faulty interpretive ideas. Another major reason for New Archaeology's formation was to combat the acceptance of plausible stories as the truth, as long as they were put forward by distinguished scholars. The need was seen for careful consideration and explicit justification of methods of enquiry and the results that were obtained: a scientific approach. A scientist assumes that the world is knowable, and that it operates in an orderly manner, which can be understood by reference to widely accepted rules or laws. Whether human phenomena are amenable to general laws, similar to those that explain the physical properties of the world, is yet to be demonstrated, but the pursuit of general principles, statistical as well as universal, remains the cornerstone of a social scientific approach. For archaeologists this has meant, among other things, a general acceptance of uniformitarian principles, not a preoccupation with precision.

There is a perfectly acceptable alternative path to knowledge, however, which for simplicity I will call humanistic knowledge. Acknowledging that there are extremely diverse approaches followed by those who call themselves humanists, I shall attempt only to characterize the practices of a substantial portion of the field. Like scientists, most humanities scholars also believe that there is a real world, but usually acknowledge the relativists' position that we come to know it only through the present. In fact, their explicit objective is often to enrich the present through perspectives generated by studying the past. Some post-processualists claim that this type of mixing of the past and the present while making interpretations is an inherent shortcoming of archaeology. To the contrary, I view this as the essential relevance of archaeology.

Many humanists do not seek a precise answer to what went on in the past, but rather are interested in opening a *dialogue* with the evidence we have of it. That dialogue is clearly reflexive, being between the evidence in the past and the scholar in the present, analogous to the situated discourse of the post-processualists. Testing, replication, and rigorously argued evidence are not requisite methods to many in the field of humanistic knowledge. This does not undermine the possibility of knowing the past, but it puts the work of many humanists in a perspective of not seeking a final truth, but rather seeking what is most convincing or stimulating. To the extent that humanists, too, claim to know the past as it was, they tacitly use interpretations that rely on uniformitarian principles.

The essential frustration many of us have had with the New Archaeology of the 1970s is that it raised our hopes for grand interpretive breakthroughs that have not occurred. The rigour, scientific method, and explicit approach of the New-Archaeology were orientated towards verification, not creation of new ideas. In the earliest New Archaeological publications, science was explicitly defined as a verification procedure, not a hypothesis generation procedure (Binford 1968; Watson *et al.* 1971). Concern was not with the origin of an idea, only with its confirmation. Lacking a methodology for generating stimulating ideas and applying them to our data, New Archaeologists looked to other fields where there were already established laws, or at least promising ideas being applied. Once again, this was disappointing.

One solution to this problem was offered by the philosophers Wesley and Merrilee Salmon (1979), who had devised a new viewpoint on how social science operates. As one of their test cases, they observed what New Archaeologists were actually doing, rather than what they said they were doing. The Salmons called their perspective the 'statistical relevance' model of scientific explanation. This approach allowed for building up confidence in ideas through an examination of the probative quality of all relevant information. Hypotheses are informally rated by archaeologists on their prior probabilities for being true, and the most likely are pursued. The difficulty of rigorously assigning prior probabilities to information, as well as other inferential pitfalls, has kept many in the science camp of the New Archaeology from accepting the Salmons' approach.

I believe that many of the best ideas in archaeology have emerged from studies that lack scientific rigour or extensive documentation. Gordon Childe's work (1936 and others) is a perfect example. Relying on only the scantiest of empirical information, he promulgated the most insightful, sweeping, views of the human career to date. More recently, Kent Flannery has made several of the greatest contributions to new ideas in archaeology. In articles that are among his most exciting—on the origins of agriculture (1969, 1973b), archaeological systems theory (1968), house forms (1972b), and the evolution of civilization (1972a) —he engages in what I would call a *dialogue* with the data. Although his propositions are surely prompted by the empirical record, Flannery gives these dialogues substance and importance by his personal insight, not by rigorous use of evidence in a process of scientific validation.

The Hodder school has rightly recognized the simplifying assumptions and lack of interpretive progress in New Archaeology and has tried to correct it by advocating a contextual approach. However, I believe that some contextualists have erred in the other direction by focusing their major effort on documenting the formulation of their idea, with little systematic effort devoted to further validation. This has led some contextualist studies to be ignored by most archaeologists because of a lack of testing, while other contextual studies rigorously document a boring pattern, something that New Archaeologists did quite well without them!

The obvious solution to archaeology's malaise would be to amplify the interpretive, idea-generating aspect of scientific approaches as has been suggested by Earle and Preucel (1987) or to systematize and firm up the evaluative efforts of the post-processualists as is attempted by Hodder in his more recent works (1986, 1987a, 1987b). There is great promise in both of these efforts, and what might very well emerge is an 'ideal' combination of the best of the two approaches. It is my belief, however, that although there may be a few cases where this marriage succeeds, it will not work out for the field at large. There are real differences in beliefs concerning appropriate knowledge that cannot be easily bridged. Hence, even though I hold out hope for the emergence of a newly unified archaeology, I think it is neither realistic nor necessary for our advancement. Rather, I would like to see a diverse, but more cooperative, discipline, with shared goals and results but distinct approaches.

I suggest that, as a discipline, we encourage those who are gifted in creative dialogue to think great thoughts: to brainstorm unconstrained by the rigour of normal scientific methodology; to look at the world from all angles, both the obvious and the less obvious; and to put forward interesting propositions, providing enough information for others to determine whether a dialogue should be pursued. I certainly would not hope to turn the entire discipline into story-tellers, but we need our share! The key is that they recognize that the pursuit of knowledge is not over once they have promulgated their story.

The majority of us in archaeology should do what we can with generating new ideas, but stick to scientific verification as our primary activity, seeking new ways to measure behavioural processes with evidence from the past (Watson *et al.* 1984). Read widely, expose ourselves to the ideas of the new thinkers, but bring them and their ideas back to earth! Be aware of the possible pitfalls that contextualists have identified, because surely there is culture-bound contextual meaning to all we study and to ourselves. To the extent that ideational factors that may have been contingent on specific cultural traditions played a substantial role, we must apply uniformitarian ideas with appropriate caution. But we must not let that be a hindrance to progress in understanding the past. As scientists, we should continue to proceed under the banner of the general validity of uniformitarianism. This does not mean that we have to constrain ourselves to projecting present patterns into the past, but at least we should use them as starting points or building blocks for a new view of the past: there is no other way. Yes, we may misinterpret some things, but looking back from our culture-bound present over the past hundred years of scholarship, archaeologists have developed many ideas about the past that have withstood careful scrutiny for generations. There *are* patterns in the past, and these patterns *are* reminiscent of things we can understand in the present: *uniformitarianism does work*!

I do not claim that we can know all of the past, or even know any particular piece of it with absolute certainty. At some level, however, there are shared elements to being human: to perceive opportunities, to categorize, to elaborate, and to cooperate for a common good. These are among the factors that have led to our position of pre-eminence in the animal kingdom, and it is what is most likely to be knowable through uniformitarian studies. If we were to reveal only those ideas to the world, archaeology would truly be a worthwhile endeavour.

CONCLUSION

I would like to conclude this discussion by departing from archaeology in isolation and say a few words about our present-day political context: how it may have led many post-processualists to reject New Archaeology and how at the same time it is creating new opportunities for our discipline. New Archaeology was born as part of the optimism of the 1960s. All was possible: racial tensions could disappear, the Cold War could thaw, the poor could be made wealthy, and archaeologists could devote themselves to testing general laws that had social significance. Unfortunately, in the broader world, as in archaeology, the problems proved too difficult to be solved at that time.

The 1980s in the United States can be generally characterized as an era of economic expansion and getting on with your work. There were more of us, more jobs, and more research money, at least in cultural resource management. In Europe, however, growth did not spread to the academic ranks, and the restrictive, hierarchically controlled university system has remained largely in place. The era of New Archaeology in Britain saw innovations in thinking, but not the massive structural shift in the discipline that accompanied it in the United States. Because of this, anti-establishment feelings are still active, and the subject of their acrimony now focuses on New Archaeology and some who once championed the British version of it, such as the legacy of David Clarke. Young scholars who are seeking to break into the establishment are more inclined to emphasize the distinctiveness of their approach, rather than its continuities with what came before.

Now in the 1990s we find ourselves in a profoundly different and rapidly changing world situation. There must now be a shift in our energies from conflict to cooperation just as there is in the broader political scene. New political alignments are forming, material goods are flowing over old barriers, and global interaction is intensifying. The ultimate resolution of these processes is difficult to foresee, but it is certain that a new world order is emerging. What do these changes mean for the course of archaeology? It can mean business as usual, or it can mean responding to a rare opportunity. I believe that people in many parts of the world are ready to embrace new world perspectives on world history and certainly a new explanation of the world order. As Binford and many others have said, we as archaeologists are especially well suited to view long-term change and to view it within a perspective unavailable to the textual historian, the ethnographer, or the sociologist (Binford 1968; Plog 1973; Watson 1973). This is an enormous challenge and fraught with difficulties. To achieve this lofty objective, archaeologists must cultivate the renewed humanistic focus on idea generation and accept the value of thoughts stimulated by the past but written in the present. At the same time, I believe that real progress can only be made if this more free-wheeling individualistic approach to knowledge is carried forward in cooperation with others who pursue the continued growth of rigour and validation. Whether we call it New Archaeology, Post-Processualism or even a New Processualism is of little importance. The essential element is that we encourage serious scholars to do what they are best at doing and to coordinate diverse thinking to form a loose but lasting alliance for new knowledge of the past and present.

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In order to capture the full sweep of human prehistory and the development of archaeological science at the same time, I would recommend starting with something like V.Gordon Childe’s *Man Makes Himself* (1936) if you can forgive him the title and balance it with Grahame Clark’s solid *Archaeology and Society* (1939). As more fieldwork was conducted, the syntheses got better too, and I still view Robert McC.Adams’s *The Evolution of Urban Society* (1966) as one of the best, and Kent Flannery’s edited volume *The Early Mesoamerican Village* (1976) as a good attempt at bringing together new archaeology and results of field investigations. To get a grasp of theoretical developments over the past few decades it would be best to start with Lewis Binford’s first major article ‘Archaeology as anthropology’ (1962), continue with the book he edited with Sally Binford, *New Perspectives in Archaeology* (1968), and check out one of his more recent books like *Working at Archaeology* (1983). For a view of parallel developments in Britain one need only look at David Clarke’s tome *Analytical Archaeology* (1968, or posthumously 1978), or Colin Renfrew’s *Approaches to Social Archaeology* (1984). For a continuation of the debate on archaeological theory one must not miss the writings of Ian Hodder that exhibit a range of viewpoints from *The Present Past* (1982) to *Archaeology as Long-Term History* (1987). The best overall summary of theoretical developments in the subject is by Bruce Trigger (1989) *A History of Archaeological Thought.*

3

THE NATURE OF ARCHAEOLOGICAL EVIDENCE

John Collis

INTRODUCTION

In this chapter I wish to explore the nature of archaeological data—what is fact, what is interpretation, or what is plain fantasy; to discuss the limits of our knowledge; and how archaeological information is used and abused. It is about the nature of archaeological knowledge, and how it can be ordered. We can never know, nor do we want to know, all that happened in the past. There is too much of it, it is too complex, much was very banal, nor do we really understand it. It is also always changing shape and perspective as our own viewpoint changes. Thus we must make a selection, and it is the results of this selection which form the database of archaeological information. The nature of that database depends on three factors. First, what do we want to know? What do we consider important? This is our paradigm, the framework of thought which we use to order the past, and the framework within which we collect data. Second, what has actually survived? There are many things which we would like to know about, but the evidence may have simply disappeared, or was not recorded by the person who made a find. In other cases it may have never existed, but we may only be able to approach it indirectly from other forms of evidence. Third, what is the technology available to us to find the evidence? This is always improving, and includes a number of methods which can be grouped under remote sensing and survey, excavation, and scientific analysis. This chapter is mainly concerned with the second question, but it is very much influenced by the first and third; indeed, the first set of questions are fundamental to the whole study of the past, as I describe in my next section.

PERSPECTIVES OF THE PAST

The archaeological database, as it exists today, consists of the accumulation of the observations and finds gathered by previous generations of archaeologists and antiquarians, in some countries stretching back several hundred years. As the discussions here and in Chapter 1 emphasize, each generation has its own perspective of the past, different aims, and different levels of understanding and technology. Even in a country with a long tradition such as England, the database is still fundamentally affected by the activities of individual antiquarians from the nineteenth century, such as Colt Hoare and Cunnington in Wiltshire (Annable and Simpson 1964; Colt Hoare 1812–21), Bateman in Derbyshire (Bateman 1861; Howarth 1899), and Mortimer (1905) and Greenwell (Greenwell 1877; Kinnes and Longworth 1985) in Yorkshire. Other areas which lacked such individuals, or, where the recording was poor for the period, are under-represented.

Different paradigms, different perspectives of the past, affect not only the sort of information which is collected, but also the methodology employed and the sorts of sites chosen for excavation. They also reflect the interest of the individuals who are engaged in archaeology at any one time, and this in turn reflects the social structure of their contemporary society. Thus, in nineteenth-century Europe, archaeology was largely in the hands of rich landowners and clerics. Their interests included art, élite architecture, and warfare, and one of the defining characteristics of their social class was their education, which included a knowledge of the Classics. Antiquarian interest therefore naturally concentrated on their interests—such as the architecture of castles and churches—and on collections of art objects especially from Greece and Rome, but also local artefacts, for display in their 'cabinets' (Daniel 1964, 1967, 1975). To gather local objects, an efficient collecting policy was developed, which consisted largely of digging holes in the middle of ancient burial mounds where success was virtually guaranteed.

With the rise of the leisured middle classes in the later nineteenth century, these interests continued to be aped as indicators of education and status. However, the middle classes brought their own concerns, especially an interest in technology and science. The Three Age System developed by Christian Thomsen was itself based on technology (Daniel 1964, 1967), and this extended into the use of types of artefact to characterize each period. Scientific approaches were dominated by Darwin's concept of evolution, not only for the antiquity and evolution of Mankind itself, but also for social evolution, in the works of Marx, Morgan and Engels. Evolution could also be linked with technology in the form of 'typology', the evolution of artefacts into evermore functional and efficient forms, an approach developed by the Swede Oscar Montelius (1903) which gave a means of refining chronology (Chapter 5). For these new demands on the archaeological database, more detailed recording was needed, especially of associated groups of finds in graves and hoards. The latter were usually chance finds made outside the control of the archaeologist, but the late nineteenth century and early twentieth century saw a great period of cemetery excavation (Hodson 1968, 1991; Wilson 1970). The paradigm of social evolution also had its impact on excavation method, producing attempts at large-scale excavation of settlements, such as the Roman towns of Pompeii (Corti 1951; Grant 1971; Maiuri 1970) and Silchester (Boon 1974), or more prosaic farmsteads excavated by Pitt-Rivers on Cranborne Chase in southern England (Bowden 1991; Pitt-Rivers 1887, 1888, 1892, 1898), or the numerous cave excavations in western France. In this way the increasing complexity of social organization could be illustrated.

The late nineteenth and early twentieth centuries were also the period of the European nation-state, not merely the traditional powers of Spain, France, Russia and Britain, but also new major European states such as Germany and Italy, as well as a plethora of smaller states, especially in the aftermath of the collapse of the Austro-Hungarian Empire. Archaeology and History were harnessed for the ideology and aims of these states, initially by seeking out heroes, mythical or historical, such as Siegfried in Germany or Vercingetorix in France, but subsequently in the development of the 'Culture-Historical' paradigm (Trigger 1989). The concept of the 'Culture' as a group of associated artefacts regularly occurring together and equating with an ancient people, was a concept developed especially by Gordon Childe (1929) for ordering European prehistory. In Europe and America it became the dominant paradigm from the 1930s to the 1960s, and as late as 1959 in the standard German textbook *Einführung in die Vorgeschichte* Eggers could claim that the two main aims for the prehistorian were dating and ethnicity (1959:199).

Though this approach relied on the previous achievements of Montelius and his successors, Reinecke ([1903–9] 1963) and Déchelette (1908, 1910, 1913, 1914), in providing a chronological framework for prehistoric Europe, it made new demands on the archaeological database. 'Cultures' did not only have a chronological range, they also had a geographical distribution, and the distribution map of different artefact types and cultures became one of the standard tools used by the culture-historical school, and they are now a standard feature of all archaeological books. Even stray finds became useful for such an approach, and were used for such purposes as defining the origins and spread of prehistoric cultures as well as historical peoples such as 'Celts', 'Germans' and 'Slavs'; or the invasions of peoples from the steppes, 'Thrako-Cimmerians', Scythians, Huns and Hungarians; or the movements of Franks, Lombards and Anglo-Saxons during the migration period. Invasion was the main explanation for the replacement of one culture by another, as indeed for most change and innovation (Trigger 1989).

Thus, what was required from controlled excavation was a sequence to demonstrate the succession of cultures replacing one another. This in its turn required close stratigraphical control, with finds clearly assigned to a specific archaeological stratum.

This led to an abandonment of the sort of area excavation pioneered by Pitt-Rivers and his contemporaries. Rather, excavation consisted of narrow trenches or boxes divided by 'baulks' with sections in which the superimposed layers were visible and so could be recorded in graphical form, as a 'section drawing' (Wheeler 1954). Alternative methods existed, such as that devised by the German archaeologist Gerhard Bersu, who used a system of alternating trenches (Bersu 1940, 1977; Evans 1989), or Sir Cyril Fox, who used a moving sequence of sections to slice systematically through barrows (Fox 1959:1–11). Less emphasis was placed on the nature of settlement, so the site plan was less important than the section. Wheeler's excavation of Maiden Castle in Dorset demonstrates this clearly (Fig. 3.1), with much of the campaign concentrating on the ramparts and gateways, but relatively little time expended on excavation of the interior (Sharples 1991; Wheeler 1943).

Figure 3.1 Maiden Castle, England. This aerial view shows the iron age hill-fort during the excavations by Sir Mortimer Wheeler. Typically for excavations carried out within the culture-historical model, the emphasis is on discovering sequence by the use of trenches. Reproduced with permission of the Society of Antiquaries of London.

The period after the Second World War saw a widening of interest in archaeology to encompass the working classes, as new educational opportunities in many countries saw the rise, first of an amateur, and later of a professional group drawn from a wide range of society. The more egalitarian countries of Scandinavia had fostered a society in the 1930s interested in settlement archaeology, dealing with the investigation of ordinary farming settlements and peasant economies (Hatt 1957; Kristiansen 1992), and after the war the political ideology of the communist areas of central and eastern Europe also encouraged extensive settlement archaeology, though still within a culture-historical framework (Sklenár 1983). The style of excavation was also still that of the 1930s, with an élite groups of scholars employing untrained labourers, who actually did the digging.

The post-war changes were most marked in Britain: excavations in the late 1950s and 1960s drew mainly on a labour force of volunteers, especially from the new class of students benefiting from wider access to state education, and these were the people who became the new professionals of the 1970s; but this period was associated with a major paradigm shift, to interests in social and economic matters. Patterns of structures could only be understood, if at all, when large areas were cleared, so excavations shifted to 'open area' methods (Barker 1977), assisted by the use of the mechanical excavator to clear large areas cheaply. This revolution hit both rural archaeology (Beresford and Hurst 1990) and urban archaeology (Biddle 1973). Excavations were no longer confined to the investigation of élite residences or ecclesiastical structures, but encompassed the merchants, craftsmen, and the poor. Questions shifted to matters such as diet, disease, housing and organization of industry. Under the previous paradigms finds such as animal bones had generally just been discarded; now they became central to the sorts of questions asked. Cunliffe's excavation at Danebury, with large-scale clearance of the interior, epitomizes this shift in interest and forms an interesting contrast with the techniques employed by Wheeler a generation earlier (Fig. 3.2).

Settlements do not exist in isolation, they are part of regional and international systems. Already in the 1950s and 1960s ambitious survey projects were started looking at the increasing complexity of society following the introduction of farming, for instance, MacNeish in the valley of Tehuacán in Mexico (Byers 1967–72), or Braidwood in Iraqi Kurdistan (Braidwood and Howe 1960). Since the 1970s, however, the 'socio-economic' paradigm, using models such as 'central place theory' and the 'world economy' (Wolf 1982), has promoted more ambitious projects looking at the political, social and economic structures of regions—for instance relating cities to their hinterlands, and using concepts derived from geography and from anthropology (Christaller 1935; Smith 1986; Wagstaff 1986). Chance finds made in uncontrolled circumstances were no longer adequate, and new methods were applied, including the systematic walking of fields and intensive aerial photography to locate a wide range of different types of settlements drawn from representative samples of the environments under study.

The 1980s and early 1990s have also seen changes, though driven more by social

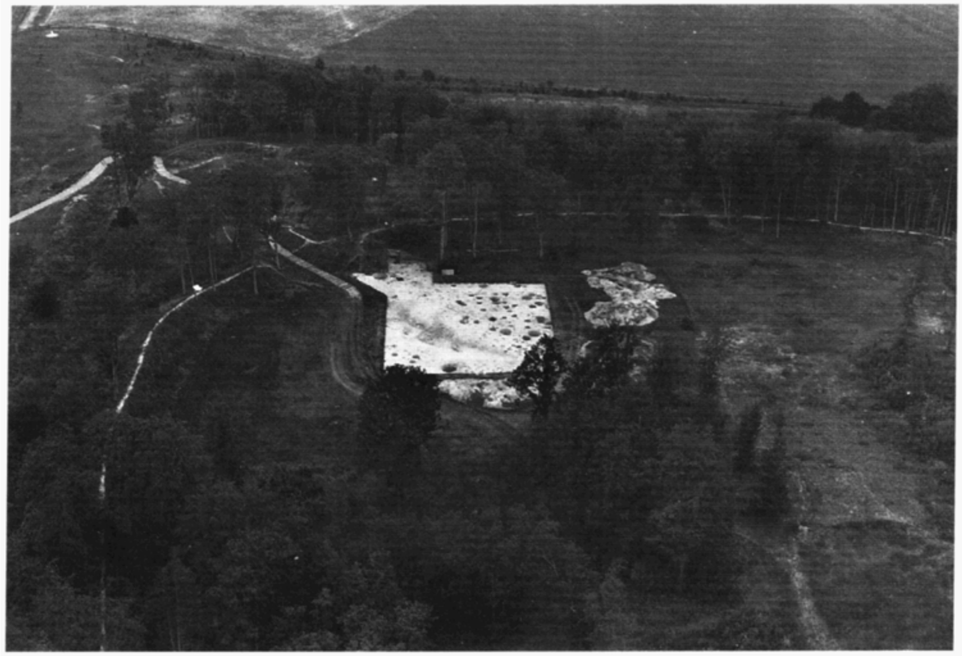


Figure 3.2 Danebury, England. In contrast to Maiden Castle, Barry Cunliffe's excavations had a socio-economic aim, and so concentrated on plan, on function, and the nature of the inhabitants, so were primarily open area. Copyright © Danebury Trust.

and political factors and by technology rather than by paradigm. Legislation in many countries includes protection of sites and monuments, and anyone destroying sites is legally obliged to have them recorded; paradoxically, in some countries such as Britain can potentially lead to less excavation and on a smaller scale. The major technological innovation of this period has been the advance of the computer, which has had an enormous impact on excavation techniques, allowing much greater detail of recording and of manipulation of the data. More ambitiously, in some countries the detailed recording of the archaeological database in electronic form is well underway. In Britain this takes the form of Sites and Monuments records developed and maintained by local planning authorities who deal with requests for development. This in turn links in with a national database and archive, the National Monument Record, developed by the Royal Commission on Historical Monuments. The full academic exploitation of these databases still lies in the future.

The requirements of the archaeologist have thus changed enormously over the last 150 years. It is not just a matter of us becoming better archaeologists—the early antiquarians were extremely efficient in achieving their aims of building up collections. In part it has been due to a change of the technology available—aeroplanes for photography, mechanical excavators for clearing large areas cheaply, computers for storing data. Our nineteenth-century predecessors hardly envisaged that little scraps of charcoal might hold a solution to the dating problems which perplexed them. Nor is it simply a matter of methodology—for instance, our ability now to recognize timber buildings and other ephemeral structures. The major driving force has been the paradigm, the questions which we pose of the data, which then demand new solutions to the discovery, recording and analysis of information.

Every generation must use the data that were acquired by the previous generation, and this by very definition is inadequate for the new aims because it was collected for other purposes. Poor quality data is still being acquired as not all finds and excavations are made under ideal conditions—the finds of treasure hunters, for instance, are often of no better quality than those of the early antiquarians, and their motives in hunting for finds are not dissimilar; nor are professional excavations necessarily of good quality. All of these data are available for our use, and have to be used, but they require evaluation in terms of their quality, both of what they tell us and what they are incapable of telling us. Better recorded data can be used as a control, but databases such as that of the British National Monument Record require care in their use, and a clear understanding of the source of the information if we are not to make fundamental mistakes in interpretation. All data are biased: they have to be used and 'read' with care, and we cannot accept them at face value. It is this problem which is the major theme of this chapter.

The same is also true, however, for written sources. An extremist might claim that History is only an adjunct to Archaeology, dealing as it does with at most the last 5,000 years of human existence and, in most areas of the world, much less than that. It is based on a limited range of artefacts; that is, documents on which symbols have been written. True, these symbols are more easily read than the symbolism which exists in other types of artefact, and are much more informative about events in the past, of people, and their thoughts and motivation. However, they are as biased as the rest of the archaeological record as someone had an interest in writing them in the first place, and then of preserving them. Such information has to be treated with the same scepticism as the rest of the archaeological record, and cannot form the basis of archaeological research. There are too many gaps in this written record, information left out by the chances of individual interest or of survival, or simply not recorded because it was deemed of no interest. We can give no precedence to the written document over the archaeological information; the two sources are simply complementary to one another.

FACT, FICTION AND INTERPRETATION

What is an archaeological 'fact'? The basic building block for archaeological interpretation is that a certain object was found in a certain context or stratum.

But we ourselves cannot be present at every find. Even if we find it ourselves, can we always be sure that we have observed it correctly, or that someone has not played a trick on us and buried it the night before, or that it is not in a secondary position, having been redeposited by some human or natural process such as erosion? Immediately we are having to make value judgements. What, and whom, can we trust?

First, there is the quality of the person reporting the find. There are good and bad archaeologists, and we can only judge the quality of the find from the quality of the report; for instance, details of the methodology used, and the standards of excavation, based on the details of the report and our judgement of photographs of the excavation, preferably with work in progress. Archaeologists have been known to falsify their evidence: the mythical story of the archaeologist who gambled away the funds for a rescue excavation and wrote a report without ever setting a spade in the soil; or more infamously the Piltdown forgery, which was finally disproved by the use of a battery of scientific techniques to prove the antiquity, or otherwise, of the find (Weiner 1955). Early antiquarians, without the use of modern maps, were often a bit vague about the location of a find; modern treasure hunters may deliberately lie to protect their site from rivals, or because they were trespassing when the find was made. In these cases we can only judge from the consistency of the individual, or how much their work is confirmed by other workers and finds.

Reports of discovery are more acceptable if they fit in with the framework of prevailing thought or previous experience. The Piltdown find was considered genuine because it coincided with the theories of the time, but as further finds were made it became more and more anomalous. It has been claimed that Archaeology is not a 'Science' because every 'experiment', every find or excavation is unique, and can never be repeated. This is only half true, because over time consistent patterns of association appear. Thus, red-slipped Samian pottery occurs with early Roman coins, and is found on sites with a distinctive form and layout which from documentary evidence we can recognize as Roman military forts. This combination is now so commonplace that it excites no comment, and would be accepted by all archaeologists as a 'fact'.

The problems start with combinations or discoveries which are unexpected, unusual, rare, or even unacceptable. A Roman coin from a stone age settlement on Tasmania would be considered unlikely to the point of impossibility. An Egyptian scarab from a site in central America might be acceptable by Hyperdiffusionists such as Thor Heyerdahl who sought the origin of American pyramids in Egypt, but it would be unacceptable to all 'serious' scholars. The occurrence of Chinese porcelain of the thirteenth and fourteenth centuries associated with the construction of stone buildings at Great Zimbabwe in central Africa was not accepted by white colonialists, who prefered to see its origin with the Queen of Sheba or some such fanciful theory, simply because they could not conceive that native Africans could build such structures; but it is entirely acceptable to archaeologists who see the rise of Zimbabwe as an indigenous reaction to the Arab trade system along the coast of East Africa (Garlake 1973). A Christian fundamentalist might accept an archaeologist's identification of the collapsed walls of Jericho, but not the discovery of early hominids from Olduvai Gorge.

Some discoveries take time to be accepted: for example, the occurrence of tinglazed pottery in medieval contexts in Britain was largely dismissed as 'contamination' from material that had fallen in from higher levels, until it was realized that 'lustre wares' from Arabic Spain were being imported; suddenly several such finds were reported (Dunning 1961). Similarly, lead-glazed pottery from Roman contexts can still be discarded as medieval contamination, though such finds are now fairly common. Other finds which were totally unexpected have been accepted immediately partly because they are so unexpected that they are unlikely to be faked, like the Barbary ape from the iron age Navan Fort in Ireland (Raftery 1994).

So far we have been dealing with positive evidence, but a major problem is negative evidence. There are periods of deposition, and periods when nothing appears in the archaeological record. Evidence can consist of burials, settlements, religious sites, hoards and so on—it is rare in prehistory for all these classes to occur together, and certain types of material may never be deposited at all. When is absence of evidence, therefore, evidence of absence? If we have two periods when we find both brooches and swords, but a period in between when we have neither, it is likely that brooches and swords continued in use but were simply not deposited. Often 'culture-historical' interpretations fail to take this into account; for instance, the 'expansion' of 'Celts' into central and western France is supposed to be marked by a spread of new brooch and ceramic types, when in fact all we are seeing is a gap in the archaeological record when burials are not readily identifiable, so the brooches and pottery which are deposited in them do not occur (Collis 1984).

So, who are the wise persons, the experts, who can pass judgement on the archaeological record? What do we do if those experts are seen to disagree among themselves, or change their minds from one generation to another? Who is to say that religious fanatics are not correct in their rejection of archaeological data; or that extra-terrestrial beings have not influenced our development; or that Egyptians were not a master race who developed and disseminated civilization? Like all sciences, archaeology has been developing 'rules of the game', which are part of the logic of western European thought. These rules can be overturned, but this can only be done by scientific knowledge, and that includes the sceptical approach to, and reinterpretation of, the database.

THE LOGIC OF DEPOSITION

Unlike the pure sciences, archaeology has few 'laws' which are of universal application, and most of these are of such a banal nature that they take us but little along the road to interpretation. There is the law of 'superimposition', which is the basis of archaeological stratigraphy and chronology, that states that a stratum which overlies another is logically later (Harris 1989). There is also the belief that manmade objects from the past can be logically ordered and placed in chronological sequence, and be used to reconstruct human activity in the past. But to go one step further and apply the geological principle of Uniformitarianism, which states that deposits laid down in the past were laid down by forces similar to those laying down similar deposits today, is a principle which can only partly be followed, and then only as a working hypothesis.

There are three problems. First, archaeological finds may have been deposited by activities which have no modern correlates—for example, there is no animal similar to the early hominids or to early species of *Homo*—and activities are also governed by ideology and belief systems, so deliberate deposition of material can reflect religious beliefs which we can never comprehend. Second, different types of activity may produce the same archaeological record: thus, 'social' exchange systems such as 'redistribution' may produce the same type of distribution of traded goods as 'market' exchange. Third, even where direct correlates exist, the link between present and past activities has to be made, often using the anthropological record, and this may not be easy, given the partial preservation and recording of archaeological data—this is what Louis Binford has termed 'Middle Range Theory' (1977, 1983).

However, our first attack in the interpretation of archaeological data must be an attempt to apply 'normative' logical principles, and this can be most successful in the areas of subsistence or domestic activities. Successful examples of such an approach include:

1 The hunting of large animals. The capture of animals and the processing of their carcasses will lead to different sorts of sites—hunting sites, butchering sites, storage sites, consumption sites, and home bases. Each should be distinguishable by different sorts of artefacts and animal waste.
2 Crop processing. Cereals are harvested, threshed, winnowed, cleansed of impurities such as weed seeds, stored, and finally sown or consumed. Each of these phases produces a different sort of residue, though different methods of processing and different types of crops can affect the nature of those residues. A failure to recognize these different phases of processing can lead to misinterpretation. Thus, a high incidence of weed seeds has been seen as evidence of collecting as against cultivation, when in fact it may merely be the residue

from the cleaning out of weed seeds from the harvest (Hole and Flannery 1967:169). By observing present-day methods of crop processing using traditional methods, archaeological samples can be directly compared with modern samples (Hillman 1984; Jones 1984).

3 Rubbish disposal. When a pot is broken, the small pieces will not be picked up, and will often become part of the archaeological record near where the accident happened. Large pieces will be removed to some distance for deposition where they will be out of the way, in middens or pits. The larger the fragments, the further they are likely to be transported (Schiffer 1976).

4 Settlement location. Settlements will be located at optimum siting for their function—hunting sites where game is likely to pass, farms on the best agricultural soils. Pasture and arable fields will be organized to keep travelling down to the minimum ('least effort' models). Similar models can be developed for the plans of individual settlements, for instance, Sjoberg's 'Pre-Industrial City' (1960), or for regional systems, for instance, Christaller's 'Central Place Theory' (Wagstaff 1986).

Even where these forms of logic seem to work, we must be aware that other less logical factors may be at play. The sorts of 'rubbish' found on neolithic and iron age sites in Britain, for instance, are obviously 'peculiar', with unusual associations of animal bones, and complete or partial skeletons of both humans and animals (Cunliffe 1983, 1995; Hill 1995). In the Iron Age in southern Britain, many settlements are on hill-tops, not the best siting for subsistence farming. They have ramparts around them, and social factors, especially the need for defence, seem the obvious reason. All these sites were subject to the same type of warfare, and presumably would need the same size of ramparts. So why do big sites have big ramparts, and smaller sites have smaller ramparts (Collis 1996)? Clearly there is another logic, perhaps social display, which is playing a part (Bowden and McOmish 1987).

SAMPLING

It is impossible for archaeologists to excavate everything. On occasion archaeologists have attempted the 'complete' excavation of 'sites', but this is self-deception— often all that is excavated is the area of most concentrated activity. On agricultural sites this may be relatively easy to define because most activities—living, cooking, processing of crops and meat—all take place at one point in the landscape. In contrast, in hunting groups these activities are dispersed at various locations. So, what does a 'site' consist of? Is it just the farm with its farmyard, or does it encompass the pens for livestock, the arable fields, areas of enclosed pasture, and shared areas of common pasture? The settlement alone will not tell us how the farm functioned (see Chapter 14). At all levels the archaeologist is forced to reconstruct the past on the basis of samples, and we must be aware of what biases enter each stage of that sampling process.

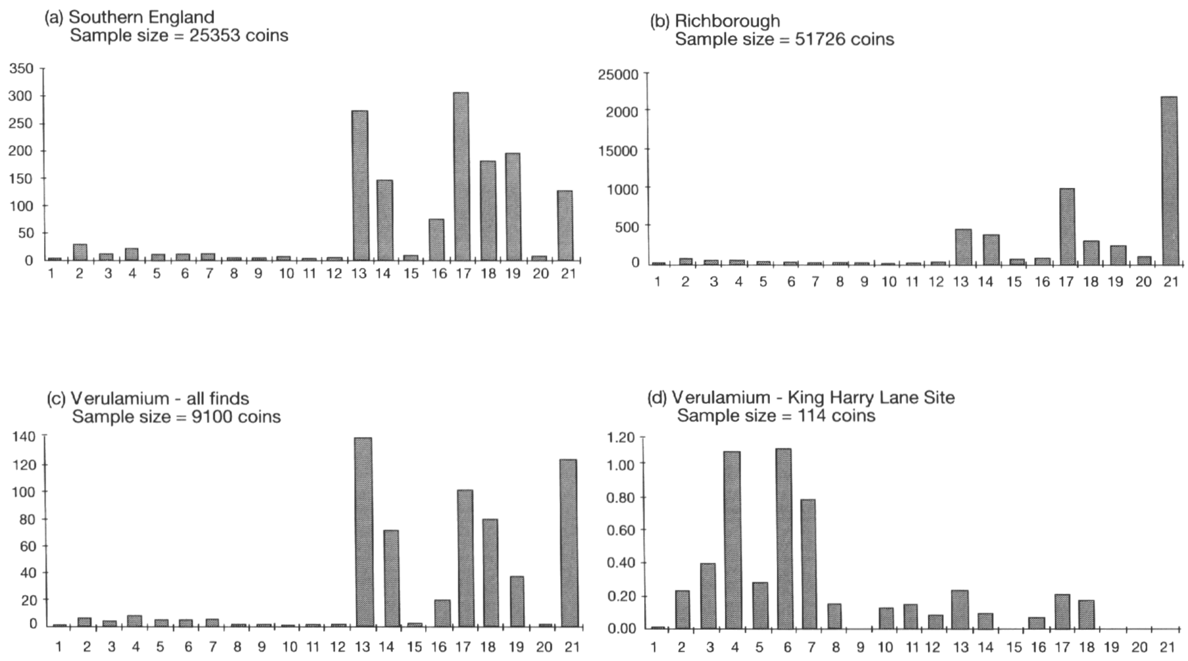
To show the nature of this problem I will take the example of Roman coinage. What is the significance of an individual coin, and what is its relationship to the total production of coinage in the Roman empire (Collis 1988)? The questions that have to be asked include:

1 How typical is the coin of the feature or stratum in which it was found? Is it a coin which has just come into circulation, or has it been circulating for a long time, or is it 'rubbish survival' (for instance, redeposited from another context)?
2 How typical is the feature or stratum of the part of the site in which it is located? Finds from a pit are likely to be different from those from occupation levels on floors. Individual deposits may have only a limited chronological range, and several periods may be represented on the site.
3 How typical is the part of the site of the whole site? Different sorts of activities will produce different patterns of coin loss, and on a major complex site such as a town there will be differences between commercial, religious, habitation and administrative areas, or between rich and poor quarters of the town (see Curnow 1988 for a good example).
4 What is the relationship between the coins lost on the site and the coins found by the archaeologist? What excavation methods were employed? Unless sieving took place, there will be a bias towards larger coins, and very small coins such as third and fourth century *minimissimi* may be under-represented if not totally missed.
5 How typical is the site of the region? The coins circulating on the site will depend on its function—market, fort, villa, peasant farm—and/or on the wealth and social status of its inhabitants.
6 Are there differences between different regions in a single province caused by different sorts of activity which could have affected coin distribution—for instance, between military and civil areas?
7 Were there differences between different provinces connected with imperial activity, such as the date of conquest or abandonment of the province, the construction of public works, or the conduct of military campaigns? There may be varying patterns of wealth, taxation and spending, and between military and civil provinces.
8 What was the imperial policy for coin production? The amount of coinage struck, the purity of the metal, its denomination, patterns of withdrawal and demonetarization, indeed the reasons for striking coinage, varied considerably from one period to another.

An understanding of the total picture is essential if we are to interpret our site finds correctly. A coin in mint condition in a deposit in which it is unlikely to have been redeposited, and of a type only in circulation for a small number of years, has more value for dating the deposit than a worn example of a common type which was minted and circulated for many years. It is even more important for the interpretation of negative evidence. Is the absence of a specific coin type due to it being small and difficult to find, of a type which is rare and therefore unlikely to occur; or if it is a type common in circulation and easy to find, does it mean the site had either stopped using coins, or even been abandoned? Does an increase in the number of coins mean that there was greater activity and wealth on the site, or simply that the supply of coins in circulation had increased dramatically, as was the case in the late third century AD?

An example of the way in which interpretation can progress is shown on Figure 3.3. Such bar charts became familiar in the 1970s, claiming to demonstrate coin 'loss' for sites and areas (Casey and Reece 1988), but they actually represent coin 'finds' —indeed, in some cases coins 'collected' or 'preserved', where they are in museums or derive from private collections; they are even further from representing the coins which may have been in circulation on a site. The charts also show the date when a coin was minted, not when it was lost, and recent work on pre-Roman coinage in Britain has shown that often means a thirty-year timelag, which can have important implications when one is trying to tie in archaeological evidence with historically dated events (Haselgrove 1987). The time period on the bar charts can range from ten to over forty years; to reduce the distorting effect of percentages, and so to allow one chart or period to compare more directly with the others, the bars show the average number of coins per year for each time period.

The first chart tries to show the general pattern over southern England, based on the thirteen sites, ranging from towns to temples, listed by Richard Reece (1972). It clearly shows how there were certain periods when there was a massive surge in coin loss. Richborough is left out, because it has an exceptionally large collection which distorts the overall pattern, and also has some anomalies compared with the other sites. Its pattern is shown on Figure 3.3(b); against the general pattern, two periods show up as different, AD 330–48 and especially the final phase of coin-using in Britain, AD 388–402, suggesting that Richborough's role as one of the major ports of entry into Britain was of exceptional importance in those periods, and that it had some special status. The third chart shows the overall pattern for the Roman town of Verulamium (St Albans), which generally follows the provincial pattern, except for the final period AD 388–402 when coin-using seems to have dropped, despite evidence we have, both documentary and archaeological, that the settlement was still important (Frere 1983). The fourth chart is taken from one site at Verulamium which was left outside when the defences were constructed in the late second century AD (Reece 1989); the area was virtually deserted and this is reflected in the coin finds. These comments, however, only touch on a complex and fascinating line of approach which can be used to investigate the rise and fall of



	Date AD
1	to AD 41
2	41-54
3	54-69
4	69-96
5	96-117
6	117-138
7	138-161
8	161-193
9	180-193
10	193-222
11	222-238
12	238-259
13	259-275
14	275-294
15	294-317
16	317-330
17	330-348
18	348- 364
19	364-378
20	378-388
21	388-402

Figure 3.3 Coin finds from Britain. The first graph (a) gives the overall pattern of coin finds in southern England, as averaged from thirteen major settlements. The second graph (b) comes from Richborough, which was especially important in the late Roman period as the major point of entry from the continent. The third (c) shows the pattern from the Roman town of Verulamium (St Albans), and the fourth (d) from the King Harry Lane site at St Albans. Based on data in Reece 1972 and 1989, redrawn by D.Miles-Williams.

settlements, their role in the wider provincial and imperial pattern, and economic and social questions like the integration of rural settlements into the money-using economy (Reece 1987).

This example covers a group of material which is extremely diagnostic, so comparison between sites and regions is relatively easy (though the statistics can get quite complex, and depend on the questions being asked), but the sampling processes are similar for all archaeological material.

SURVIVAL OF THE EVIDENCE

Like any form of history, what we can glean from archaeology is very much dictated by what actually survives. In the example of coinage examined in the previous section, it was assumed that nothing had happened to the coin between deposition and discovery to make it unusable or inaccessible to the archaeologist. But even with something as solid as a coin, processes can go on which will destroy the coin. In an acidic situation, the coin will be attacked chemically, and by the time it is excavated, all the archaeologist may have is a mass of corrosion products, perhaps not even identifiable as a coin, let alone to a type or ruler.

Survival depends on three related factors: the material of which the evidence is made (stone, bone, wood, and so on); the conditions under which it was deposited (soil type, location of the site, climatic conditions, speed of deposition); and subsequent processes to which the object or deposit was subjected (such as erosion or chemical change).

Burial and deposition

For much archaeological material, and for archaeological sites generally, survival will depend especially on the speed of burial, or indeed, if it is buried at all, the process known to geologists and archaeologists as 'taphonomy' (Schiffer 1987). In the recent geological record, most deposits have been laid down under wet conditions—sediments in seas and lakes, silts in river basins, or peats forming on moorland. None of these are normal habitats for the human species and, if archaeological finds do occur, they are usually redeposited, or they represent unusual occurrences (for instance, shipwrecks), or atypical communities, such as the 'lake dwellings' which occur around the world in various forms. The majority of our species has lived in dry environments, often on higher ground where visibility is better and well-drained soils occur, but where erosion is more likely than deposition.

On sites exposed to erosion by wind and rain, only the most resilient materials, such as stone, will survive, and even those are unlikely to remain at their original point of deposition, but will be moved around by heavy rain, or by animal or human activity on the site. Soft organic remains will quickly be scavenged by birds, animals, and insects, and carcasses and other waste spread around the nearby countryside. Bones and pottery will be shattered by frost or eroded by the wind; metals will corrode and disintegrate. Even in high ground situations where deposits are subsequently covered by peat, or in the lowlands by alluvium and colluvium, the process of burial may have been so slow that little survives intact.

The amount of information that is lost when the living surface of a settlement is lost is obviously huge. Hints of how much are given by sites such as the so-called 'lake-villages' of the Alpine area (Drack 1969, 1971), or the iron age settlements of Glastonbury and Meare in the Somerset Levels of southern England (Coles 1987; Coles and Minnitt 1995). These sites are generally rich in the numbers of finds that they produce, not merely the organic materials which drier sites will not produce, but also in pottery and metalwork, or traces of industrial production. Is it merely that living surfaces have survived and show us what sort of material was normally lying around on settlement sites, information which is normally destroyed by erosion? Or is there something special about deposition caused by the unusual location of these sites in damp conditions which caused items to be lost or discarded in a way which would not be normal on dry sites, such as an axe or sword being dropped into the water or lost under a raised floor and not recovered? Or are these unusually wealthy sites exploiting a rich environment with lake resources such as fish, and the potential of using boats for trading over long distances? Or are they special-purpose sites? Each interpretation gives us a very different view of the prehistoric societies and their organization.

Only rarely do natural causes provide a quick burial of an archaeological find or settlement. Water is the most common agent in the form of flooding, from the flash flood which caught a group of early hominids at Hadar in Ethiopia 3.5 million years ago (Johanson *et al.* 1994; Radesovich *et al.* 1992) to the iron age bridge at Cornaux les Sauges in Switzerland (Schwab 1989). In the latter case, the bodies of some of the inhabitants of the nearby village were caught in the collapsed remains of the bridge, along with some of their possessions (Fig. 3.4). Mud slides and avalanches also can seal over complete settlements, especially in mountainous areas. An exceptional case was the so-called Ice Man from the South Tyrol, whose body was covered by snow which subsequently turned to ice and preserved his body for 5,000 years (Spindler 1994).

The most spectacular sites caught by such acts of nature are whole communities buried by volcanic activity. Sites such as the Mycenaean settlement of Akrotiri on the island of Thera in the Aegean (Doumas 1978), or the Roman towns of Pompeii and Herculaneum in Italy (Corti 1951; Grant 1971; Maiuri 1970) provide spectacular centres for tourism because their masonry buildings have been left standing to exceptional heights. Buried sites with less imposing methods of construction, perhaps of timber, clay and thatch, are also known throughout the

Figure 3.4 Cornaux les Sâuges, Switzerland. The finds from this site have been interpreted as the results of a flash flood which destroyed a bridge dated by construction between 120 and 116 BC over the river Thielle, and drowning at least twenty inhabitants of a nearby settlement whose bodies were trapped under the collapsed timbers. Source: Schwab 1989.

world, such as deserted Viking farmsteads on Iceland, or the sixth-century farming village of Kuroimine north-west of Tokyo in Japan (Hiroshi 1992; Niiro 1993). The importance of such sites is twofold. The fall of ash is sufficiently fast to preserve buildings and artefacts *in situ,* but without the disruption caused by a flood or landslide; the settlements were sealed at a moment in time, and then left undisturbed until excavated by the archaeologist. Also, they tend to be fairly typical settlements of their period, so that the insights and details of daily life that they reveal can often be extrapolated to a wide range of other less well-preserved sites.

Occasionally wind-deposited sand can have the same effect. At Gwithian in Cornwall, a bronze age farm and its fields were engulfed by sand dunes, so that even the individual marks left by spades and plough furrows were still recognizable (Megaw *et al.* 1961; Thomas 1970). In coastal areas with unstable sand dunes, such occurrences are not unusual, and dunes may have stratified sequences of such sites; but the sites are equally prone to destruction by the wind. More normally, burial by sand is a relatively slow process, leading to gradual rather than sudden abandonment. One thinks of some of the trading oasis cities of central Asia (Mongait

1961), but it is equally true, for instance, of the whole of the Tiber estuary west of Rome, which was slowly engulfed by coastal dunes in the post-Roman period (Meiggs 1960). At sites such as Ostia, the buildings themselves may survive to a remarkable degree, but, unlike at Pompeii, Ostia's inhabitants had time to remove anything worth taking.

However, the majority of the archaeological record is preserved because of the activities of humans themselves. On sites which suffer erosion, 'artefact traps' are set up which cause archaeological deposits to build up. The most common are pits, post-holes, ditches and cellars dug into the subsoil. Defensive ramparts, house walls and fences act as physical boundaries against which material may accumulate. The problem with these man-made contexts is that they introduce an additional bias into deposition. Why and when are pits dug? Where does the material filling them originate from? This fill may reflect the purpose for which the pit was dug (for instance, rubbish pits, pottery kilns, graves, or cesspits), or it may have nothing to do with the original purpose. Unwanted cellars, grain silos, subterranean workshops and sunken dwellings such as Anglo-Saxon *Grübenhäuser* were just filled in with whatever was at hand when they were no longer needed. The fill may represent seasonal activity: for instance, when pits for seed grain are emptied in the spring, the pits are likely to be filled in soon after; or quarries are dug only when houses have to be constructed. Possibly the material has been gathered from above-ground middens, or it has been deliberately deposited for ritual purposes (Cunliffe 1983, 1995; Hill 1995). Thus the finds from such sub-surface contexts may bear little relationship to the deposits which have been eroded away.

From the earliest times, people have introduced materials from elsewhere on to their living areas—food to eat, stone and organic tools, bedding, housing materials—thus causing an accumulation of objects, but also concentrations of chemicals such as phosphates. On many sites the process of erosion is quicker than the accumulation. As society became more complex, settlements more permanent, and especially with the arrival of wheeled transport, transporting bulky material around was made easier, and on certain types of site accumulation started to outstrip erosion. Anyone standing at the gates of a pre-industrial city would have seen much more entering the gate than leaving it. Even the rubbish tended to stay within the enclosed area, in cesspits, rubbish pits and middens or, if it was removed, it would only be for a short distance. In some societies, such as those of medieval Europe, even the dead would be buried within the city.

The major component of this build-up would be from building materials, such as sand and gravel for streets, floors and foundations; sand and lime for mortar; clay, stone, timber and bricks for walls; timber, thatch, tiles and slates for the roofs. In areas such as the Near East where sun-dried brick was used, it was easier simply to demolish the old building and build on top of it with new bricks brought in from outside. The result are the *tells,* often many metres high, which form such a distinctive feature of, for instance, the floodplains of the Tigris and Euphrates. Though such sites represent an extreme case, the characteristic of rapid accumulation is common elsewhere in the world. In western Europe the process is often disguised partly by the location of sites in terrain where the contours will mask the build-up, partly by the presence of modern towns and suburbs on and around the accumulation. None the less, excavations in the centre of towns reveal the accumulations; in major towns in Roman Britain, about a metre per century is quite normal, though the rate of accumulation is often directly proportional to the city's importance and prosperity.

The result is that excavation in urban centres, while extremely expensive because of both the depth of stratigraphy and the complexity of the deposits, is very much more productive for certain aspects of research (such as the construction of a detailed chronology of artefact types) than on rural settlements, where accumulation is usually limited or non-existent. In the past thirty years such deeply stratified sites have tended to attract greater attention than less spectacular poorly stratified sites. They also allow better analysis of the function and layout of buildings, as floors and living surfaces tend to survive, buried under later deposits, whereas on minor sites they are commonly destroyed by erosion and ploughing. In some areas such as the Near East, because of the need for a chronological framework, our knowledge of the archaeology was largely confined to the major sites, producing a major bias in the archaeological record.

The influence of deposition and survival of evidence is even more apparent when we consider matters such as religious belief and ritual. One way to divide prehistory is into 'periods of living' and 'periods of dying'; that is, periods when we can find plentiful evidence of settlement sites, but no trace of burials, and vice versa (Collis 1977). At certain periods, monuments are built either as containers for the dead, such as pyramids, barrows, and mausolea, or as a focus for burial (for instance, medieval churches). Burials in holes in the ground (graves), especially inhumations in a non-acidic soil, will attract notice and comment from even lay people not otherwise interested in archaeology. But from many periods and places we have no such data. What was happening to the dead? Were they exposed on platforms or in trees, floated down rivers, or cremated and scattered, or simply exposed to the elements and to excarnation by animals and birds? In Britain today we are entering a period when we are shifting from inhumation on centralized cemeteries, to scattered cremation, often on secular sites following the wish of the deceased individual, in contrast with other western European countries such as Spain or Italy where multi-storey blocks are sometimes constructed to accommodate the dead.

POST-DEPOSITIONAL TRANSFORMATIONS

We have already discussed how surface sites can be transformed, if not totally destroyed, by processes such as erosion. Even sites which are deeply buried are not exempt from destruction, both from natural processes such as erosion by the sea or by rivers or, in the case of sites on light sandy soils, by the wind. Increasingly, we humans are becoming the main force for the destruction of our own heritage, by urban development, quarrying, road construction and deep ploughing. In considering settlement distributions, all these forms of development which destroy the archaeology, or render it invisible, must be taken into account. Most transformations of the archaeological record are, however, not of this drastic nature, but are due to natural processes of change which affect virtually all archaeological sites. Few soils are static and free from chemical or microbial activity. It is essential for archaeologists to understand these processes of change in the soil itself if we are to maximize our use of the archaeological record. In fine-grained soils such as clays, the mechanical movement of the grains, due, for instance, to the expansion and contraction of the soil as it dries or becomes wet, can erode even tough materials like pottery. Rising groundwater or percolating rain may move chemicals up and down the soil profile, most clearly visible in processes such as the formation of iron panning on acidic soils.

The chemistry of the soil itself has a profound effect on what survives. Acid soils will attack bones and completely destroy them within a few years, whereas in alkaline soils they will survive better. But even on strongly alkaline soils such as chalk and limestone, local conditions such as patches of clays with flints will lead to very localized acidic conditions which will cause differential survival. This is most clearly visible when complete skeletons are excavated: in one grave all the bones may be completely preserved, in a neighbouring grave only the larger ones such as the skull and long bones may survive, and then probably in a very friable state. Often such contrasts of preservation are visible in the same grave (Fig. 3.5). Studies of the fills of ditches on chalk sites have shown how small bones do not survive in the upper fill of ditches, but do in the lower fills. A jaw of a sheep in the upper fill may only survive as a collection of eroded teeth, but be completely preserved in the lower fill (Maltby 1996:19). What might at first sight seem to be a change from a sheep-dominated economy to one dominated by cattle may thus simply be due to factors of preservation.

Changes in water content can have a disastrous effect on metals, and accelerate the process of decomposition. The combination of plentiful oxygen, an acidic soil, and water, quickly reduces bronze objects to piles of corrosion, and is even more disastrous for iron. If preservation of bones and cultural artefacts tends to be better in alkaline soils, these produce their own problems. Organically they are much more active, not only in microbial activity but also because larger creatures living in the

Figure 3.5 Wigber Low, Derbyshire, England. The skeletons of a man and a woman, buried around AD 700 with a number of weapons and other material, show the typical differential preservation on alkaline soils. Though generally the long bones have been preserved, some of the ribs and smaller bones have already decayed, but others have not, demonstrating different local soil conditions within a few centimetres of each other. Photograph: J.Collis.

soil can have a major disrupting effect on the stratigraphy. Chief among these creatures is the humble earthworm, whose ability to turn over many tonnes of soil per year has been recognized ever since Darwin's pioneering study in which he observed the speed with which earthworms could 'bury' a stone (Atkinson 1957). In fact the burying process is caused by the object sinking, as it is systematically undermined by the removal and redeposition of the finest grains of soils. The effects of this are clearly visible in soil profiles, with a fine stone-free loam forming on top of a layer of 'pea grit' mixed with larger stones and artefacts at the bottom of the worm-affected profile. The impact on the archaeological record is twofold: first, it has the effect of mixing objects which may have been deposited over a considerable period of time, and which all gradually sink to the level of the pea grit; second, worm activity causes objects which might not have been incorporated into the archaeological record to be buried. They will tend to be concentrated in areas where the soil profile is deepest, and so worm activity is at its maximum, for instance, above pre-existing pits and ditches but also occasionally in the upper filling of natural features. Such finds can be an indicator of a period of inactivity on that part of the site, with pasture replacing cultivation, rather than a period of increased activity as the number of finds might imply. On the negative side, this movement of the soils through the gut of the worm is one of the factors which can destroy other evidence such as pollen grains, as well as mixing the soils.

A HIERARCHY OF PRESERVATION

The survival of evidence from the past can be envisaged as a continuum from, at one end, inorganic materials which are virtually indestructible, to actions and beliefs, which at the most can only leave indirect traces on other materials.

Inorganic remains

Material objects made from inorganic remains are by far the most resistant. Our earliest records of human existence consist largely of stone objects, flint, quartz, obsidian and other rocks which have been turned into artefacts. Under normal circumstances they will remain intact, perhaps with little change other than the formation of a surface patina. Traces of wear from the use of the artefact, even traces of the substances on which it was used (for instance, blood traces from the cutting of meat), can survive. Only physical erosion can destroy the surface; only heavy pounding, for instance from the waves on a seashore, can totally destroy the object. Softer stones may lose their form: for example, shale used as bracelets and other jewellery, which can be worked like wood when fresh, will crack and disintegrate when exposed to a dry environment. Generally, however, stone stands at the top of the survival hierarchy.

Metals form their own hierarchy, from the 'noble' to the 'base'. Gold is virtually unaffected by chemical activity, and physical pressure or melting will only cause it to change its shape. Silver, tin, lead and the numerous alloys of copper are resistant to varying degrees. Under benign alkaline conditions a patina will form which will protect the underlying metal, and preserve surface detail such as the inscription on a coin. Under poor conditions such as in an acidic soil, all of them can be reduced to oxide powders. Iron represents the other extreme: it will rust and corrode under almost all conditions, especially where it is exposed simultaneously to both damp and oxygen. The surface rarely survives intact.

Man-made organic materials are generally resistant. Highly fired clay is almost as durable as soft stone, but poorly fired ceramics are prone to destruction from natural forces such as frost and abrasion. Thus, in field walking, post-medieval pottery, Roman Samian pottery and porcelain will survive under conditions in which prehistoric pottery disintegrates. Ancient glass is variable—surfaces can oxidize and flake on exposure to air and sunlight, while glass made from potash, like medieval glass in Europe, simply disintegrates even under normal preservation conditions.

Organic materials

Soft tissues of either plants or animals rarely survive, and generally it is only the skeletal structure which is resistant. Bones of animals will survive under alkaline conditions, but are attacked by acidic soils. In sandy soils only the most resistant parts such as the enamel of teeth may be found, though the outline of not only the skeleton but of the whole body may be traced as a ‘ghost’ of darker staining; the same may be true for wood, for instance the outline of the boat from Sutton Hoo (Bruce Mitford 1972, 1975). Bones of birds and fish are prone to destruction. In the latter case even under conditions where animal bone and shell are preserved, fish may only be represented by otoliths, the compact bony structure of the ear (Mellars and Wilkinson 1980). On the other hand, the silica structures of plant and tree pollen, and phytoliths (silica which fills cells in the leaves of plants, especially grasses) are resistant to acidic soils, but less so to abrasion such as occurs in soils subject to animal and microbial activity.

Soft tissues will only survive under the exceptional conditions of cold and damp, described in the next section. Otherwise, many organic remains need to undergo some form of chemical change, such as the replacement of tissue with some more resistant material which happens with the fossilization of bone and shell. For softer tissues this can mean being in contact with a metal whose corrosion products will produce salts which infiltrate and preserve the structure. A common example of this is traces of clothing (textiles, fur, and so on) in contact with copper salts from objects such as belt fittings or brooches. This happened in the iron age burial of Hochdorf in south-western Germany, where fibres included some silk-like threads, presumably imported from the east Mediterranean, and also the hairs from the pelts of badgers, with even some of the pine needles caught in their hair (Biel 1985).

The most common chemical change which leads to preservation of organic material is from burning. Under slow-burning conditions in which not enough oxygen is present to form carbon dioxide, plant remains will simply be carbonized, and wood charcoal, carbonized seeds and even chaff will be preserved, but these can only be recovered systematically by a carefully thought-out strategy of sampling, sieving and flotation. Moreover, the formation of charred remains is heavily biased towards those activities which involve fire, for instance drying cereals, heating them to assist de-husking, and especially cooking. Accidents in cooking occasionally provide us with complete loaves and residues inside pots, which, other than the stomach contents of preserved bodies, or of coprolites, are our only hints at eating habits and cuisine. The charring and cremation of bone will also lead to it surviving in acidic soils in which bone is not normally preserved.

Actions and beliefs

It is one of the basic tenets of modern archaeology that we can go beyond the actual objects themselves, and by careful observation of location and context of objects and debris we can get at the intangibles of the past, such as belief systems and activities. Occasionally this can be the single action, often of a prosaic nature, but which by its utter banality can give us a feeling of being close to our ancestors: the group of early hominids who left their footprints in the silts at Laetoli as they crossed the mud flats (Leakey and Harris 1987); a glass wine bottle in a pit in Winchester with the stone that smashed it resting on the broken pieces; the violent death of a defender at Maiden Castle with the Roman ballista bolt still embedded in his spine (Wheeler 1943). All these bring back vivid events which link us as humans to our human past, though the circumstances which surrounded these isolated events can only be conjectured.

It is the regularity of actions that it is most useful for the archaeologist to identify. An example is the regularity of movement of humans across or within space. Thus, at Wroxeter, wear on the stone rubble of collapsed early Roman buildings identified the positions of paths between the timber buildings of the fourth and fifth centuries AD (Barker 1969, 1977). Potentially worn areas in the floors of rooms may indicate movement around the house, and so how space was used; conversely, unworn areas may indicate the position of bedding or of furniture. It is such subtleties of the archaeological deposits that earlier archaeologists, intent on discovering objects or chronological sequences, failed to identify.

The examples just quoted are cross-cultural phenomena. Regular movement by humans, animals, and wheeled vehicles will produce wear at any time anywhere in the world. But at what point do such 'natural' laws give way to another logic of culturally influenced results? Ploughing a hillside will cause the soil to be eroded. Careful ploughing following the contours will conserve moisture and minimize erosion; ploughing across the contours, whether through ignorance or through greed in obtaining a quick return with no concern on the long-term effects on the environment, can cause major erosion and degradation. In this case the natural process of erosion is influenced by the cultural choice of the farmer.

The effect of cultural ideology on the archaeological record is most obvious in the realms of religion and funerary rites. Anthropologists are sceptical about the extent to which beliefs are translated into regular activity, as observations in the field generally show there is great variety (Ucko 1969). In a case quoted by Ucko, the Ashanti supposedly bury their dead facing the village; in fact not much care is taken in ensuring the body is actually facing in the right direction, as they also believe that the body itself will turn over and face in the right direction. So how can an archaeologist identify these beliefs? The anthropologist is usually making observations over only a short period of months, at most years, during fieldwork. By contrast, an archaeologist excavating a cemetery may be looking at decades, perhaps centuries, of activity, and long-term trends and norms are more easily identifiable, even if much of the detail of the ceremony and the beliefs surrounding the actions is unknown. A number of factors may influence the homogeneity of the burial rite: the nature of the belief systems; how much deviation from the norm is tolerated; how familiar the group carrying out the burial was with the norms of the burial rite. This latter will be influenced by the time that has elapsed between one burial and the next, and whether there was a group within the society which specialized in giving advice or actually conducting the ceremony. Many of our distribution maps of objects are influenced by the basic factors in the disposal of the dead.

The burial of objects with the dead may occur for many reasons: to accompany the dead person in the after-life; as a display of destruction of wealth to demonstrate power; due to taboos about using objects belonging to someone dead; or simply sentimentality, like the woman recently in Chesterfield in Derbyshire (England) who buried her husband's beer mug with him! The deposition of gravegoods is something 'understood' cross-culturally, even among societies where it is not practised, though its actual meaning may not be understood. The deliberate destruction of wealth for religious or prestige purposes (for instance, a potlatch) are less 'understood'. As a coroner in Guildford said, summing up for his jury for them to decide whether a group of gold and silver coins was buried with or without intent of recovery (and so whether it was treasure trove, and thus according to English law the property of the Crown): 'what person in their right mind deliberately throws away gold and silver?' For capitalist westerners, such an act is folly and incomprehensible; for a Kwakiutl chieftain it would have been a potent sign of power and prestige.

Even less obvious is the boundary between 'natural' and 'cultural' in a 'domestic' context. The case of clearing away large fragments of pottery from the living area and depositing them elsewhere where they were out of the way may seem logical, but is such logic always followed? Hodder has discussed cases where the attitude towards 'rubbish' can be very different even among adjacent and contemporary societies with similar economies and technologies, one systematically removing it, the other disguising it but leaving it on the settlement (Hodder 1982). On neolithic and iron age settlements in Britain, archaeologists have generally assumed that pits and ditches were filled with 'rubbish', but once the basic proposition was questioned, it was found that the contents of pits by no means conformed to the 'rubbish' that a settlement might logically be expected to produce (Cunliffe 1983, 1995; Hill 1995). So, is iron age 'rubbish' simply different from 'rubbish' in other societies, or was the deposited material something radically different with ritual overtones, or is the whole concept of 'rubbish' false in such societies, and merely imposed though our own cultural bias?

These are direct examples where ideology and belief impose themselves directly on the archaeological record; they can also do so indirectly. Artefacts and ecofacts survive usually because they are buried, and they are more likely to become buried if there are holes for them to become buried in. As an example, why do some societies enclose settlements, fields, houses, with ditches? It can be for defence, to define areas with different functions, to prevent animals from straying, for display and prestige, or simply as a symbol of a boundary (Collis 1996). Whatever the reason, these ditches will subsequently fill up with 'natural' or 'cultural' deposits, but it is the very presence of the ditch that allows this material to become incorporated within an archaeological deposit, making such sites easier to locate, for instance through aerial photographs. Thus, sites and periods with ditches are likely to be over-represented and better understood than those without. They will also bias distributions of objects against those areas where ditch digging was not the norm, so one type of object may be commonly found in one area and never in another, even though both areas were using the same objects.

Thus the recognition of such norms and regularities of belief systems are an essential first task for the archaeologist wishing to interpret the archaeological record. But we have to adjust our thinking away from our own cultural bias if such regularities are to be identified. We in our turn may be able to identify regularities of which the practitioners themselves may have been unaware.

SPECIAL CASES OF PRESERVATION

So far we have generally been dealing with 'normal' conditions under which the vast majority of artefacts and debris produced by a society disappeared through the natural process of decay. There are, however, exceptional circumstances in which this process is arrested.

Preservation through desiccation

One immediately thinks of the valley of the Nile as the supreme example of preservation in desiccated conditions—the wooden ships of the pharaoh Cheops at

Giza, the tomb of Tutankhamun, the mummies which grace almost every large museum in Europe. Much of our knowledge of early literature is derived from such sources, Egyptian papyri such as those from Oxyrhinicus, the Dead Sea scrolls (Allegro 1956), or the texts from the caves of Tun Huang in central Asia (Renfrew 1987: 64–5). Desert conditions in the south-west of the United States have preserved a rich range of finds, mainly from caves, made by the early Indian 'Basket Maker' cultures—not only the basketry and other woven containers which give their name to the culture, but a range of wooden artefacts and less attractive material such as coprolites which give us a detailed insight into the diet. The timbers of Pueblo Indian villages have allowed the construction of a dendrochronological sequence for the south-western United States, and with it details of the major drought in the fourteenth century which decimated the rich cultures of the area (Douglass 1919, 1928, 1936). The desert areas of Peru have also produced preserved finds, especially bodies, from caves.

But such conditions are not as rare as we may think, though finds may not be so old or as spectacular as those already mentioned. Anywhere where damp is unable to penetrate and the microbial organisms responsible for decay are unable to survive, organic remains are likely to survive. Timbers in many churches and castles in Europe have survived for a thousand years or more, and wood in domestic buildings several hundred years old is not uncommon. Finds such as leather shoes and dead animals are regularly found under floors or in chimneys, sometimes deliberately deposited. Stone-built tombs in cathedrals can preserve wooden coffins and textiles, as in the tomb of St Cuthbert in Durham; some of the objects such as the decorated coffin itself date to a couple of years after the saint's death in AD 687 (Cronyn and Horie 1985), others to the date of his reburial in 1104. Preservation is greater where deliberate efforts at conservation are made, in libraries and treasuries.

Waterlogged conditions

When organic material is permanently under water, and oxygen is unable to penetrate, microbial activity is likewise inhibited. This is the most common form of preservation in temperate Europe, both in natural and man-made situations. Bogs may not have been entirely congenial conditions in which people could live, but they do preserve sequences of natural vegetation, both in the form of macroscopic plant remains, and as pollen grains and spores. But such conditions did attract early people, with their resources of fish, wildfowl, reeds for basketry and thatching (Coles 1992). Sometimes trackways were constructed to provide access to these resources, or simply the bog may have been in the way and had to be traversed, giving rise to the sorts of trackway found in the Somerset Levels dating to as early as the fifth millennium BC (Coles and Coles 1986).

However, the degree of preservation is also dependent on the mineral content of the soil. Textiles are preserved under some circumstances, like the clothing in the coffin burials of Egtved, Muldbjerg, Bornum Eshøj and Skrydstrup in Denmark (Glob 1974). Leather is more common, in the form of shoes, belts, caps, and cut-offs from leather working, largely because it has undergone a tanning process which makes it more resilient to decay. The famous 'bog' burials of Denmark and northern Germany ostensibly seem perfectly preserved, even to the wrinkles on Tollund Man's face (Glob 1969). The stomach and other internal organs also survive, but this is largely due to the tannin derived from oak trees growing in the vicinity which has naturally 'tanned' the skin. Despite this the bones generally do not survive as they have been dissolved by the acid conditions. The softer tissues disappear, both of plants and animals, or rather they collapse as the water content is dried out, but the harder materials such as the husks of seeds, the epidermis of insects, parasite eggs, pips and stones from fruits, commonly survive under waterlogged conditions.

Wood is the most resilient of the organic materials to survive by waterlogging, often in exquisite detail. To name only some of the more spectacular examples, there are the 5,000 fragments of votive offerings from the early Roman shrine at Chamalières in central France (Provost and Mennessier-Jouannet 1994:57–61; Fig. 3.6). Many are simply rough-hewn arms and legs, but there are also schematic representations of internal organs such as lungs and intestines, as well as breasts and eyes, presumably a request to the divinity for these parts of the body to be healed. One or two are high quality portraits like the bust of a woman, or goddess, shown wearing a torc. Both in terms of scale and quality of artistic content, the most spectacular find is the Viking ship from Oseberg in Norway, perhaps the burial of a queen who died around AD 800 (Brøgger and Shetelig 1951; Wilson 1970; Fig. 3.7). The ornate carving of the prow is among the finest surviving examples of Viking art, but other finds loaded on to the boat included vehicles such as sledges, and household furniture and containers, pillows, and decorative items such as peacocks' feathers. The oldest surviving wooden artefacts are the pointed stick or spear from waterlogged contexts at Clacton-on-Sea in England, dated to about a quarter of a million years ago, and the newly discovered finds from Schöningen in Germany dated to about 380,000 years ago (see Chapter 20).

Shipwrecks too often produce plentiful wood remains, but only if the timbers have been buried in silt, and so preserved both from attack by sea creatures and from currents (for instance, see Bass 1996). The presence of a wreck is often only betrayed by inorganic finds such as wine amphorae or iron cannon, and there is a natural bias in discovery towards periods when ships were carrying such visible items. If the boat has sunk in an upright position, usually only the keel and the lower part of the hull are preserved, but many boats keel over, so preserving one side of the boat. Two almost new boats whose sinking was recorded historically have been located and raised for preservation, the Swedish man-of-war, the *Vasa*,

Figure 3.6 Chamalières, Puy-de-Dôme, France. Some 5,000 wooden objects, depicting mainly legs, arms, but also breasts, intestines, busts, and images of animals, were deposited in a shallow lake, presumably as votive offerings. Source: Provost and Mennessier-Jouannet 1994.

lost in 1698 (Landstrøm 1988), and the *Mary Rose,* which sank on 20 July 1545, destabilized by the simultaneous firing of its cannons (Rule 1983). In both cases they have produced a wealth of ship's instruments, personal belongings and stores, including weapons such as bows and arrows. The early medieval ships displayed in the boat museum at Roskilde were deliberately sunk to protect the entrance of the harbour from attack, and though not so informative in terms of contents, they do show a range of the different vessels in use at the period (Olsen and Crumlin Pedersen 1967; Wilson 1970).

Frozen finds

Even in the Arctic it is only under special circumstances that remains will become frozen. Normally settlements are on the surface, so subject to thawing and freezing

Figure 3.7 Oseberg, Norway. A view of the ship burial as found; it is dated to around AD 800. It had been preserved by burial in a damp environment, and by being sealed with clay. © Universitetets Oldsaksamling.

with the seasons, and only in conditions of permafrost will organic material survive, for instance in pits or shelters, or where a settlement has been buried in an avalanche. Thus, some burials and settlements have been preserved, for instance at Utqiagvik (Barrow) in Alaska (Dekin 1987; Lobdell and Dekin 1984) and at Qilakitsoq on the western coast of Greenland (Hart Hanson *et al.* 1985, 1991), and, in the latter case, also the Viking settlement which was wiped out by worsening climatic conditions in the fourteenth century AD.

The Austrian 'Ice Man' was a freak preservation (Spindler 1994). Bodies incorporated into glaciers normally come out at the bottom within a century or two. He died in a natural hollow protected from glacial action, but also his body must have been buried quite quickly, again under worsening weather conditions. The famous burials from Pazyryk only survived because water condensed on the stones of the cairns and dripped into, and flooded, the underlying timber chambers

(Rudenko 1970). In the winter the ice froze, but during the summer in the cases where the cairn was sufficiently large, it acted as insulation, and the tombs remained permanently frozen; this did not occur under the smaller cairns.

In all these cases the material is exceptionally well preserved, including the soft tissues. In all three cases, Eskimos, the 'Ice Man', and at Pazyryk, tattoos could be identified on the skin, in the last case with elaborate animal art. At Pazyryk, dated to around 400 BC, felt clothing, a wagon canopy, carpets and silk textiles, saddles and harness, along with the horses' bodies, and equipment for inhaling hemp, all survived intact.

Mineral preservation

Fills of cesspits often survive in exceptional condition, due to the process of waterlogging followed by desiccation which can mineralize the contents, thus preserving seeds, and eggs of internal parasites such as tapeworms.

An unusual case of preservation due to carbonic acid from a volcanic spring occurred in the Roman cemetery of Les Martres-de-Veyre in central France (Provost and Mennessier-Jouannet 1994:182–86; Fig. 3.8). Not only were the wooden coffins preserved, but also the plaited hair-dos of the women. In one case a body was buried wearing shoes, woollen stockings and a woollen dress and belt. Small plates and cups are common in Roman burials, but only at Les Martres have the contents been preserved—small tarts, raisins, plums and coriander seeds.

The salt mines at Hallstatt in Austria have also produced numerous organic remains preserved in the salt (Barth 1983). Much of it is prosaic, such as coprolites and the charred ends of the pine torches used to light the galleries. Wooden tools such as handles, mattocks and wedges are also known, and the haversacks made of wood and skin used to transport the salt out of the mine. In the eighteenth century the preserved body of a miner was found, but unfortunately reburied without any scientific study. He was interred at the local church in the modern town of Hallstatt, but outside the consecrated ground, because it was thought that he might not have been 'a true Catholic'!

THE ARCHAEOLOGICAL RECORD

We are now in a position to review the nature of the archaeological record, what it can and cannot tell us, and how potentially it can be misunderstood and abused. As with the case of the Roman coin, it is useful if we do this as a sort of hierarchy, working from the single individual find and building up to inter-regional comparisons. At all levels there are potential pitfalls in interpretations and misunderstanding.

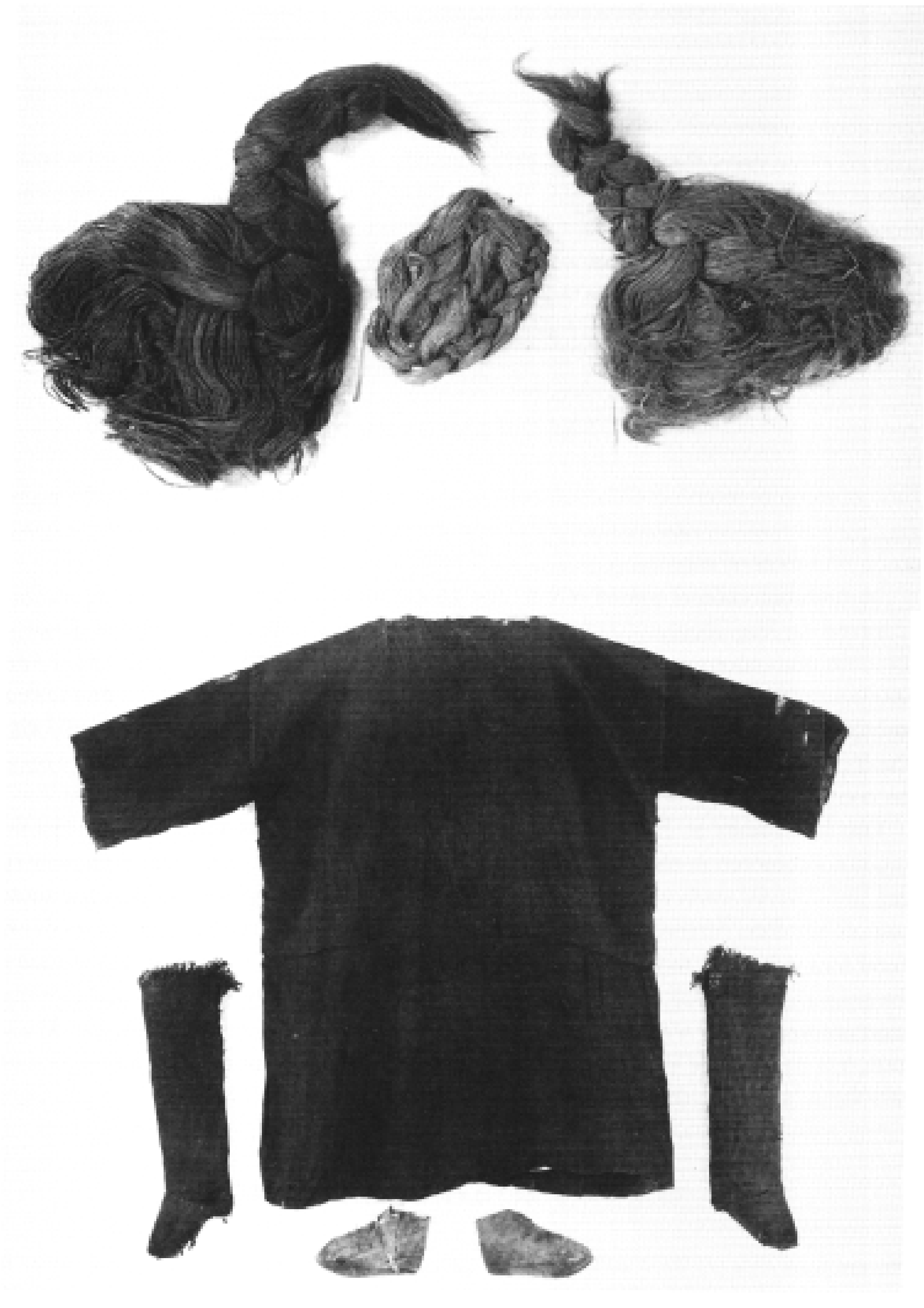


Figure 3.8 Les Martres-de-Veyre, Puy-de-Dôme, France. Better known for its Samian pottery kilns, the site has also produced Roman burials with exceptional preservation due to mineral springs. Not only are the clothes and hair of the dead preserved, but also the food offerings in the cups and bowls which are normal accompaniments of Roman burials elsewhere. Reproduced with permission of the Centre Regional de Documentation Pedagogique, Clermont-Ferrand.

The individual, the artefact and the ecofact

At the lowest level, there is the individual find, be it a potsherd, a bone, a person, or a pollen grain.

At all levels of the hierarchy we must face the significance of absence as much as presence. At the lowest level it is a question of what has not survived; in other words, post-depositional transformations. On most sites this will be the majority of the material culture, everything made out of organic material such as wood, tissues and leather; on acidic soils it may also include bones and metal objects as well. Considering absence does help to concentrate the mind on maximizing the value of the evidence which does survive. Thus, a skeleton may not survive as bone in a grave, but its presence should be looked for, either in the form of a silhouette, or a few pieces of tooth enamel, or simply as a concentration of phosphate in the grave. Suitable strategies can then be prepared to recognize and record such evidence as may exist.

For objects which are found, there are two immediate questions which pose themselves; the first is, when was it deposited and is it contamination? It may have been brought down from a higher level by a burrowing animal or by worm action, and it could have slipped down through a crack in the soil, or even been introduced in the mud on the excavator's boot. The resolution of this depends on maintaining a clean digging environment. If it is a genuine find in its proper context, there is the second related question of how it was deposited. Is it in its primary position, a potsherd or group of potsherds with unworn breaks, dumped soon after the pot was broken, or is it a worn and highly fragmented sherd which has been lying around for some time, perhaps even deposited from another context? This question of 'residuality' is a major problem on deeply stratified and long-lived sites. It is relatively easy to recognize with intrinsically dated objects like pottery or coins, but less easy to identify with undated material like bones. In the case of bones, are the fragments fresh, with little sign of erosion and gnawing? Perhaps they are even in articulation with other bones, or dumped as a group of bones derived from a single carcass. Though it is best to be treating the group of finds as a sample, dating is provided by the latest object in the group, for instance the latest coin, and this provides the *terminus post quem*—that is, the earliest date that the deposit could have formed (see Chapter 5).

Material can be deposited due to entirely natural processes, pollen rain for example. At the other extreme, objects can be deliberately placed in position by humans, and that positioning may be highly significant, like the orientation of a corpse or the location of a pot or other object in the grave. In these cases the archaeologist will need to record the details with care. Most deposition falls between these two extremes: material that has been thrown into a pit as part of rubbish disposal; rubbish that had been dumped nearby and was finally deposited through erosion; an animal that had fallen into a pit and died. These are the subtleties of deposition which need to be understood if a deposit, indeed a site, is to be properly interpreted.

The context

The context is a term used by field archaeologists to describe the location of a group of finds. Normally it is synonymous with a layer in a pit or a ditch, or a floor, or a wall of a building, and so on: it is the matrix in which archaeological finds are found, and so it is a means of grouping finds into meaningfully associated groups. In theory such a group of finds in a context is contemporary, but this is only true to the extent that they were deposited at the same time, or during the period of time in which the soil which forms the matrix of the context was accumulating. The context could contain 'residual' finds, material accidentally dug up when a pit has been cut through earlier deposits, a common problem on deeply stratified sites. It may also contain material that has been 'stored' for some time, like rubbish on an above-ground midden or, in the case of human remains, a body that had been excarnated by exposing it to the elements, and only buried after the flesh had been removed by animals and natural processes of decay. It may contain material that was in use at the same time, but which included items which had been in circulation for some time, such as family heirlooms or coins which were a century or more old but which still had a value and were still in use.

Such a group of finds represents a 'sample', partly a sample of what was actually in use and circulating at the time of deposition, partly a sample of all the rubbish that had already accumulated on the site. Deciding which category individual finds belong to is not always easy. One way is to look at the fragmentation patterns, distinguishing between primary deposition (large, fresh fragments) and secondary deposition (small, worn, fragments derived from elsewhere), but such distinctions depend on the nature of the deposit. In a pit, contemporary sherds are likely to be large, whereas in a floor level they are likely to be small and highly fragmented.

As at the artefact level, a distinction needs to be made between 'deliberate' and 'natural' deposition. The latter will include the effects of erosion, but may also include deposits which have taken a long time to develop, such as a 'turf line' which may have been subject to worm sorting over a considerable length of time. In contrast, deliberate dumping of material is often something which happens over a very brief span of time, though the material used may have been gradually accumulating somewhere else. This distinction between material that has accumulated *in situ,* and material which has been brought from elsewhere and dumped, is important if we are to identify 'activity areas', as dumping can distort the spatial pattern.

Seasonality is also an important factor. Most hunter-gatherer sites are of a seasonal nature, and even in sedentary agricultural societies there may be seasonally occupied sites, connected with activities such as transhumance, salt-making, or fairs, all of which involve part of the population moving away from the permanent settlement for a period of time. But even on sites which are occupied throughout the year, there are activities which will lead to seasonal deposits forming, such as the filling up of storage pits in which the seed grain was stored over winter. In this case, infilling will take place in late spring and early summer, though the actual fill may be derived from above-ground middens formed throughout the year. Effects of heavy rain or frost on newly excavated ditches and pits may also lead to more rapid build-up in specific seasons, and again introduce the bias that material from certain seasons is more likely to be buried and be over-represented. Such seasonal bias has to be tested for against a model of what might be expected, and seeing if, for instance, certain stages of eruption of animals' teeth are over-represented, and looking at the presence of migratory birds, or of shed and unshed antlers of deer.

The feature

A feature can be defined in several ways. It may be an individual hole dug into the ground: a pit, a post-hole, a ditch, or an oven. Or it may be part of a larger structure: a room of a building, an enclosure in a farmyard complex, or a field, or a trackway. Each of these is a separate functional unit, with activities which may be special to it, and therefore associated with different sorts of finds. Within a house, separate rooms will have different functions: kitchen, entrance hall, dining room, bedrooms, storage, dairy, though in a simpler and poorer house one room may perform many of these functions. Rooms may be used by different categories of people, with differentiation by class (owners and servants), by sex (male and female quarters as in Roman public baths), by age (the children's nursery), or by occupation (outdoor and indoor servants, doorkeeper). Each in theory should leave behind a distinctive group of finds, like the hairpins which appear in the drains of the female bath establishments in the Roman period.

The reality is, of course, more complex, one of the problems being the relationship of context and finds to the feature. In houses, rubbish will not usually start accumulating until it has been abandoned, though some items reflecting the original use may be left if they are not worth recovering. It is only in the case of uncontrolled abandonment, through flood, avalanche, volcanic eruption, plague, or some such disaster, that the finds may be genuinely those used in the room; such cases are important, as they allow us to extrapolate to less well-preserved situations. But many mistakes have been made in the past by assuming too readily that finds in a feature reflect its use. Carbonized grains from the post-hole do not mean that it was part of a granary, and carbonized grain in a storage pit is unlikely to have been burnt *in situ*. Sunken-floored houses *(Grübenhäuser)* of the Anglo-Saxon period in England are often assumed to have had an industrial function, especially for weaving, so occurrences of loomweights are carefully recorded, but they are often just amongst the rubbish dumped to level up the hole when it was abandoned and may have nothing to do with the original use.

Ditches and storage pits, or tanks used for industrial purposes like tanning and dyeing, are kept clean until they are no longer needed. Thus the finds in a ditch date to the period when it was going out of use, and may reflect neither the period when the ditch was first dug, nor the activities which went on in the adjacent enclosures. A corn silo is only filled when it has turned sour, or the sides have become too degraded for it to be used. Only in some cases was the pit made deliberately to be filled with its contents—foundation trenches for stone walls, graves, rubbish and cesspits.

The structure

Features are parts of larger entities. Rooms, courtyards and gardens make up house compounds; byres, stables, dairies and livestock enclosures form farmyards; arable fields, pastures and trackways make field systems. At this level, too, it is easy to pick up functional and social differences: the residences of the rich and the poor; domestic houses; workshops and factories; cult buildings. Even so, the outward form may not necessarily reflect function; indeed function can change, like the conversion of the courtyard houses at Pompeii into industrial buildings, or redundant churches into barns and offices.

The site

Even in the simplest social systems, sites have different sorts of function: the base camp, the hunting stand, the kill site, or sites occupied seasonally to exploit special resources. Such sites will have their distinctive range of tools associated with those activities. In more complex sites there may be functional hierarchies: city, town, village, farm; or special sites: ports, cult sites, industrial centres, forts. These too will possess special types of architecture, finds, and industrial waste, reflecting their role.

However, it is not always easy to define a site. In normal archaeological terminology a site is represented by a concentration of finds, but when we consider a farm, it consists of farm buildings, stock enclosures, arable fields, pasture, and trackways to give access both to the field and to neighbouring sites. A town could be supposed to consist only of the built-up area, but in Roman times, for instance, the town also included a *territorium,* which included fields and allotments belonging to the inhabitants, as well as the cemeteries of the town, which by law had to be outside the built-up limits. Such sites consist, then, of a complex of zones with different functions. In discussing the functioning of the rural estate, von Thünen in the nineteenth century defined the areas in terms of concentric circles of exploitation— dairy, arable, woodland, pasture—each with their own distinctive activities (Chisholm 1962). Geographers have attempted similar analysis of urban centres (Haggett 1965), like Sjoberg's concept (1960) of the 'pre-industrial city', with its core dominated by religious and administrative buildings; around this were the houses of the élite land-owning class who controlled the religion and administration, and in the outer core of the city were the poorer areas, themselves fragmented into separate zones. These different quarters could be defined in terms of occupation (butchers, leather workers, merchants, weavers), or by wealth, or by ethnicity (for instance, the Jewish quarters in medieval towns).

But archaeologists also deal with time. Settlements expand and contract, and the pattern of occupation in one part of the settlement may be very different from that in another. A good example is the Roman town of Verulamium (St Albans, Herts.), which started around a Roman fort, at first expanding along the primary through-routes, then along secondary parts of the street grid (Frere 1983). At various times defences and boundaries were established. Wheeler's excavations in the 1930s suggested that the town was in general decline by the early fourth century, based on his excavation in the southern part of the walled area (Wheeler and Wheeler 1936). Frere's excavations in the 1950s in the centre of the town produced wealthy houses constructed towards the end of the fourth century (Frere 1983:20–25). In contrast, the western suburb of the town was isolated from the main part of the town by the construction of a new defensive wall, and it was already in decline in the third century (Curnow 1988; Stead and Rigby 1989). Excavations in different parts of the town therefore have given very contrasting pictures about the origin and the final abandonment of the site.

The region

In comparing one settlement with another, for instance the relative occurrence of imported pottery compared with local wares, or the ratio of different animal species, it is obviously important to be comparing like with like. If one wishes to compare two settlements in terms of access to fine pottery or glass, it is pointless if the sample for one comes from an élite part of the town and for the other from a low-class or industrial area. Adequate sampling strategies need to be in place both for individual settlements and at a regional scale. With caution, for some categories of finds, regional 'norms' can be established, even using chance finds as has been done for coins in various parts of the Roman empire, and the occurrence of coins on a particular site can be compared with the norm (Casey 1988; Reece 1972, 1988). The relative rarity of first- and second-century coins in Britain would mean that their absence on a site would not be particularly significant, whereas the absence of common third- and fourth-century coins would. The sort of mistake that has been made in the past is claiming, for instance, a great upsurge of activity on a site in the mid-third century because coin numbers increase dramatically, when in fact this simply reflects the regional norm.

In looking at a region, potential biases must first be investigated. An active museum can encourage finds to be reported in its close proximity; the activities of individual fieldworkers can increase densities of finds; some sorts of sites show up better on aerial photographs and some soils and crops are more susceptible to such methods. Settlements may be completely masked by woodland, pasture, or modern conurbations; they may have been completely eroded, or be buried under deep deposits of colluvium or alluvium. Even where attempts are made to overcome these biases by systematic field walking (Haselgrove *et al.* 1985; Shennan 1985), certain periods, for instance with an abundant lithic technology or with more durable pottery, may be better represented than those without. If a certain period is poorly represented, some independent confirmation should be looked for before it can genuinely be interpreted as a drop in population: one thinks of the Dark Ages in both Greece (Morris 1987; Snodgrass 1971) and western Europe, when in part the lack of sites is due to a drop in the production of pottery, though a drop in the population is certainly part of the explanation. In parts of Poland, at the end of the Lausitz period in the Early Iron Age (the sixth century BC), the lack of sites seems to be confirmed by evidence from pollen cores, which show considerable forest regeneration, implying abandonment (Buch and Gramsch 1986).

Inter-regional comparisons

The distribution map is a common archaeological tool, a method of quantifying archaeological data visually. Usually all such maps show are the positive occurrences of the traits plotted, and rarely are symbols used to show a genuine lack of evidence, for instance, where there are pottery assemblages which lack the type being plotted. Blank areas on maps may reflect either a lack of fieldwork, or a genuine gap. They can also mean that the trait being plotted is not actually the one that it is claimed to be plotted: the distribution of Roman coins and bronze vessels in Figure 3.9, for example, is not one of Roman trade contacts but of local burial rites. Thus, a distribution map of a sword type may not show where such swords were in use but simply where they were deposited in graves or in votive offerings at religious sites or in rivers. In inter-regional comparisons, it is usually

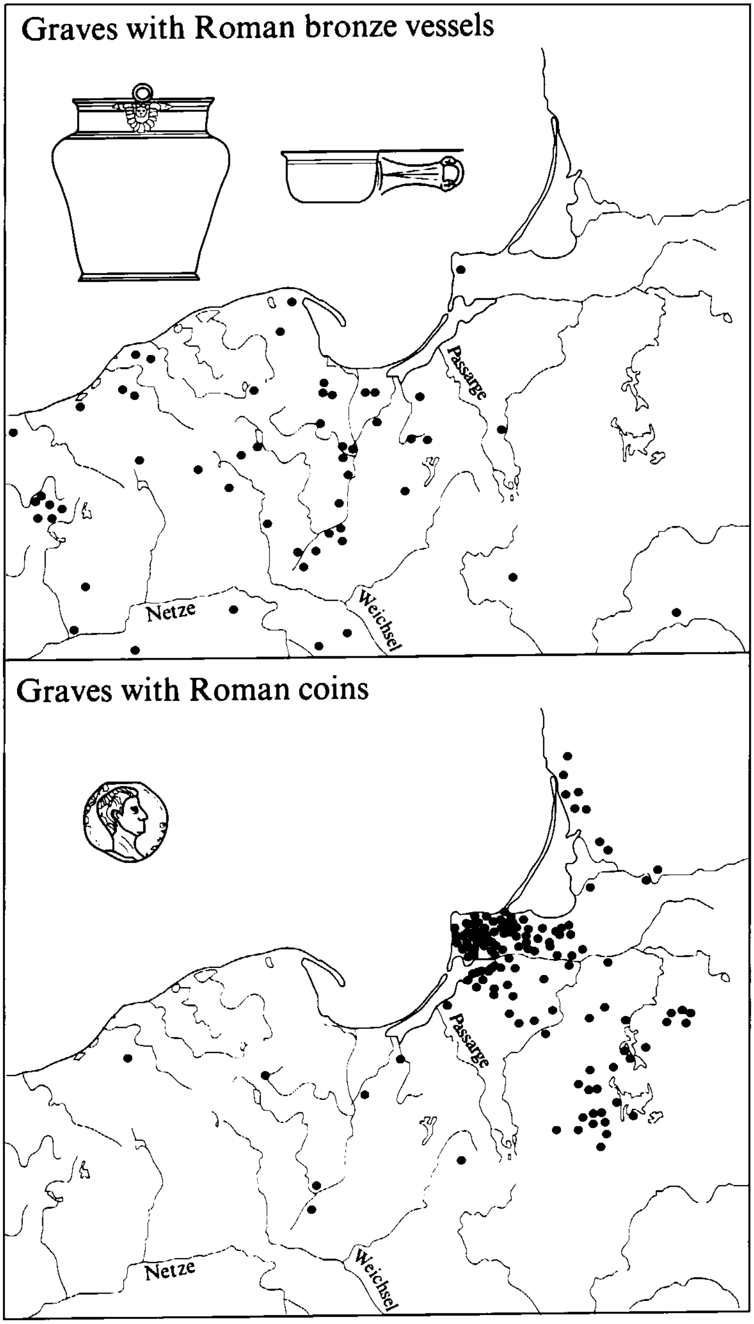


Figure 3.9 Distributions of graves with early Roman finds from the eastern Baltic. The distribution does not show the intensity of trade contact, but simply two areas with different burial rites, one employing imported Roman bronze vessels, the other Roman coins. © Piper Verlag GmbH, Munich 1959. Redrawn by D.Miles-Williams.

two things that are being plotted, field activity, and deposition. Rarely do such maps show genuine distributions of the use of objects.

CONCLUSION

Like any historical document, archaeological data can tell us a great deal about the past as long as we are aware of the biases that are inherent in them. They form a document that has been written by many people, most of whom were not conscious that someone later would try to 'read' what they had left on the landscape. They are a document written in many languages, some of which we think we can read, some of which we may be misled by, and some of which is in a language nowadays totally incomprehensible. Much of the document has been destroyed and defaced and will never be reconstructed, and we need to preserve as much of it as we can until our reading becomes more proficient, though for many sites time is short as we are destroying the archaeological record at an alarming rate. Each of us has our own reading built on our own experience, and none of us will read the document in precisely the same way; each generation will see the document differently, but this is one of the attractions of archaeology.

The archaeological record is a complex tool, full of the knowledge accumulated by generations of archaeologists. It is constantly being improved as more sophisticated questions are asked of it, as more and more archaeologists are employed, and as our means of data storage and manipulation develop with better technology. With due caution, we can use areas which have been intensively investigated to give us clues about areas where less work has been done; large-scale and skilful excavations of selected sites can inform us about the many sites it is not possible to dig; and chance discoveries of exceptional quality in terms of preservation can tell us much about what does not normally survive in the archaeological record. But we must also be aware of the negative aspects of the record, and how it has become biased and distorted, due to the processes by which it came into existence. Archaeological data have enormous potential for interpretation, and even more possibilities for misinterpretation.

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Roman coinage forms one of the best examples of the problems of sampling, survival of the evidence and interpretation. Several of the chapters in Casey and Reece (1988) can be read with profit, as can Reece (1987). For more statistical approaches to archaeological sampling, Redman (1974) lays out the various options, and the problems of implementing them. These techniques are applicable both to field survey and to excavation, but his excavation of Qsar es-Seghir (Redman 1986) is virtually unique in applying strict sampling (both statistical and judgement) to an excavation. There are many books on the methodology of field survey, but the edited volumes by Haselgrove *et al.* (1985) and Cherry *et al.* (1978) are two which can be recommended, and Shennan's *East Hampshire Survey* (1985) is a classic of the genre. Renfrew and Bahn (1996) give many examples of survival of data, but for distribution maps they are more concerned with their potential rather than their limitations. A good sceptical approach to the use of burial evidence can be found in Morris (1987) and (1992).

4

FIELD ARCHAEOLOGY

Martin Carver

INTRODUCTION

Field archaeology is both an art and a science: an art because it requires imagination, creativity and flair; and a science because it requires the systematic recording and analysis of data. It is thus either an unusually imaginative science or an unusually disciplined art, and in practice requires both kinds of thinking to be successful.

The purpose of field archaeology is to detect and define every kind of trace left by people in the past, whether buildings or midden heaps, pottery or pollen, whether solid or ephemeral, and whether visible or invisible to the naked eye. These traces of human material culture are mapped in plan and chronicled in sequence, using both non-invasive and invasive methods ('survey' and 'excavation'). The targets of field archaeologists are principally *sites,* such as cemeteries or settlements, where cultural remains are concentrated, and *landscapes,* where they are more widely dispersed. From the records made during their interventions in the field, archaeologists make interpretations of the economy, social organization, ideology and the environment of ancient communities and examine how and why these changed.

PRINCIPLES

Formation processes

As discussed in the previous chapter, the buildings, artefacts and natural resources used by ancient people do not survive intact but are subject to a battery of natural and human agencies which modify their character sometimes beyond the powers of modern recognition (Rapp and Hill 1998; Fig. 4.1 Schiffer 1976, 1987). The primary factor in this transformation is the particular form of the ancient material culture itself. Communities who built pyramids, or stone triumphal arches, or buried their dead deep under earth mounds, have successfully ensured the memory of their culture, while those who built in timber and used mainly organic materials in their daily lives have left a more vulnerable legacy. Groups of finds ('assemblages') or groups of structures and activities ('sites') begin to be changed as soon as they are abandoned: the occupants may take away their choice possessions, and later people may remove, disturb or scramble what remains. The abandoned site or 'deposit' may lie very shallow, as many prehistoric settlement sites do on gravel or chalk, or very deep, as do settlements of long duration built over streams or valleys. Both kinds are immediately subject to physical attrition, shallow sites by ploughing or quarrying, and the deep sites, often in living towns, by continuous occupation and the construction of new buildings.

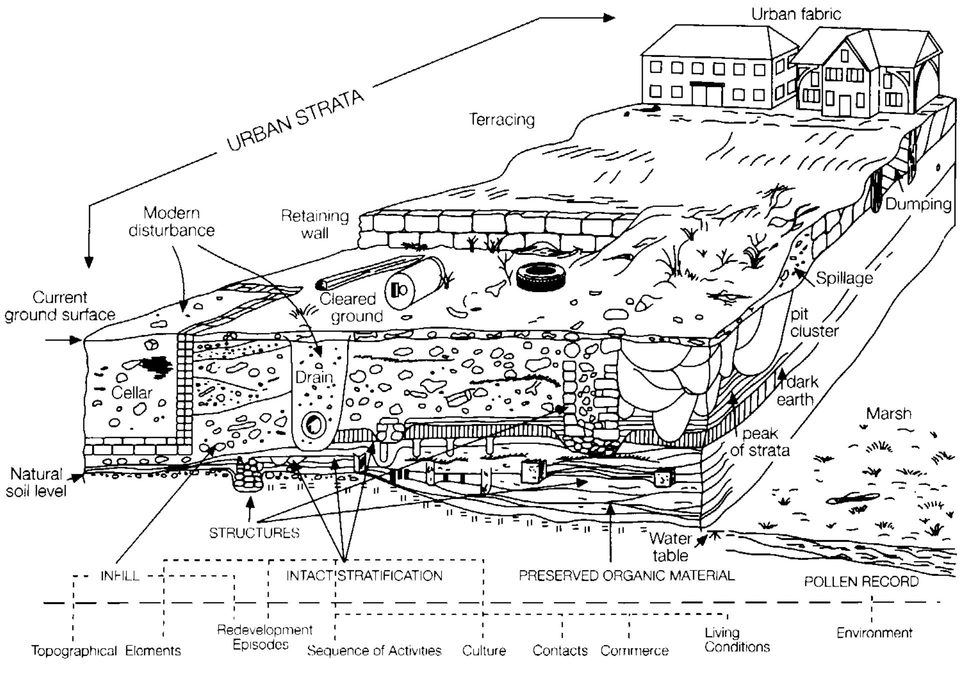

Figure 4.1 A slice of urban strata, broken down into its components and what they can tell us. Source: Carver 1983.

Most decisive of the natural agencies in the formation process is the chemistry of the subsoil itself. High acidity and the free circulation of oxygen, such as characterize sands and gravels, make a corrosive combination which can reduce timber structures, bones, metals and even certain types of pottery to little more than discoloured smears. If the terrain is very dry, very cold or starved of oxygen (anaerobic) it will by contrast result in a high degree of preservation, since these conditions inhibit the bacteria which cause organic decay. The site is further modified by the climate it has endured: it may be eroded or buried by wind, flood or volcanic ash. Under the sea or in a river, the remains of a ship and her cargo may be remarkably preserved, or dispersed by the agencies of current and looting. The character of the sites and deposits encountered by the field archaeologist is therefore immensely varied.

Theoretical platforms

The practice of field archaeology still grows wild from a number of different roots, in spite of the attempts of archaeological theorists to cultivate and tame it. People have long been excited by buried treasure, which was sought by early grave-robbers and is pursued more energetically than ever in the popular hobby of treasure hunting, whose adherents may be formed into clubs and equipped with technically advanced metal detectors.

Those with greater curiosity about the past, wondering whose treasure it was, and why it was deposited, broaden their enquiries to the documented people of the past, and this remains a traditional goal. In the nineteenth century archaeologists working in the Middle East, like Sir Austen Layard, took the Bible as their historical framework, and Heinrich Schliemann in the Aegean took the writings of Homer as his: he declared his chosen site, the *tell* or mound settlement at Hissarlik, to be the Troy of the *Iliad,* and went on to identify Agamemnon's Mycenae and the palace of the Minotaur at Knossos on Crete, later excavated by Sir Arthur Evans. Other ancient texts, those of classical Greece and Rome, of Egypt, of China, of the Maya, of the early Christians, and of Islam, continue to provide historical frameworks in which field archaeologists have worked.

Buildings and groups of artefacts (assemblages) present cultural signatures ('a culture') for a documented people, and in the 1920s and 1930s Gordon Childe, following German methodology, logically attributed an equal cultural identity to material which, being prehistoric, had no documentary references (see Chapter 12). Ever since, the goal of many archaeologists has been to write history from cultural sequence, and cultural sequence from sites and assemblages. The provenance of diagnostic, dated finds, plotted on a map allows the cultures to be tracked and equated with migrating and settling peoples and their 'culture-zones' (for example, Syedov 1982). In this approach, it may be deemed sufficient to excavate small parts of monuments to characterize the cultural history, a procedure adopted with famous precision, for example, by Sir Mortimer Wheeler equally in the hill-forts of late iron age Britain (1943) or in Mohenjo-Daro, an abandoned town of the Indus civilization some 3,000 years older (1945, 1946, 1976). Within this approach, the culture sequence is sampled mainly by 'sections', vertical profiles cut through the deposits which can be seen to be divided into layers. The finds recovered from each layer during the digging define the culture.

Much field archaeology has been influenced by anthropological goals. In the late nineteenth and early twentieth centuries, the ethnicity of peoples became a popular explanation for the apparent success or failure of cultures: A.L.F.Pitt-Rivers, the first Inspector of Ancient Monuments in England, excavated sites of all periods on his private estate at Cranborne Chase in Dorset, determining changes in the form of objects, the form of sites and the form of the human skull as being symptomatic of wider evolutionary forces (Bradley 1983; Pitt-Rivers 1887–1905). Other examples of ethnicity-driven research were studies of the mound builders of Ohio (Willey and Sabloff 1974) or the graves of Anglo-Saxon England (Leeds 1945).

Later anthropological directions have been more influential still. Steward and Willey saw a major area of explanation in the interaction of humans with their environment (Willey 1953), and fieldwork targets henceforward included the sequence of natural vegetation and the landscape which contained it, derived from pollen analysis (Godwin 1956; Dimbleby in Brothwell and Higgs [1963] 1969) and environmental survey (Vita-Finzi 1978). Binford (1972) and Clarke (1968) urged that the material culture sequence be studied as a *process,* in which society is expressed as a network of intersecting environmental, economic and social *systems*. Fieldworkers revealed these systems by taking *samples* of sites and landscapes, and constructing explanatory models of how and why systems change (Cherry *et al.* 1978; Mueller 1975). Another fruitful branch of anthropology, drawn from studies of modern traditional peoples, has shown that the organization of human society and its material culture were both strongly influenced by the mental structure shared by a community—its beliefs and mythology. The material culture actually found, therefore, was not only dependent on the environment but on the ideological decisions of the community concerned (Hodder 1986). Specific fieldwork targets are here more difficult to define, although new agendas for recording and interpretation have been suggested by studies of cult sites and cult practices (Carver 1993; Renfrew 1985; Richards 1987).

Practical approaches to fieldwork

While all these approaches have greatly enlarged the expectations of field archaeology, it has remained in practice an activity in which the empirical has dominated over the theoretical. Archaeologists working in the field are often divided into those doing excavation and those doing survey. Survey is seen as a group of operations that are generally non-destructive and on a large scale, while excavations destroy the archaeological deposit and are usually applied to a smaller area of deposit or site. This division is in fact rather artificial (Scholfield 1991): survey, for example, is employed during excavation—and can be destructive—as when pottery is taken from the ploughsoil. Both excavation and survey are employed at most stages of the research procedure (see below). Further divisions are sometimes made between archaeologists working mainly with buildings and those working underwater. These divisions are generated by the varied practicalities concerned, including (in many countries) different legal frameworks and academic communities. However, the principles of research procedure apply equally to all, and shared approaches and practices are becoming more common (NAS 1992; Wood 1992, 1994).

In survey, much attention has been given to mapping the archaeological resource with the aim of making the inventory of known sites as full as possible. In nineteenth-century England, for example, the Victoria County History devoted the first chapter for each county to a synthesis of pre-Norman evidence as known at the date of publication; while the Royal Commission on Historical Monuments set out to complete an inventory of all visible monuments. These provisions have had their analogues in many countries, sometimes managed by governments and sometimes the result of scholarly initiative, such as Stephens and Catherwood's survey of Maya sites (Stephens [1841] 1969), or Gsell's survey of sites in Algeria (1901). Since the mid-twentieth century, these initiatives have been supplemented by the creation of regional 'Sites and Monuments Records' (the term used in Britain), in which all kinds of sightings of known or suspected archaeological sites are routinely recorded. More recently, methods have been developed for mapping the buried archaeological evidence of a region rapidly. This is achieved by a sampling strategy in which sample areas distributed across the region are examined (Redman 1987; Renfrew and Wagstaff 1981).

Archaeological excavation, the oldest branch of fieldwork, has developed in a series of approaches, sometimes rather dogmatically promoted by their practitioners. The *trench* is a simple rectangular area excavated to the natural subsoil, leaving the sequence of layers excavated in sections on all four sides. The trench is still commonly used for sampling in pursuit of cultural, historical and processual goals, or for *evaluation* (see pp. 142–50). Wheeler extended the method by digging a number of square trenches side by side, the earth baulks between them providing a network of sections from which the sequence could be read (Wheeler 1954). Danish archaeologists, working in opaque soils with little visible strata, dispensed with these baulks and opened large areas in order to better understand the character of settlements which leave only earth traces, such as post-holes and pits. This 'open area' excavation was further developed in England by Hope-Taylor at Yeavering

(1977), Biddle at Winchester (1975) and by Barker, whose excavations at Hen Domen and Wroxeter set new standards for the definition of ephemeral structures and activities (Barker 1969, [1977] 1982). Vanished post-Roman timber buildings on these sites were indicated by soilmarks or patterns in stone rubble which were visible only in large areas viewed from above.

The objectives of excavation are to record activities both in plan and in sequence, and excavation strategy is usually a compromise between the two. The British school of archaeology has always championed *stratigraphy,* the art of reading sequence from archaeological strata, as the dominant contribution to excavation methodology. Stratigraphic recording was practised in the eighteenth century by Thomas Jefferson, who used it to investigate the sequence in Indian burial mounds, before he embarked on a second career as President of the United States. The method was used by Schliemann at Troy (Schuchhardt 1891) and was greatly influenced by Charles Lyell, whose *Principles of Geology* (1830–33) inspired Pitt-Rivers, who in turn inspired Wheeler. Most excavators read their stratigraphy from sections, until in the 1960s open-area excavation was employed in town sites with their long and complex sequences. Sequence models were then developed which showed the interrelationship of all the layers in the deposit (Harris 1975, 1989).

A large modern open-area excavation can employ about forty persons, and as the scholarly and technical demands have risen, so the team of excavators has become increasingly professional. Excavation is thus expensive, and its cost has become an increasingly important factor in its development. Excavation is also destructive, often totally so; rarely can much new information be expected from a second excavation in the same place. An equally formative influence on field methods, therefore, has been the development of archaeological ethics.

Ethics

The archaeological resource, comprising all the remains of previous ages, is largely buried and invisible and therefore vulnerable to unwitting destruction by the modern community who quarry it and build in it. Archaeologists have long been aware of this problem, but the pace and extent of modern building operations raised new consciousness in the 1960s. Rapid survey methods developed under the impulse not only of research hunger but of the imminent destruction of the landscape, for example by quarrying for gravel for the construction of a motorway. Heritage managers have often seen excavation as an extension of their conservation strategy, the excavation record being seen primarily as a substitute for the archaeological deposit itself. This approach received a great boost in Europe and the United States during the second half of the twentieth century, when archaeologists began to sense the losses of information due to the intensive and competitive use of land, in comparison with their new expectations from technique. Known as ‘rescue’ in the

UK, and 'salvage' in the USA, these field interventions were usually justified as providing a 'preservation by record' of the threatened deposit. The goals of 'preservation by record' implied that the recovery of the evidence should be as full as possible so as to compensate for the loss. 'Total excavation', as expounded by Barker ([1977] 1982), required the recovery of every detail, a laudable edict which initially had the effect of promoting more meticulous observation and recording. However, 'total excavation' is conceptually impossible, since the anomalies observed and the records made of them require acts of recognition, definition and ultimately of choice. In other words, the excavator decides that one group of stones is more significant than another, and thus worth drawing or keeping on the basis of imagination and prior knowledge, rather than from objective observation. A further paradox comes from the fact that total excavation is most ethically appropriate to 'rescue' situations, where it is most difficult to apply due to constraints of time and money. On unthreatened sites, such as monuments in public care, total excavation is more practical, but less ethical, since total excavation is total destruction, and the site cannot be reinvestigated to answer new research questions in the future.

Access to the archaeological resource is regulated in many countries by a state archaeological service, a group of experts who make decisions on the basis of their laws and regulations; while in others, the fate of the resource is decided by open competition between the different values championed by different sections of society: amenity value, commercial value, sentimental value and so forth (Lipe 1984). *Archaeological value* has to compete with these, but a competition cannot take place unless archaeologists know the value of that resource in advance and how to define it. Archaeological value can be defined as the product of a research agenda and a deposit model: what we need to know with what we can know at a given time (Carver 1996). Archaeological value is assigned by field archaeologists during a process known as *evaluation* (see pp. 142–50). Modern field archaeology is therefore a compromise between theory-led research objectives, practicalities imposed by terrain, and the ethics of contemporary society: a compromise between what archaeologists would like to know, what they are capable of discovering, and what society will allow them to investigate.

A FRAMEWORK FOR FIELD ARCHAEOLOGY

A modern approach attempts to construct a framework for field archaeology by combining these theoretical, practical and ethical imperatives into a single procedure (Carver 1989, 1990). The procedure is divided into a series of stages in one of which at a given moment every archaeologist in the field is knowingly (or unknowingly) engaged (Figs 4.2 and 4.3).

Reconnaissance is the act of exploring the archaeological resource without a

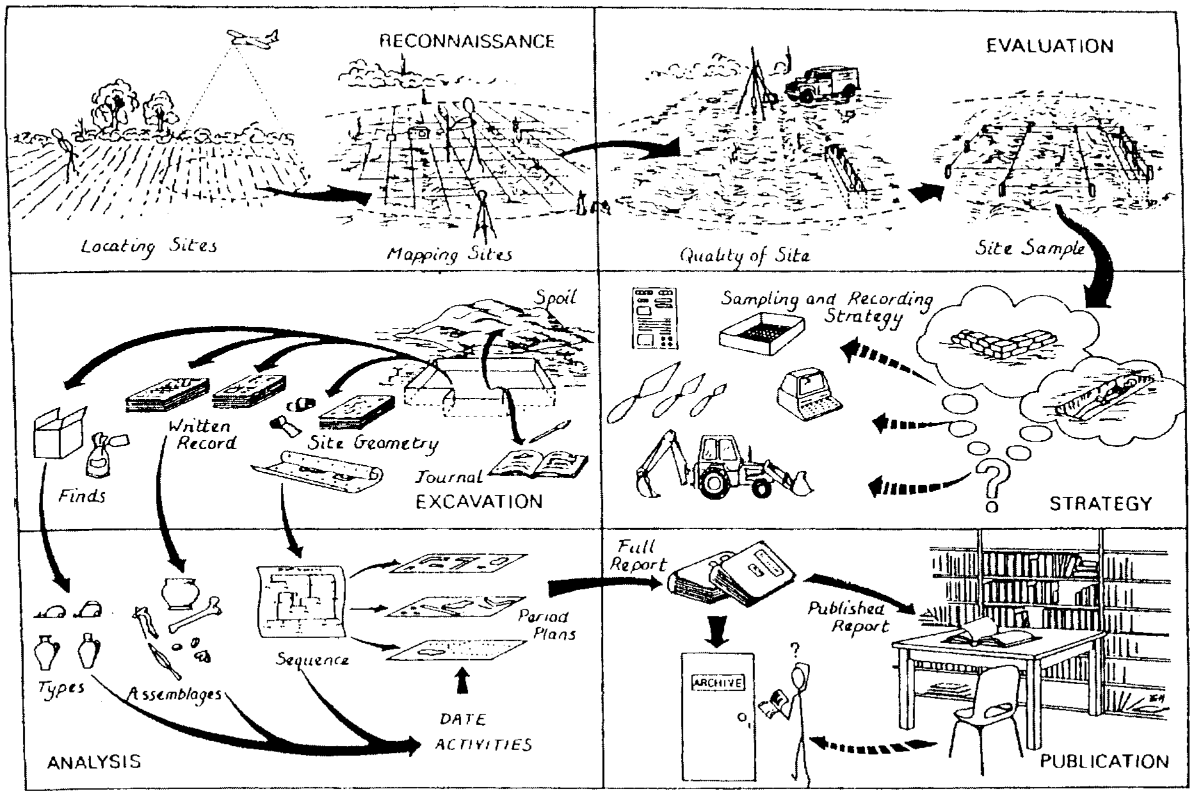

Figure 4.2 Field Research Procedure, the staged approach to fieldwork. Source: Carver 1987.

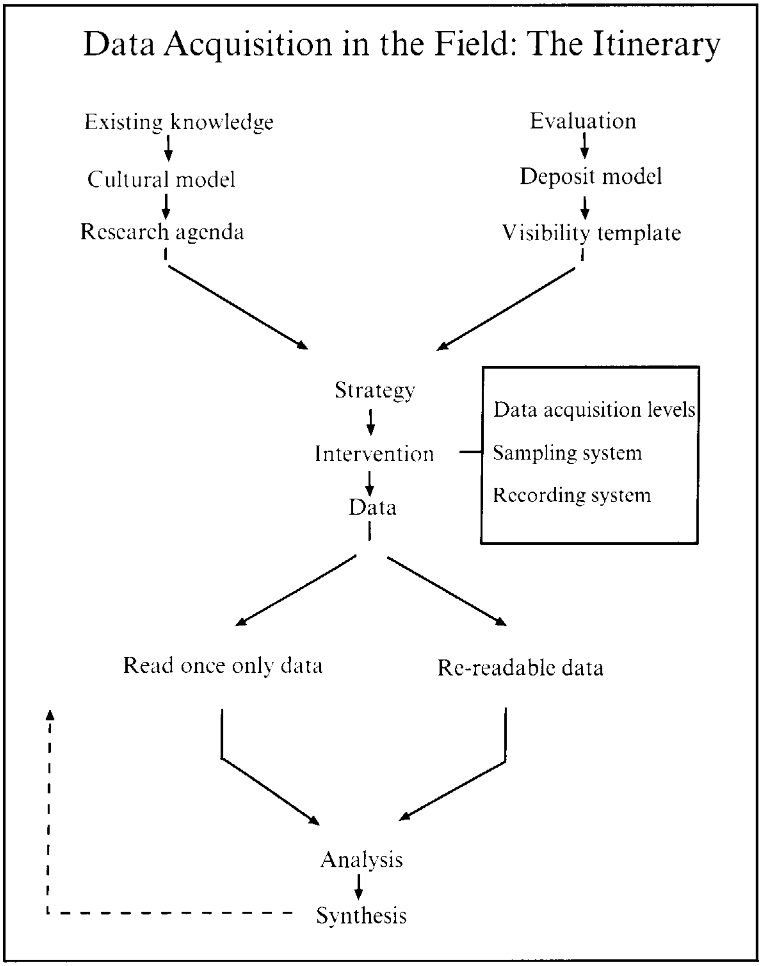

Figure 4.3 Field Research Procedure, showing the stages as a flow chart. Source: Carver 1990; redrawn by D.Miles-Williams.

particular research aim. The result is the location of sites and other aggregations of archaeological deposit. *Evaluation* is the process of assigning archaeological value, from which a *strategy* for conservation or other intervention, whether by destructive or non-destructive means, can be devised. It is usually expressed as a project design which contains the programme of fieldwork, defining what is to be recorded, and how, during the *data acquisition* stage. Data acquisition refers not only to excavation but to programmes of survey which are driven by a research agenda. The data recovered during this stage is then subject to *analysis* from which a model of the sequence, the story revealed, is compiled in a *synthesis*. Parts of the analysis and synthesis are then selected for publication and the remaining data stored in archive.

The implications of this approach are that field operations are classified not by their methodology but by their purpose. This makes them easier to programme in the service of research and easier to justify to society, whose support for the operations is required at all stages. Thus, reconnaissance is a continual necessity for the management of an archaeological resource, and evaluation the principal means of defending it. The strategy stage is essential to obtain funding for fieldwork, which will be judged on its practicality and potential contribution to science. The concept of 'data acquisition' encourages the use of non-destructive means wherever possible, and reduces destructive intervention (excavation) to the viable minimum. The precept of total excavation is rejected in favour of an explicit strategy in which recovery is not 'total' but the most appropriate in its day. The procedure follows a continuous 'analytical itinerary' (Fig. 4.3) driven by research, which is the sole criterion for its success. Thus the 'data' recorded are only those for which an analytical destiny has been identified. Other observations will be made during excavation and survey, but belong more properly to the 'reconnaissance' or 'evaluation' stages and are not strictly data. Rescue excavations carried out solely to mitigate threatened destruction will still occur; but their results, if they are not the consequence of research questions, can also be seen as belonging to the reconnaissance or evaluation stages of the procedure.

Field research procedure must also influence the way archaeological projects are managed. Each stage is planned, justified and reviewed before passing onto the next. Whether regulated by government or the field archaeology profession itself, this process of programming is an essential feature of the field archaeologist's duty (English Heritage 1992). For just as the past belongs to everyone, including those as yet unborn, so field archaeology, which alters that past, acts not for the individual but for society as a whole.

RECONNAISSANCE

Reconnaissance is the procedure by which the unknown parts of the archaeological resource are located. The objective is to map the probable location of previously unknown sites and areas of archaeological potential. The methods used are primarily non-destructive and may be divided into four: those used from the air; those used on the ground surface; those which penetrate the ground; and those employed underwater. Many of the same techniques are also extensively deployed in the *evaluation* and *data acquisition* stages (pp. 142–50 and 155–64).

Aerial photography has been amongst the most effective methods of active reconnaissance in archaeology (Alvisi 1989; Bewley 1993; CIRA 1982; Maxwell 1983; Scollar 1978; St Joseph 1977; Whimster 1989; Wilson 1975, 1982). Sites, whether surviving as traces on the surface or buried beneath the ground, are more easily recognizable from the air, since the eye picks out those regularities of line which betray the presence of a site, such as a buried Roman fort or prehistoric earthwork which are invisible at ground level (Fig. 26.5). Surface features which have very slight variation in height, for example an ancient ploughed field with its ridge and furrow, or an eroded burial mound, or a destroyed building in the desert, can be enhanced by the photographer using special conditions of sunlight. Field monuments show more clearly where their modest traces are thrown into relief by low sunlight, or by being backlit with respect to the viewer or by being dusted with a light cover of snow.

Where there are no surface traces, the aerial photographer relies on 'soilmarks' or 'cropmarks'. Soilmarks are created when a monument, usually one containing buildings, is thoroughly ploughed out, so that, within the ploughsoil, traces of mortar, brick, stone and other debris can be glimpsed, particularly after rain. The plough does not move this material far, and so its plan reflects the plans of the buildings that were once there. Cropmarks are formed in a different way. Here, the crop which grows in a cultivated field puts down deeper roots and grows taller where there are intrusions cut into the subsoil. Ancient intrusions such as Roman ditches or neolithic pits contain nourishing soils which roots seek out. The difference in height amongst the crop is sometimes visible, but is not so evident as differences in colour, which are caused by moisture deficit. In this case, the crop which is growing over ancient intrusions is favoured by having access to more moisture than the crop which grows over adjacent subsoil. This situation is clearly enhanced at times of drought, so that in long hot summers many cropmarks are visible in the wheatfields of Europe. If the moisture deficit is sufficiently marked, then the effect is visible in other types of crop than cereals, for example in grass. Grass favoured by growing over moisture-retaining features remains greener, while grass not favoured by growing over dry-stone walls is starved of moisture and eventually dies. The patterns caused by these differences are known as 'parchmarks'. Aerial photographers are not always and only engaged in reconnaissance, although it is here that their greatest contribution has been made. Many use the technique of aerial photography to conduct research programmes, where the objective is to map particular types of feature, for example field systems (Riley 1980). Here, they would be engaged in the data acquisition phase of field research procedure.

An array of techniques exists for mapping the ground surface from the ground. In the case of trace-monuments, the most effective of these are *topographic surveys,* where the surface of the ground is measured in three dimensions and presented in the form of contours or hachures. This enables the archaeologist to see what is often invisible on the ground; namely, the irregularities of the structures and features which betray a settlement or cemetery (Fig. 4.4).

Surface collection or *field walking* are terms used to refer to the mapping of spreads of artefacts which have been disturbed from buried settlements and

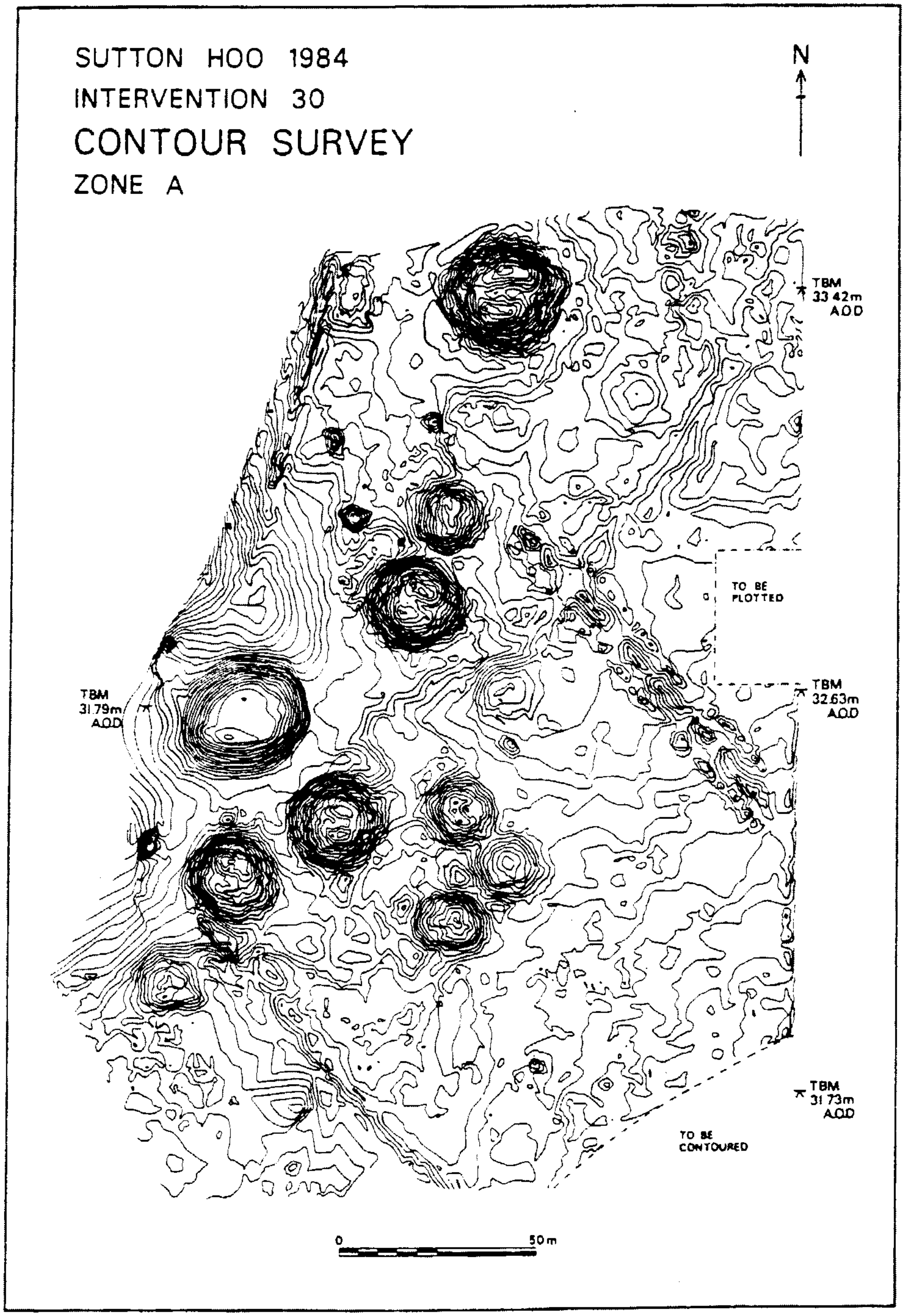

Figure 4.4 A contour survey, showing the surface of shallow earthworks, in this case ploughed-down burial mounds at Sutton Hoo. The plan was created by a GINOSURF program from the coordinates of 10,000 points recorded by a total station theodolite. The vertical interval is 100 mm. Source: Carver 1986, fig. 11.

cemeteries. Most effective in ploughed soils or in deserts, surface collection consists of mapping (not necessarily collecting) visible archaeological materials and from their distribution inferring the presence of archaeological sites (see discussion and illustrations in Chapter 13). The archaeologist normally lays out 'transects' which may be in the form of regular parallel lines 5–500 metres apart, depending on which stage the reconnaissance has reached. For terrain about which virtually nothing is known, 'random samples' of quadrats or transects may also be used to avoid the bias of preconceived ideas about where a settlement ought to be.

A third level of intensity in reconnaissance is achieved by attempting to see below the surface of the soil, a type of *remote sensing* relying on scientific techniques of detection. There are chemical methods, such as measuring the concentration of phosphate in the topsoil: most human activities involve the life and death of animals, and these in turn produce insoluble phosphates amongst their decay products. Where human activity has been concentrated, the phosphate is also concentrated. The amounts of insoluble phosphate present in the topsoil are measured by taking a sample of soil at regular intervals, say every 10 metres over a grid. The phosphate is extracted as P_2O_5 and measured in ppm (parts per million) (Craddock *et al* 1985).

The most intensively used methods of remote sensing at ground level, however, are the group of techniques known as geophysical survey (Clark 1990; Gaffney and Gater 1993; Weymouth 1986; Fig. 4.5). Geophysical instruments, which were developed during and after the Second World War for detecting sub-surface anomalies, rely on three basic phenomena: the passage of electric current through the ground which varies according to the resistivity of the soil, the ability of sub-surface features to distort the earth's magnetic field which is measured by magnetometry, and the ability of sub-surface interfaces to reflect radio waves, which is detected by means of pulse radar. Each of these methods functions differently on different kinds of terrain. In spite of nearly fifty years' experience, however, it is still difficult to predict which, if any, is capable of making sub-surface features visible within a particular terrain. It appears that resistivity works the best at detecting 'dry' features, such as walls and roads, but it has also performed well on gravel where it has found boundary ditches and other large negative features. Those methods which rely on magnetic anomalies are particularly good at searching out burnt clays, such as those found in hearths and burnt-out buildings. Magnetic susceptibility locates buried pedological and/or cultural zones. Radar has been, and is being, extensively tested both in rural and urban sites, but has yet to find a reliable place in the routine geophysical repertoire (Addyman and Stove 1989; Atkin and Milligan 1992; Carver 1986; Imai *et al.* 1987; Scollar *et al.* 1990; Weymouth 1986). Geophysical methods, like aerial, perform in the reconnaissance, evaluation and data acquisition stages (cf. Gaffney and Gater 1993: 'levels I, II, III').

Other methods of looking beneath the ground's surface are less technical. Lerici, one of the pioneers of archaeological remote sensing, began his experiments by

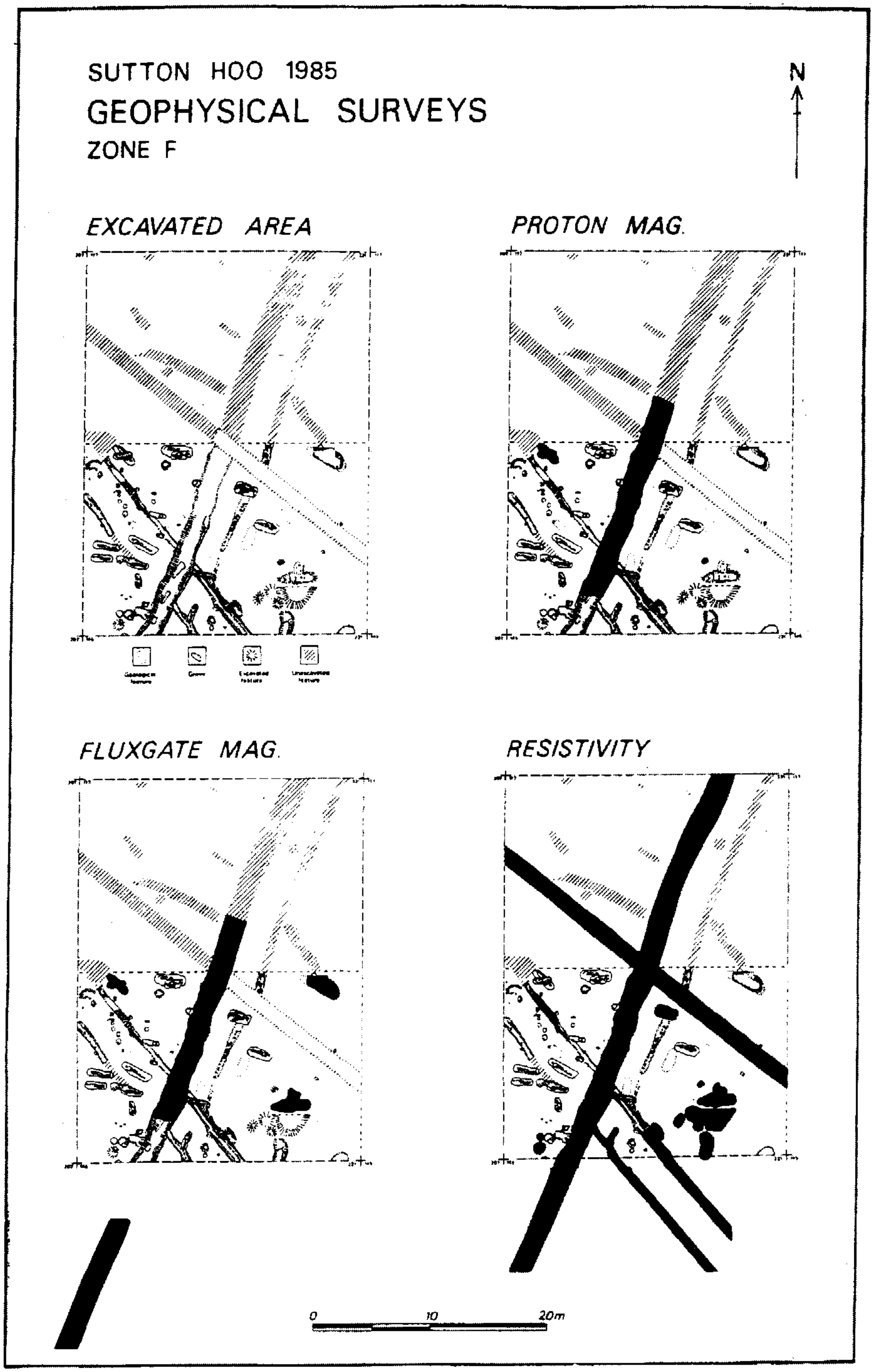

Figure 4.5 Results from different types of geophysical survey at Sutton Hoo, showing the powers of three different gadgets to detect underground features in an area that was subsequently excavated (top left) —their success is marked in black. Source: Carver 1986.

driving a periscope down through the roof of Etruscan tombs, photographing the interior and resealing the hole, thus achieving a non-destructive entry (1960). Boreholes drilled with an auger are routinely used by the Lerici Foundation, among others, to map the extent and depth of deposits. A variety of surface collecting methods, where the surface is unbroken or obscured, involves 'shovel-testing' — lifting the surface at intervals to recover the pottery and other artefacts lying in the topsoil.

The principal target of *underwater reconnaissance* is the ancient wreck, although submerged harbour-works and settlements are known, and likely to become an increasingly large component of the archaeological resource during global warming. The location of historic sites may be predicted by documentary references to known shipping lanes or known ships, as in the case of the *Mary Rose,* lost in 1585 (Rule 1982). More often, sites are discovered by chance, or by the hunch of divers inspecting the sea bottom. Sonar can be used to detect the presence of ancient wrecks, just as it can for submarines. The sub-bottom profiler picks up anomalies under the silt, which can then be investigated further by divers. Visibility, current and mobility of deposits conspire to make the reconnaissance particularly challenging on the seabed, and it is here too that the competition with unregulated treasure hunting is at its most intense (Muckelroy 1978; NAS 1992; Throckmorton 1987).

EVALUATION

Evaluation is the process of assigning 'archaeological value'. Some attempts have been made to equate 'value' with the archaeological quality of a deposit, defined as its legibility for research purposes (for example, Carver 1983). Others have provided a rationale for management selectivity by ranking sites according to their relative rarity, diversity of content, clustering and so on (for example, Darvill 1988; Darvill *et al.* 1987; Startin 1993). A third approach, more theoretically correct but harder to implement, defines archaeological value in terms of both the known deposit and current research interests (Groube and Bowden 1982). The most recent definitions accept that the deposit-model and the research agenda are both constructs of their own time and should be given equal weight: 'value' is computed by matching the two (Carver, in Arup 1991; Carver 1990). This view also enshrines the political principle (following Lipe 1984) that the objective is to enable archaeological resources to compete with other social demands, not with each other.

In all cases, the fieldwork component of evaluation is largely dedicated to mapping deposits and assessing their quality. Evaluation has to be clearly distinguished from both the reconnaissance stage which precedes it and the data acquisition stage that follows it, although it can look like them and uses many of the same techniques and field methods. What distinguishes evaluation is its purpose, which is to anticipate the result of a fieldwork programme, whether the programme is predominantly conservation, survey or excavation. Such anticipation requires the archaeologist to know as much as possible about a deposit without actually removing it. Obviously, it would be pointless to destroy the deposit in an attempt to establish its value, since there would then be nothing of value to defend or research. Evaluation therefore relies heavily on the power of archaeology to predict the character of deposits while they are still invisible, an ability which is by no means highly developed.

The earliest recorded evaluation is probably that of Claudius J.Rich at Babylon (1839), where the objective was to make as full an account of the ancient city as was possible without putting a spade in the ground. Others have used and developed the evaluation stage in their projects, without publishing the fact or, in many cases, recording it. The most intensive and large-scale mapping of a deposit has probably been that by Millon and his team at Teotihuacan (Cowgill *et al.* 1984). In the UK, Martin Biddle's study of London (Biddle and Hudson 1973) was a report on the archaeological implications of modern building construction in the city. This report also contained some predictive mapping, and this technique, and the concept of evaluation itself, was more explicitly developed in the West Midlands urban campaign of the same decade (Carver 1987; Fig. 4.6). In 1983, evaluation moved to the countryside where it was applied to the site of the Anglo-Saxon burial mounds at Sutton Hoo, and preceded the research programme there (Carver 1986).

In 1988 mandatory 'impact assessment', which had long been a fact of life in the USA, became law in the European Community. Under Article 5(1) of the 1988 Act, member states are required to ensure that the sponsor of a development project produces a description of 'the aspects of the environment likely to be significantly altered by the proposed project' (including the architectural and archaeological heritage) and does so 'having regard inter alia to current knowledge and methods of assessment'. The current professional interest in developing evaluation—and the techniques of deposit-mapping in particular—comes not a moment too soon.

What is measured? The parameters to be sought are the extent and depth of the deposit, its quality of preservation for artefacts and biota (seeds, animal bones and other organic materials), its legibility (the ease with which layers can be distinguished from each other) and its status (whether the layers are *in situ* or have been redeposited) (Fig. 4.7). Notice that the results of deposit-mapping do not add up to any kind of historical or prehistoric sequence, and it would be misleading to claim as much. The quality assessment is limited to inspection of the surface, or at the most of a cut section. The temptation to over-interpret is always at the evaluator's elbow, but the temptation must be fought. Evaluation is not only intended for other archaeologists, who can be relied on to take their colleagues' assertions with a pinch of salt, but for planners, developers and public representatives, who are inclined to take other professionals at their word.

When fighting for access to land in the value-forum, archaeologists would be well advised to stick to what is measurable. An imaginary example might run as follows:

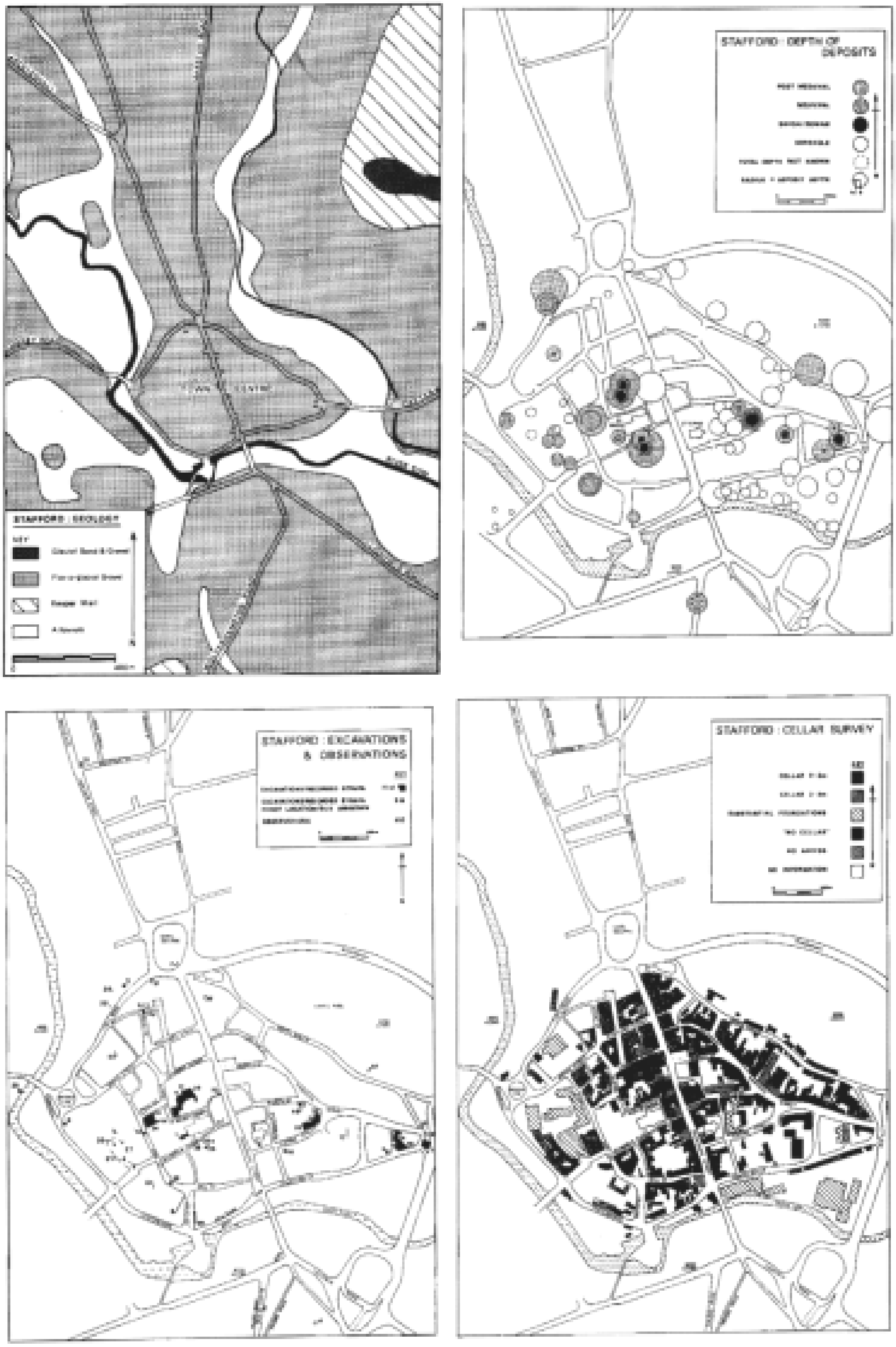

Figure 4.6 Four contributions to the deposit modelling of an urban site (Stafford). Top left: the position of the interventions. Top right: cellar survey, showing the depth of strata destroyed by cellaring. Bottom left: the base geology determined by stripping off the modern town. Bottom right: the depth of strata that survives. Source: Carver 1987, after research by J.Glazebrook.

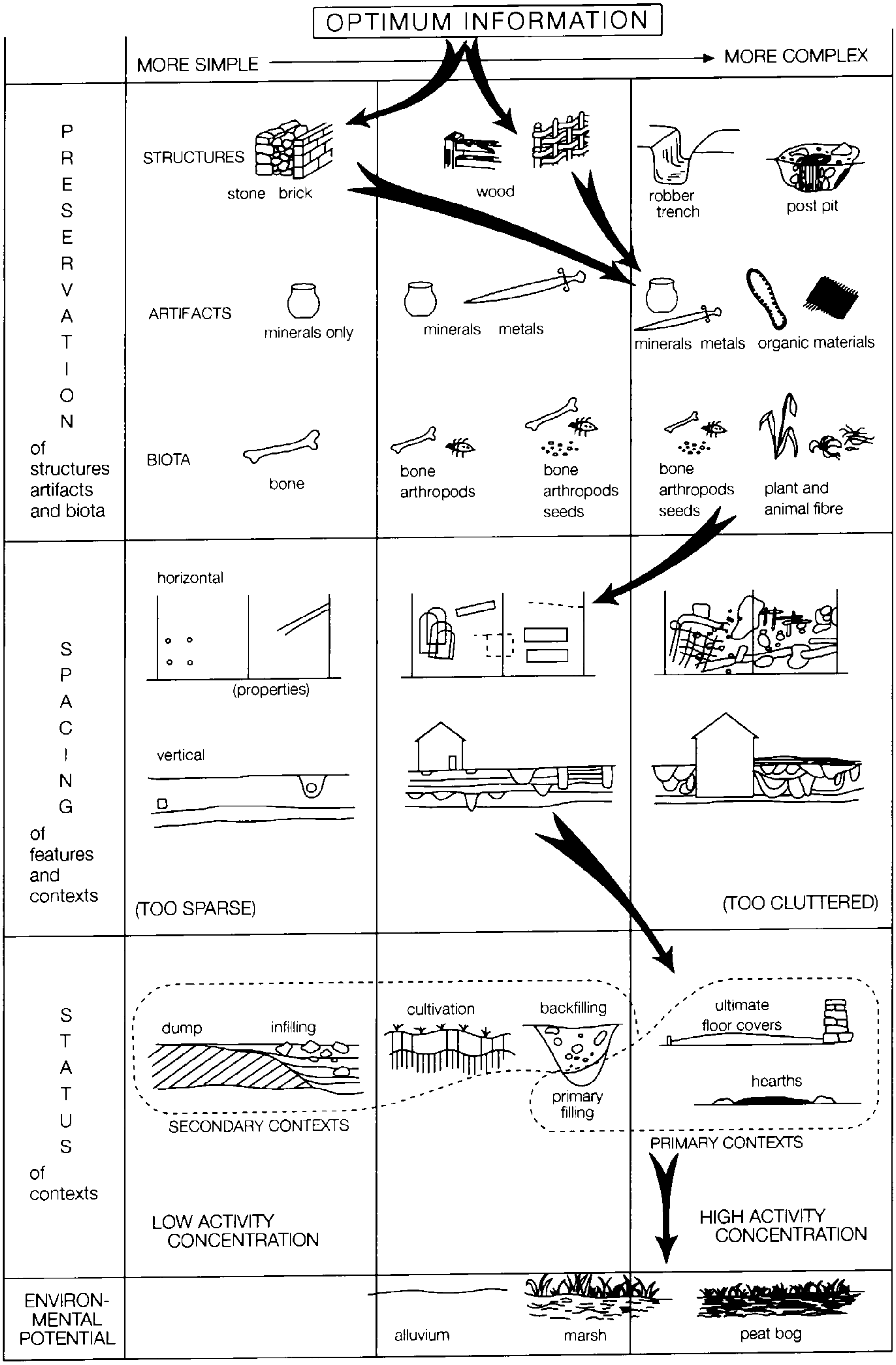

Figure 4.7 The quality of a deposit, based on what it can tell us: a 'good site' follows the arrows. Source: Carver 1983.

- *Deposit model:* the deposit in question extends to 0.25 ha; its depth varies from 1–3.5 m; it is anaerobic and preserves leather and other organic materials from 2.5 to 3.5 m deep; the top metre is thoroughly disturbed and is of low archaeological value.
- *Research agenda:* the site is predicted to be a late Roman tannery reoccupied in the late Saxon period, possibly by an ecclesiastical community (documentary evidence); the lowest metre of deposit is of immediate relevance to questions on Roman manufacture posed by the recent review of research priorities in Roman Europe.

The measurements of the deposit are here separated from its likely historical context, allowing the rival exploiters of land to see that, whatever the site turns out to be, there is nevertheless a deposit of some kind there. This is, strangely enough, often the hardest thing for the non-archaeologist to accept. To produce positive evidence of the existence, size and quality of a deposit is far more persuasive to other professionals than imaginative tableaux about its possible contribution to world history. On the other hand, these last are necessary to win public support.

In the countryside, archaeological deposits are often spread thin and shallow and relatively unencumbered by modern buildings, so a deposit located by reconnaissance can be evaluated by concentrating many of the same techniques upon it. The extent of the deposit is most readily mapped from surface collection of flint or pottery or phosphate, but since this material can also arrive in the topsoil through ancient manuring and modern cultivation and dumping, it would be important to test the validity of the distribution with test trenches sited over predicted boundaries. If there is coincidence between the surface patterns and the feature patterns, the former is likely to be a useful indication of the occupied area. Aerial photographs provide a powerful mapping technique (see above), but the ground may not offer the right conditions at the time the evaluation is needed. Unploughed grass surfaces suspected of containing earthworks, however slight, may be mapped by three-dimensional topographic survey or by photography under enhanced lighting. 'Grass-mark survey', the pattern given by the flora after mowing, may also indicate the degree of disturbance by revealing the pits of early robbers and former burrows of animals. Sub-surface mapping of features also helps to establish the extent of the deposit, though since the effectiveness of different types of geophysical instrument varies markedly with terrain, it is important to evaluate the techniques themselves (Fig. 4.5): a portfolio of instruments is set to map the same small area (approx. 10×10 m) which is then excavated, the instrument which 'saw' most then being selected not only in the evaluation phase but for a role in the subsequent data acquisition strategy (see below).

The results of a rural evaluation project are presented as a deposit model which shows, first, the extent and depth of the deposit, second, its quality, and third, its

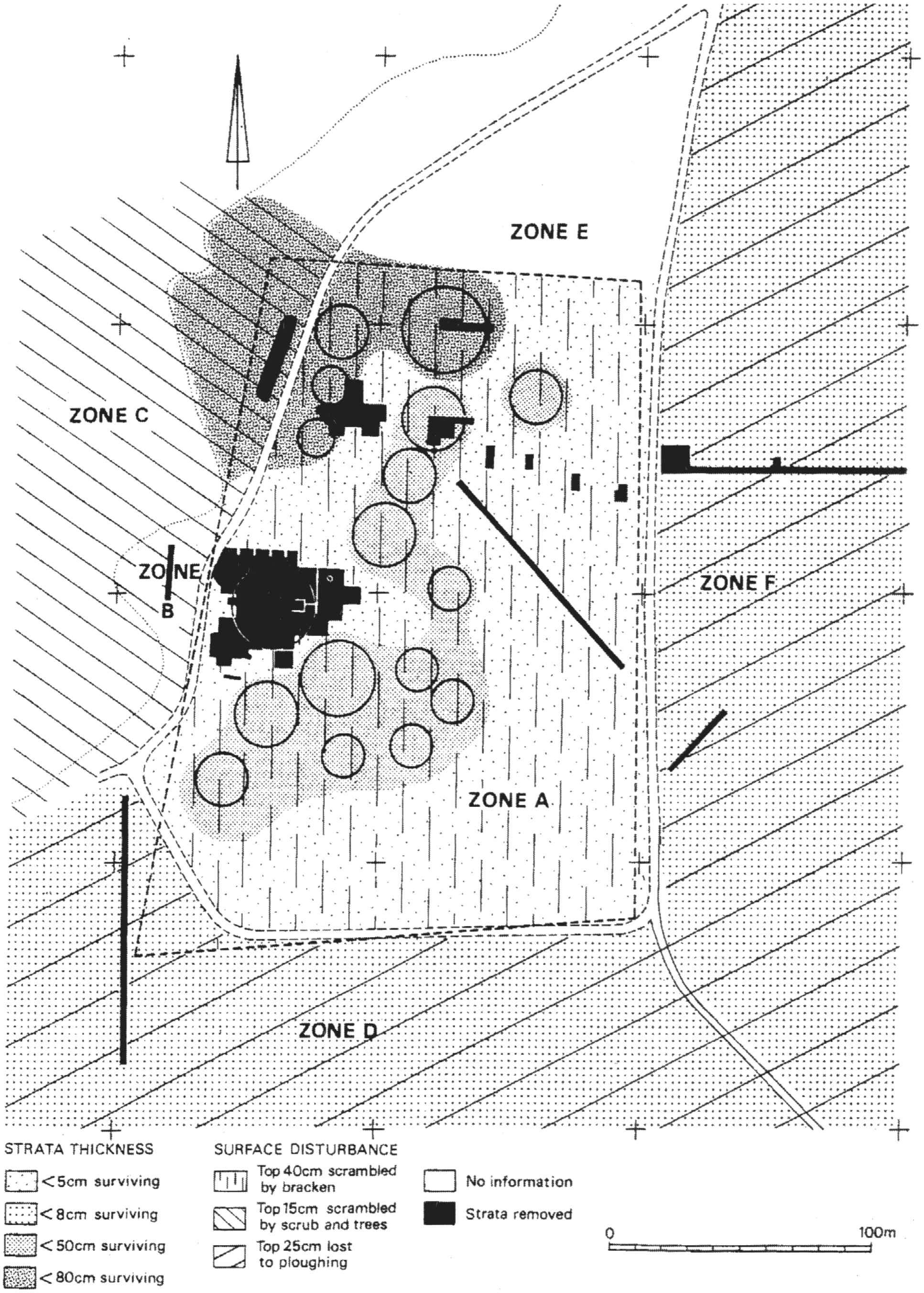

Figure 4.8 Deposit model for a rural site: Sutton Hoo. The black areas have already been excavated. The stippling shows the depth of strata, and the hatching the depth to which they have already been scrambled by ploughing and roots. Table 4.1 shows the different sizes of features and finds that could be found over this area by different intensities of intervention. Source: Carver 1986.

Table 4.1 The 'visibility template' at Sutton Hoo

Method	*Potential; yield*						
	Features >1.5m	*Features >1.0m*	*Features >0.5m*	*Graves*	*Finds >2cm*	*Finds >1cm*	*Finds >1 mm*
Non-destructive							
AP	x						
Field walking					x		
Surface mapping	x						
Metal detector					x	x	
Resistivity	x	x	x				
Magnetometer	x						
Fluxgate	x	x					
Radar	x						
Phosphate							
Contour	x						
Destructive							
Level A	x						
Level B	x	x			x		
Level C	x	x	x		x	x	
Level D	x	x	x	x	x	x	x
Level E	x	x	x	x	x	x	x

Note: This visibility template prepared for Sutton Hoo shows the size and kind of archaeological evidence that can be detected by different methods, both non-destructive (like topographical survey) and destructive (shown as five levels of excavation).

degree of disturbance. In the example shown as Figure 4.8, the model concentrates on the extent and depth of the deposit and the damage it has sustained. Note that, in Zone F, the post-war ploughing has removed all earthworks and the features are covered by 25 centimetres of ploughsoil, which can be read for pattern from surface collection. The 'scheduled monument' (Zone A), covered in grass and without potential for surface collection mapping, has retained traces of earthworks, but they have been disturbed to a depth of 40 centimetres by bracken roots and rabbit burrows. This predictive map shows the limits of Anglo-Saxon burial and where the prehistoric site has been best preserved, and it was used in the strategy (see below). The site given as an example had had a number of earlier excavations, but, even so, additional test trenches were necessary; it is nearly always necessary boldly to cut such trenches in support of a rural evaluation programme.

These procedures can be extended to evaluate a whole landscape. If this seems an impractical proposition at present, that is because the time allowed by impact assessment (which usually provokes the work) is far too short. There is a case, therefore, for investing in pre-emptive evaluation for whole regions as part of a management programme for the curation and conservation of the archaeological heritage.

Abandoned towns, such as Teotihuacan (Cowgill *et al.* 1984), may be treated under the rural procedures, but the stratigraphic situation in living towns is different, in that deposits often lie deep and their surface is thoroughly obscured by buildings, roads, pavements and car parks (Fig. 4.1). On the other hand, in towns occupied during the last three centuries there have usually dwelt archaeologists and antiquaries who were curious about them and have recorded their encounters with the deposits underground. In most cases these sightings, kept in scrapbooks, letters and newspaper cuttings in the local city library, are perfectly usable by the modern evaluator. They can and should be supplemented by test sections which give firsthand views of the strata. Such test sections can often be achieved with the minimum damage to the deposit by removing the walls of cellars and recording the section in the vertical earth face which lies behind them. The more technical methods of mapping buried strata are occasionally effective in towns. Photogrammetric aerial survey has been employed by Meeson at Tamworth to reveal the square platform of the Anglo-Saxon palace (Carver 1987:118). Resistivity survey has been carried out on tarmac car parks at La Charité-sur-Loire by flooding the surface with water (Bossuet 1980). Georadar has been claimed as an effective instrument for the mapping of deep urban strata, but has still to develop a successful protocol for regular use and reliable interpretation.

Urban evaluation therefore relies heavily at present on direct observations of the deposit, whether ancient or modern. From these observations, predictive maps can be compiled, which show the extent, depth and quality of the deposit, and the degree to which it has already been removed or disturbed by cellars and other buildings (Fig. 4.6). Arising from the deposit model, other maps can be generated for management and research purposes. One may show the areas of particular archaeological interest and vulnerability; another the template used to sample the urban activities relating to a particular period. The exploration of a town's records for evaluation purposes can lead to some interesting discoveries. At Worcester, a large area of open ground, now allotments, which characteristically produced pre-historic pottery and flint, turned out to be an area of dumped dredging, including the remains of an ancient ford, taken out of the River Severn. This prehistoric material lay, misleadingly, *on top of* a Roman watercourse (Carver 1980:23).

Although the character of deposits varies from site to site within a town, offering different management problems and different research opportunities, each town preserves a general 'personality' in its deposits below ground, as it does in its buildings above street level. A surprising amount of information about this buried resource can be drawn from the town simply by walking around it: a half-buried medieval church doorway or Roman arch, a line of houses echoing the line of a buried amphitheatre—such occurrences give hints of unseen deposits and monuments. The deposit-character which distinguishes town from town is determined, on this scale too, by basic topography and geology, the most important factor in deposit-formation. High rocky sites tend to shed their deposits in a lens at the base; towns built around a river or stream creep out across them in periods of expansion, sealing, often in anaerobic strata, the debris of that age. In towns equipped with a thick and permanent wall, deposits tend to rise inside the wall—the so-called 'belting effect'. Towns of different topographic circumstances thus give rise to different kinds of strata-capture. Just as the comparison between site and site within a town can provide the basis for research and conservation planning, so comparison between towns can allow the programming of the urban project on a regional or a national scale (Carver 1983).

Urban archaeological evaluation was developed in Britain in the 1970s (Carver 1987) and is currently receiving notable development in France (CNAU 1990–). The evaluation of York (Arup 1991) broke new ground, both technically by introducing the computer-mapping of the underground deposit (Richards 1990), and conceptually by insisting on the relevance of the current research agenda for both curation and intervention strategy.

Evaluation is thus the linchpin of a scientific field archaeology, the basis for all management and research programmes and the ticket to the public debate on social value. With the model of the buried riches of a particular site or landscape in mind, the field archaeologist can go on to formulate programmes of formal intervention designed to answer questions and push forward society's enquiry into the past. This is the strategy stage.

STRATEGY

The aim of this stage is to turn the predicted model of an archaeological site as defined by evaluation to good account by devising a plan for its management and its research. Strategies may emerge in a number of written forms. A *research design* is specifically directed to a data-acquisition programme intended to meet research objectives. A *management plan* is directed rather at the conservation and/or presentation of a site. A *project design* refers to a combination of the two.

Each of these components of strategy may be applied to either a site or its territorial analogue, a landscape. Published fully developed strategies for landscapes are uncommon, although they are implicit in many a successful survey project. The reason for this is that landscape evaluation is rarely sufficiently thorough to allow a full programme to be stated at the outset; more usually a strategy for data acquisition over a landscape is followed by research strategies for individual sites, often as a result of survey. Management plans follow at several removes, or are developed independently, sometimes by a different group of archaeologists. This stage, like those of reconnaissance and evaluation, may therefore be revisited several times in the course of a single project.

A *research design* will include a statement of the present understanding of the past culture and the questions to be addressed. The choice of territory is justified, and reasons are given why it is likely to offer the answers, drawn from the evaluation. The data selected to be recorded are defined, and how they are to be analysed, with what expected result. A recording system appropriate to these data forms part of the same design. A *management plan,* similarly springing from the evaluation, provides both short- and long-term protection for the archaeological asset that has been located. Where damage from other exigencies of society cannot be resisted, a 'mitigation strategy' (which may include rescue excavation) is included in the plan. For sites that are to survive contemporary excavation, 'presentation' —the management of public access to a comprehensible monument—is an important component (see Chapter 10). It can be argued that, in many countries, presentation is the most effective way of winning public support for the fossilization as 'heritage' of land which might be much in demand for other purposes: presentation is in this case the ally of conservation. A *project design* which incorporates both these aspects must also report on their cost, duration, staff and viability. Major factors in all branches of archaeology, they are fundamental in excavation.

Examples of field projects incorporating some or all of these concepts have been seen in many countries in recent years. A famous and exemplary project, which combined research-driven ecological and settlement survey with selective excavation and was subsequently presented in an entertaining and instructive manner, was conducted in the Oaxaca Valley, Mexico, by Kent Flannery (Bahn and Renfrew 1991:446–54; Flannery 1976). At Danebury in England, Barry Cunliffe designed a model project which showed the role of this iron age hill-fort in its territory, combining large-scale excavation of the interior with intensive survey of its hinterland; fieldwork was followed by publication at several levels and a management plan for the monument (Cunliffe 1993; Cunliffe *et al.* 1984–91). At St Catherine's Isle (Georgia), off the south-east coast of the United States, Hurst Thomas set himself the problem of locating and excavating the Spanish mission station of Santa Caterina. Treated as a single site, the island was surveyed in parallel transects, using surface collection. Of 135 sites located, only five threw up sixteenth- and seventeenth-century Spanish ceramics. These were then mapped more intensively with a power-auger (used normally for digging fence posts), which narrowed the search to an area one hundred metres square. Geophysical survey was then used to map the buried buildings, and a choice could be made where to apply the more costly and unrepeatable measure of excavation (Hurst Thomas 1989:227–36). At Qsar es-Seghir, a ninth-century Islamic city in Morocco, Redman began by exploring the circular walled area by random quadrants—the equivalent of the reconnaissance and evaluation stages, but as the geography of the buried town became clearer, he was able to develop his data acquisition strategy, targeting excavation areas so as to address research questions on the society and economy of the citizens (Redman 1986; Fig. 4.9).

At Sutton Hoo in Suffolk (south-east England), evaluation produced a map of a prehistoric (Beaker period) settlement underneath the famous Anglo-Saxon cemetery. The 'visibility template' (Table 4.1) indicated that the prehistoric field

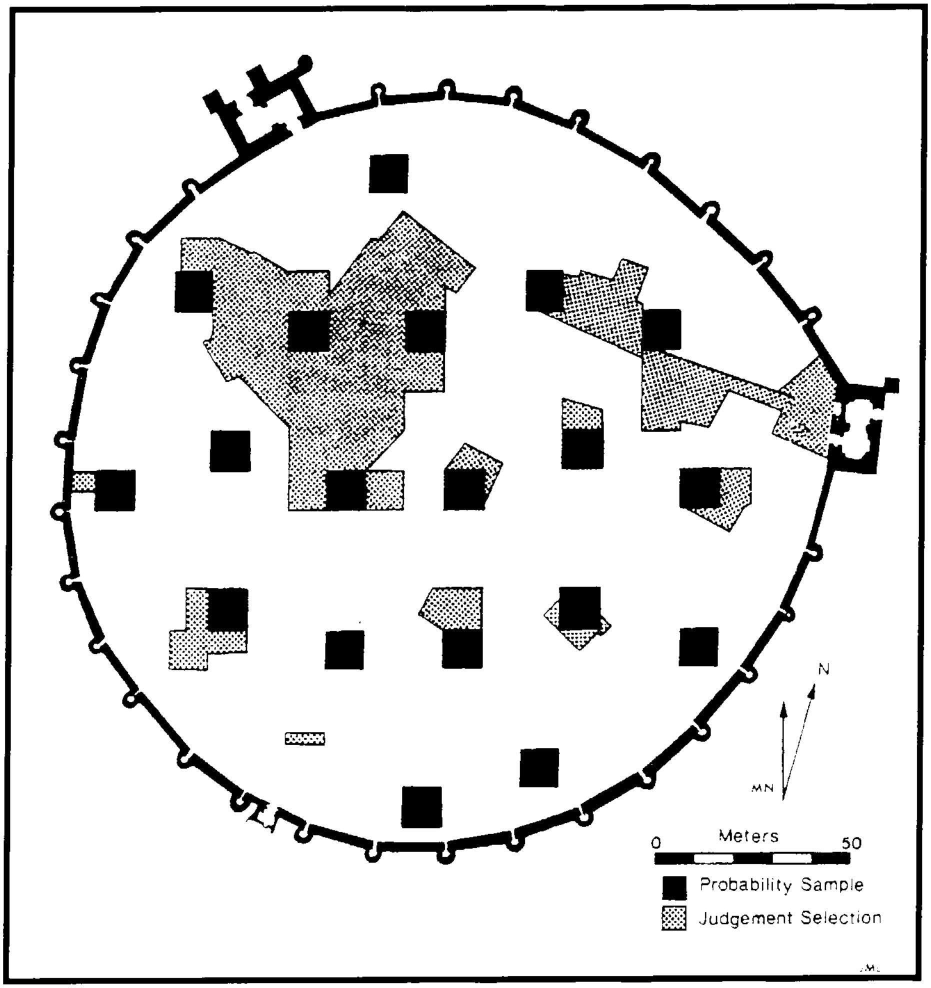

Figure 4.9 Strategy at a town site: areas selected for excavation in the Islamic town of Qsar es-Seghir, Morocco. Source: Redman 1986.

system could be mapped by remote sensing, whereas the prehistoric structures had survived comprehensively only beneath Anglo-Saxon burial mounds. The research agenda required the sequence of burial rites to be determined and mapped, on the theoretical grounds that this sequence would reflect the changing ideology of the Anglo-Saxon community during the period that their historical kingdom was being formed, the seventh century AD. This sequence could only be ascertained through excavation, since the graves had proved impossible to detect by the currently available remote-mapping technology. The strategy for intervention, therefore, comprised the excavation of a cruciform transect and an adjacent area for remote mapping (Fig. 4.10). Subsequent excavations showed the excavation sample to have been the right size for the questions asked. The excavated site was subsequently returned to grass, with one mound reconstructed to its seventh-century height to aid presentation. Simultaneously, the Deben Valley (in which the site lay) was mapped by field survey, this being one of six sample regions to be surveyed in the known kingdom of East Anglia.

A large-scale evaluation carried out in the 1960s in Northamptonshire, in the English Midlands, provided the material for a management plan for the whole of that county, and a similar exercise for Dorset resulted in the publication of an explicit strategy in which the surviving archaeological assets were matched with a research agenda (Groube and Bowden 1982). In the latter work a system of scoring was introduced which ranked the problems seen as crucial to each period, the scarcity of the deposits likely to solve them, and the threats from farming and other forms of disturbance likely to inhibit or prevent their solution. The management of the resource was therefore here combined with research priorities which targeted named areas and sites for survey and excavation.

Some final examples may be offered from the specially challenging situation in living urban sites, which vary no less than rural in what they have to offer to research, but where the archaeologist rarely has a free hand to choose where to excavate. In the Winchester campaign of 1961–71, the opportunities presented by redevelopment were combined with those allowed by conserved monuments to give an intensive array of research-directed interventions which has rarely been matched in a living city (Biddle 1975). At Stafford, a full evaluation of the small county town (Fig. 4.6) was followed by four area excavations targeted on the early medieval borough. At York, twenty years of intensive investigation of the city within the rescue framework were followed in 1991 by the construction of a deposit model and a research agenda to match it (Arup 1991).

In the 1990s, as European countries follow the American lead and deregulate their archaeological management from the centre, strategies are certain to become more explicit: the well-known question ‘Why did you dig there?’ is no longer merely the casual enquiry of a bystander. In an age of intensive demand on land and money, society as a whole requires a reasoned, convincing, and indeed competitive public answer to this question.

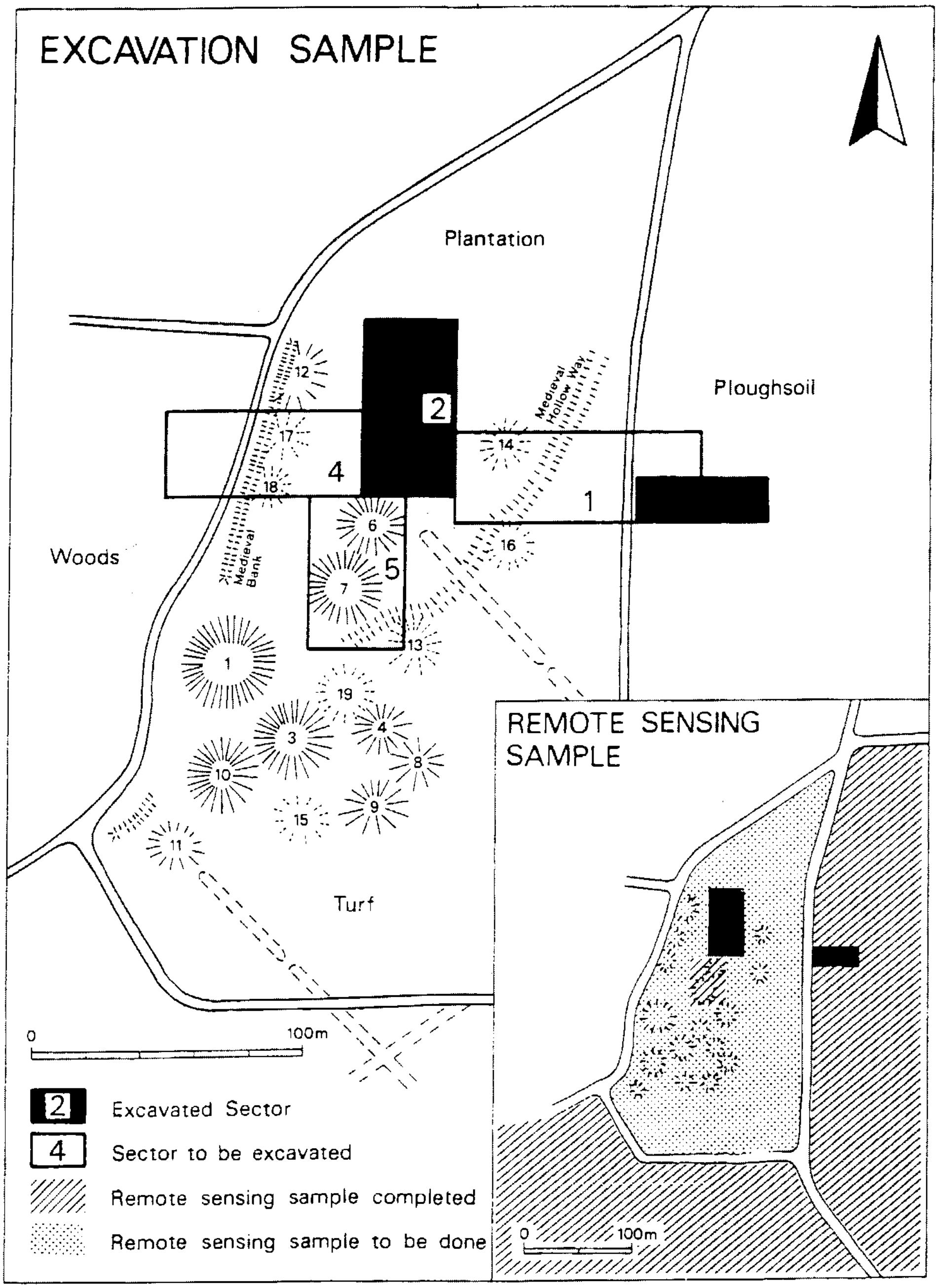

Figure 4.10 Strategy at a rural site (Sutton Hoo): the decision on what interventions to undertake expressed as an area for excavation and an area for remote mapping. Source: Carver 1986.

DATA ACQUISITION: SURVEY

The non-destructive acquisition of data for research purposes is carried out routinely by archaeologists world-wide (Redman 1987). The techniques employed are shared with *reconnaissance* and *evaluation* (see pp. 137–42 and 142–50) and survey is often used as a prelude to excavation or combined with it in the same strategy. Although survey can map settlements (for example by aerial photography) and retrieve finds by surface collection, occasionally in the same place, the lack of secure stratigraphic context, obtainable only by digging, often means that sequence and dating remain imprecise.

Settlements, field-systems, dykes and other features captured by survey can, however, be classified by their shape and a few dated examples are then often sufficient to determine the pattern of settlement and land use (Edis *et al.* 1989). Settlements can also be ranked from their size, and occasionally by the type of surface find: in some cases the use of the metal detector has proved decisive here, providing metalwork finds diagnostic of status from the ploughsoil. In areas of extensive and shallow ploughsoils, aerial photography can provide comprehensive accounts of land boundaries (Riley 1980) using interruptions in the pattern to determine their sequence. In lands rich in pottery and obtrusive monuments, such as those bordering the Mediterranean, ground survey has been able to confront major questions without excavation (Adams 1981; Barker and Lloyd 1991; Keller and Rupp 1983). Leveau's survey of the territory of Iol Caesarea (Cherchell) in northern Algeria in the Roman period, distinguished villa sites from native sites from their building materials and showed how affluence moved between the town and its hinterland as the economy and society changed (Leveau 1984). In the Guadalquivir Valley, Spain, the geography of olive oil production was mapped from extant olive presses, centuriated olive groves, and kilns producing amphora to transport the oil (Mattingly 1988). In southern Etruria north of Rome, surface collection over many years allowed the mapping of settlement patterns from the neolithic to the medieval periods (Potter 1974; Fig. 25.2).

As in the reconnaissance and evaluation stages, ground survey is usually conducted in systematic transects or quadrats (Fig. 4.11), although total coverage is always preferred and sometimes attempted (Bahn and Renfrew 1991:454). Within a transect, a group of field-walkers, say four to six persons, walk slowly along the axis of the transect in a line abreast, each having the responsibility for searching a strip 2–3 metres wide. Recent developments in surface collection such as the analysis of assemblages for their representivity (Bintliff 1985; Millett 1991; Scholfield 1991) promise new levels of sophistication. A parish survey at Witton conducted over twenty-five years mapped not only the changing size and location of settlements during the first millennium AD, but also the amount of land under the plough, on the assumption that freshly broken pottery could be attributed to a buried settlement

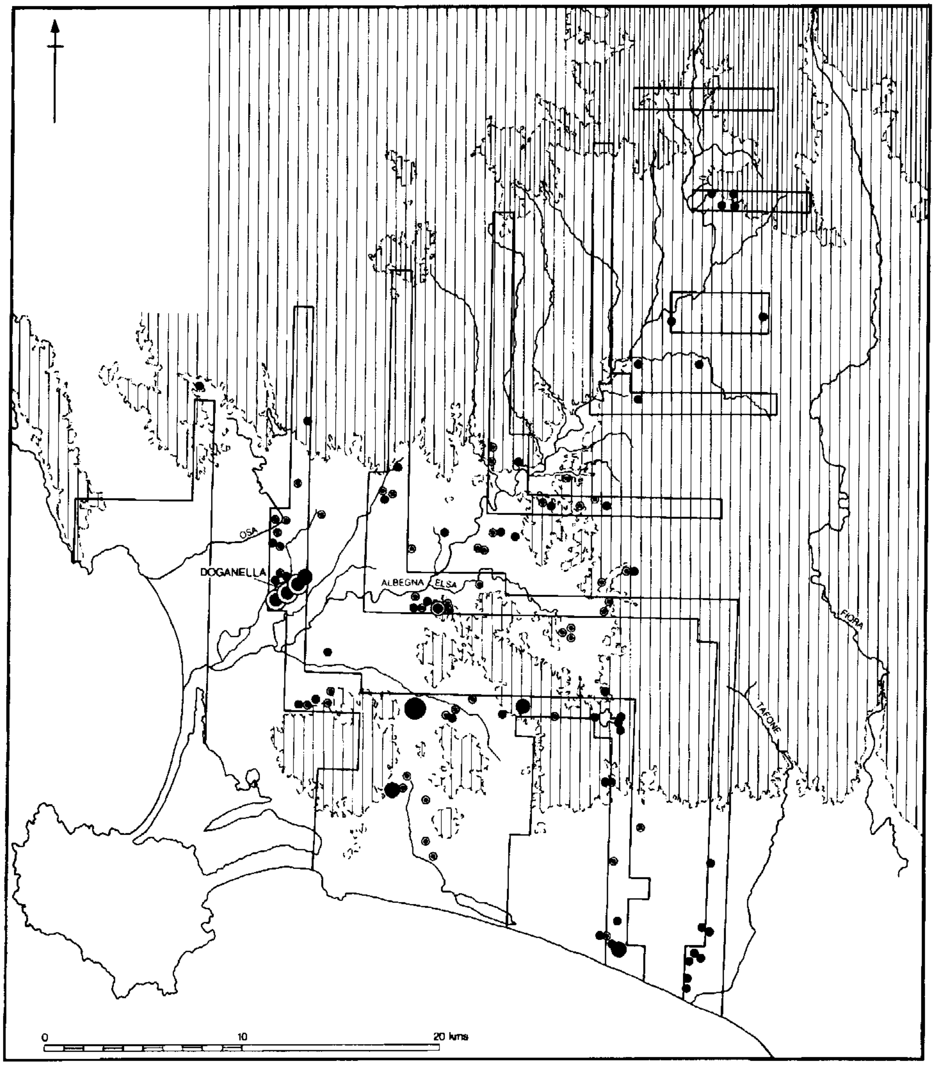

Figure 4.11 Exploring territory by surface collection in transects—the Albegna Valley survey, Italy. The circular symbols represent different-sized assemblages of Etruscan amphorae. Source: Barker and Lloyd 1991.

and smaller, abraded, sherds to the practice of manuring ancient fields with household rubbish (Wade 1983). From the resulting model it was argued that land dedicated to arable farming had doubled in size every 200 years, and with it the population.

Detailed questions about natural resources, preferred economic strategies and the use of land are also in reach of environmental studies or palaeoecology: as Chapter 6 describes, organisms such as pollen (Dimbleby 1985; Faegri *et al.* 1989) and land snails (Evans 1972, 1978), and the sediments themselves (Courty *et al.* 1990; Limbrey 1975; Rapp and Hill 1998), can be read for the sequence of local vegetation: woods, pasture or arable farming.

Survey projects therefore deploy a parcel of techniques which, when harnessed together, can write the history of extensive landscapes over considerable stretches of time. The changing character of the landscape itself, its exploitation by people and the geography of settlement are all within reach of survey, which is moreover a mainly non-destructive form of study. Although excavation has traditionally enjoyed pride of place in field archaeology, it can now be argued to be the junior partner in the enterprise: survey provides not only the backdrop, the *longue durée* of the human experience, and the basic human strategies of existence, but the basis of the archaeologists' strategic choice of which sites merit the more penetrating and more final measure of excavation. Nevertheless, it is only through excavation that the most intimate and significant questions of past human behaviour can be addressed.

DATA ACQUISITION: EXCAVATION

Archaeological excavation is the systematic dissection of a cultural deposit. An appropriate modern term would be 'deconstruction', since the principal objective—to determine the way the deposit was put together—is achieved by taking it apart. In this case, however, it cannot be reassembled: excavation is always partially, and often totally, destructive. There is therefore only one chance to excavate a given deposit, and since the operation usually takes place outside and in public, a high degree of organization, both in precept and in practice, is essential.

Preparation and management

The location and size of the area to be excavated are selected by the strategy, as discussed above. Around this chosen area are arranged the facilities which will support the excavation process without inhibiting it: the area where excavated soil is to be dumped (the 'spoil-heap'), the offices, and the viewing platform for the visiting public. In the countryside, the excavation team will usually have to be accommodated, often on the site itself. One site office will serve for the processing of finds, another for the cataloguing of drawings and photographs, another for the checking of written records and the entry of data on computer file. In the toolshed, trowels, hand shovels, spades, wheelbarrows, finds trays, sprays, and surveying equipment await the signal to begin.

The assembled team will include a director responsible for planning and coordinating the operation, supervisors responsible for managing certain areas or tasks, and excavators who may be professionals, amateurs, labourers or students. Supervisors share responsibility for managing artefacts, biological material, survey, photography, drawings, and for the written record, each of which must be treated consistently throughout the operation. The excavation area is demarcated with nails and string, or a white line, and its condition before excavation is recorded photographically. This is for legal reasons, since excavation always takes place on someone's land, the character of which is about to be altered irreversibly. Faced with a piece of blank ground, excitement is intense and the responsibility formidable, but though neither the excitement nor the responsibility ever quite vanish, a modern excavation is not a hunt for the unexpected: if the evaluation was effective and the strategy well thought out, the course run by the excavation should be quite precisely known in advance.

Stratigraphic units

Thanks to this preparatory work, moreover, the excavator can also imagine the components of the unexcavated deposit in some detail, and has already decided the measures necessary to define and record them. These components have largely entered excavation practice through tradition and consensus. For the early excavaators, they were 'layers', 'walls', and 'pits', each of which would be numbered separately (pit 1, wall 2, etc.). In modern systems, the site is divided into 'contexts', which are layers, walls, and all other sets of materials seen as being homogeneous, discrete and individually definable together with their interfaces (Harris 1977). These are the basic 'stratigraphic units' of which the physical stratification of the deposit is composed. For some excavators, the 'context' is the only stratigraphic unit used, apart from 'find'. Others prefer a hierarchical system, where *additional* higher entities of interpretation are also defined, recorded and numbered separately (Carver 1979; Fig. 4.12). Thus a 'structure' (a building) is a set of 'features', and a feature (a post-hole) is a set of 'contexts', and a context (a layer) is a set of components, which may be anything from grains of sand to fragments of charcoal, bricks or stones. A 'find' is simply a component which is kept. This system maybe acknowledges that each entity requires an act of definition and is not strictly a fact to be observed.

The ability to define finds, contexts and the higher-order stratigraphic concepts depends, of course, on how far they can be seen, and this depends in turn on the terrain that contains them and the effort made to make them visible. So here, too, the controlling influence is provided by the excavator and the excavator's strategy. A midden heap or a rubbish pit may have contained several hundred acts of dumping and discard; but the number of layers into which the excavator can divide it on

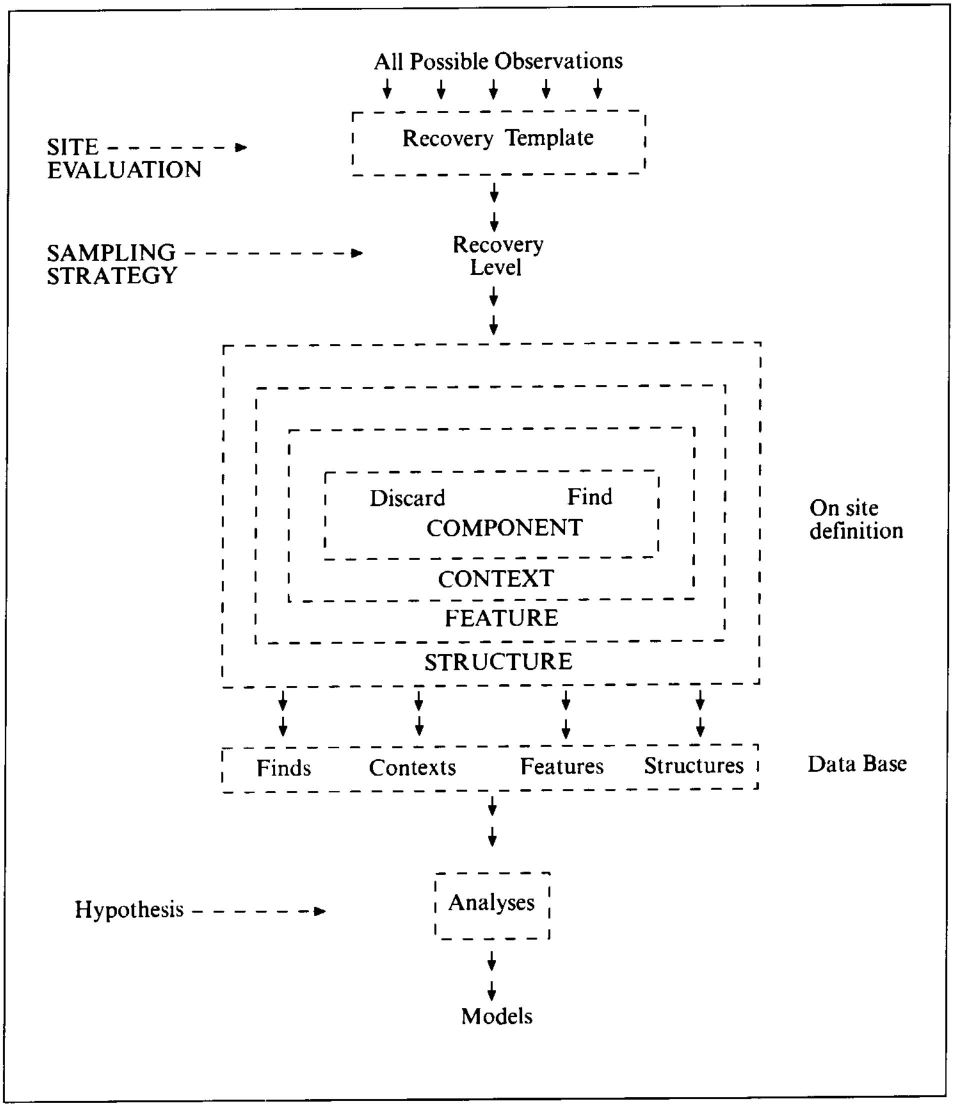

Figure 4.12 A hierarchical system of stratigraphic units. The smallest definable entity is known as a 'component', which might be a pebble or a potsherd. The components that are kept are the 'finds'. A group of components which is defined as forming a set is called a 'context'. A group of contexts which forms a set is called a 'feature'; and a set of features is called a 'structure'.

rediscovery will depend on the degree of preservation and the excavation method applied. Dug with a shovel, it will be resolved into only two or three major episodes and only the larger finds recovered; the remainder will end up on the spoil heap. Dissected with a spatula, and analysed in a laboratory, it can risk being divided into more layers than there actually were, but the traces of macroscopic plant remains recovered will greatly enrich the assemblage. Plainly, not every cubic centimetre of a site will be excavated with a toothpick, or offered for microanalysis in the laboratory, nor would there be any point in doing so in a research-driven procedure. Selectivity of recovery is therefore inevitable. It is logical to impose selectivity, but still more essential to make the selectivity explicit and record it. This can be done using the device of information recovery levels (Table 4.2), which allows the excavator to match the levels of the precision of digging to those of recording, and both to the data demanded by the strategy. The system provides the excavator with a series of 'gears' with which to control the pace and intensity of the excavation.

The techniques of excavation applied are those appropriate to the recovery level. Thus the topsoil might be removed by a mechanical excavator (level A) and the surface of the site then cleaned with a shovel (level B); the contexts contained by an earthwork might be defined with a trowel (level C), but those expected to contribute more detail, for example, graves, dissected as level D or E. Extremely fragile groups of finds, or contexts containing organic traces, might be lifted in a block and examined in the laboratory as level F.

Recording

What to record is also decided by the recovery levels, and a recording system will be devised to suit the particular terrain (DUA 1990; *Lattes* 1986). The first essential of any recording system is a grid from which to locate every recorded entity in space. A local grid is established by setting wooden pegs or iron rods at regular intervals beside the excavation area to provide permanent points of reference, tied into the national geographic system. The grid is often extended across the excavated area itself, so that every find and context can be located with reference to the nearest line of pegs running east (easting) and north (northing). This generates the location to the nearest 10 metres, 1 metre or 1 centimetre, depending on the precision required. For locations more precise than a metre, a planning frame is placed over a known metre square and the target located by the mini-grid of parallel strings. The third dimension, height, is measured with a level and staff, and related to a temporary benchmark. The inconvenience of a grid of pegs, which must be lowered continually with the excavation, has been partially overcome with the use of electronic distance measurers (or total station theodolites) which record all three dimensions working from a point of reference on an offsite grid.

With the grid established, the records made can be conveniently managed in five parts: the *written record* (Hirst 1976) consists of pro formas, such as context cards,

Table 4.2 Guide to information recovery levels

Level	*Operation*	*Find*	*Component*	*Context*	*Feature*	*Structure*
A	Machining	PLOT 2-D	(not recovered)	OUTLINE PLAN	OUTLINE PLAN	OUTLINE PLAN
	Fieldwalking	PLOT 2-D	(not recovered)	(not recovered)	Inferred from density plot	Inferred from density plot
	Geophysics	(not recovered)	(not recovered)	(not recovered)	Inferred from density plot	Inferred from density plot
	Topographics	(not recovered)	(not recovered)	(not recovered)	Inferred from map	Inferred from map
B	Shovel scraping (definition)	PLOT 2-D	(not recovered)	SHORT DESCRIPTION, OUTLINE PLAN	SHORT DESCRIPTION, OUTLINE PLAN	SHORT DESCRIPTION, OUTLINE PLAN
	Shovel excavation	Recover by context	Optional sampling	SHORT DESCRIPTION, OUTLINE PLAN	SHORT DESCRIPTION, PLAN and PROFILE	SHORT DESCRIPTION, PLAN and PROFILE. PHOTOGRAPH (PostX)
C	Coarse trowelling (definition)	PLOT 2-D	(not recovered)	DESCRIPTION, OUTLINE PLAN	DESCRIPTION, OUTLINE PLAN	DESCRIPTION, OUTLINE PLAN
	Excavation	Recover by context	Optional sampling	FULL DESCRIPTION, OUTLINE PLAN	FULL DESCRIPTION, PLAN, SECTION. PHOTOGRAPH (PostX)	FULL DESCRIPTION, PLAN, SECTION. PHOTOGRAPH (PostX)
D	Fine trowelling (definition)	PLOT 3-D	(not recovered)	FULL DESCRIPTION, DETAILED PLAN. PHOTOGRAPH	FULL DESCRIPTION, DETAILED PLAN. PHOTOGRAPH	FULL DESCRIPTION, DETAILED PLAN. PHOTOGRAPH
	Excavation	PLOT 3-D SAMPLE SIEVING	Selective sampling	FULL DESCRIPTION, DETAILED PLAN, SECTION. PHOTOGRAPH (PreX)	FULL DESCRIPTION, DETAILED PLAN, SECTION. PHOTOGRAPH (PreX/PostX)	FULL DESCRIPTION, DETAILED PLAN, SECTION. PHOTOGRAPH (by phase)
E	Detailed excavation	PLOT 3-D DESCRIBE ATTITUDE. SIEVE ALL	KEEP ALL	(as LEVEL D) Optional colour plan/section	(as LEVEL D) Full photographic record	(as LEVEL D) Full photographic record
F	Block removal for controlled dissection	(as above) PHOTOGRAPH and DRAW in situ	(as above)	(as LEVEL E) Full photographic record	(as LEVEL E)	(as LEVEL E)

which give the number of the context, describe the materials which compose it, its stratigraphic relationships, its location and its recovery level. The *drawn record* consists of maps, plans and sections: maps show a number of contexts and their relationship in the horizontal plane; plans show the outline of individual contexts and features; and sections show the relationship of contexts in the vertical plane. The *photographic record* includes photographs of individual finds, contexts and features, and of the methodology employed during the excavation. Photography is now also used for planning, especially on sites of low stratigraphic visibility. A camera is used from a tower, or suspended from a quadrapod. Some excavations now use videocameras to record both maps and plans, inserting the taxonomy and descriptive commentary by sound.

The *finds record* includes an inventory of the finds recovered, their location, their recovery level and description, often supported by a drawing and photograph. The finds record includes not only the finds recovered from the site, but also the details of their processing: washing, drying, marking, and cataloguing. The 'finds' also usually include samples taken for palaeoenvironmental analysis or dating, though most samples on excavation will be taken from 'anthropogenic' contexts, where they represent material gathered and deposited by or because of human activity, rather than those which have accumulated naturally. The extraction of this material is achieved by sieving: dry sieving for animal bones, and fine mesh assisted by water flotation for seeds and other plant remains (plant macrofossils) and by paraffin flotation for insects.

The final part of the recording system is the *notebook,* essentially the logbook of the excavation, which records the decisions and the progress made. The recording system is mainly dedicated to recording the data required by the strategy to serve the analytical itinerary, but it must also serve two other functions required by the special and unrepeatable nature of excavation. The first of these is that the recording itself must be monitored, by stating what was recorded and why, at all times. This monitoring of the records made is clearly allied to the second additional obligation: that of recording all chance observations. Although the recording agenda has been set by the strategy and looks forward to the analysis, it must be emphasized that excavators will remain constantly on the alert for new anomalies and previously unrecognized signs of past activity. The excavator is here acting as evaluator, and although it is unlikely that a new concept can be quickly included in the current enquiry, it is certain that it will help to construct the framework for future projects. It is in this way that the excavator may reconcile the obligation to follow a research-driven programme with the obligation to record everything that could conceivably be useful to the scientific community during a unique trip below ground.

In practice, the excavation technique and the recording system vary markedly with terrain and more particularly with stratigraphy. Stratigraphic excavation is by far the most powerful method of reading a deposit, and the stratigraphic sequence is the most fundamental information that an excavator can provide. The opportunities for applying the stratigraphic method do vary, however, and sites which have virtually no visible stratification are common but play an important role in research programmes. Many rural sites are covered by a thin layer of topsoil and the remains of the ancient site consist of a number of holes cut into the subsoil, not necessarily related to each other. Here, the topsoil (which contains most of the finds disturbed from floors or midden heaps) is examined by surface collection, and then removed with a mechanical shovel or toothless backhoe (at level A). Each feature is subsequently investigated at higher recovery levels. On some types of terrain, for example sand, even these features are difficult to define and may not penetrate the subsoil. The clean surface is therefore recorded before excavation, generally as a 'horizon map' or a 'horizontal section' to locate anomalies which are most visible from above. In the struggle to improve visibility on such sites, methods of chemical mapping have been developed which locate traces of skeletons, detritus or timber which the taphonomic trajectory has rendered undetectable to the naked eye (see, for example, Conway 1983 for phosphate mapping; and Bethell 1991 for mapping vanished bodies with ICP). The recording system in this case emphasizes the spatial relationships given by these maps and the characteristics of individual features.

By contrast, many deep deposits, particularly under towns, contain stratification which is readily legible (Fig. 4.1). Contexts can be individually defined even at low recovery levels and provide the main target for both digging and recording. The recording system emphasizes the stratigraphic relationships which are presented in stratigraphic sequence diagrams (Figs 4.14, 4.15), by entering the stratigraphically related contexts on the context card or, more reliably, by planning each context separately and using the 'single context plans' to generate a diagram.

Other types of site offer deep deposits, but with little stratigraphic legibility. It is here that the section proves useful: in the excavation of burial mounds, for example, layers in light soils are difficult to distinguish in plan, but the horizons between them may be visible in section. For some investigators, this vertical sequence is decisive, which is why burial mounds have often been examined by cutting a trench through them. In the rescue excavation of the enormous (100-metre diameter) mounds of the Kurgan culture, the trenches were cut through the centre, initially with a box grader, and a sequence of secondary burials read from the exposed section (Ministry of Education, Ukraine 1986). On the other hand, it is normally important that relationships in plan are not sacrificed for those in section; the mound may therefore be examined in successive vertical slices, advancing towards the centre as in early excavations in the United States, or divided into quadrants. The reconciliation of visibility in plan and section can also be achieved by creating 'running sections' along a profile maintained at the same axis, but demolished at drawable intervals, so as to pause and examine the site in plan.

The stratigraphy of buildings requires a specially subtle reading, since walls, windows and other features can be added and subtracted from above, from beneath, or from the side (see Chapter 8). The principle for stratigraphic ordering in buildings is not so much 'superposition' (as in soft deposits) as 'post-position', where the later feature may be underpinning from below, or an inserted panel or opening. These are detected by signs carried on mortar or timber, and by the fabric, form and style of the newer material.

How to dissect and what to record are therefore the result of decisions made before the operation starts and modified during it. These decisions depend on the evaluation, which predicts what can be seen, and the strategy, which proposes how the research targets can be met. The recording system is dedicated to the consistent recording of the data destined for analysis, but must also monitor itself, and include all the other observations that modern techniques allow to be made. Even if electronic data capture takes part of the load, the records of an excavation are bulky: ring binders full of context cards, rolls of drawings, sheaves of photographic negatives and slides, numerous notebooks, and boxes of potsherds, animal bones, human bones, fragile metal objects, and biological samples. A fairly modest excavation can produce a truckload of these records which, of course, may compose all that remains of the site. The next task is to analyse and curate them.

ANALYSIS

The analytical phase of a field project, sometimes called rather vaguely 'post-excavation', is a crucial part of the scientific journey which takes an archaeologist from the first result of a quest to its publication. It is unfortunate that so much of this procedure tends to remain hidden, a kind of black box from which the interpretation eventually emerges. If the analytical stages are explicit, as they should be, it is not only the present generation which benefits, but the next.

The post-excavation process begins with the organization and management of the *field records*. The data generated in a survey or excavation project, together with its log, are indexed and archived in a *site file*. The site file may be accompanied by a *project file,* which contains management records, and a *research file* which contains research notes and a record of all analyses and experiments undertaken, whether or not they led to a result. The 'raw data' must then be worked into a *field report,* which gives a full account of the archaeological discoveries and their significance. Parts of this report, suitably edited, may merit circulation in multiple copies as a *research report* (see Frere 1975, where the field records, field reports and research report were termed Levels II, III and IV respectively).

The production of the field report from the records made in the field is achieved by carrying out a series of analyses which may be broadly grouped as follows:

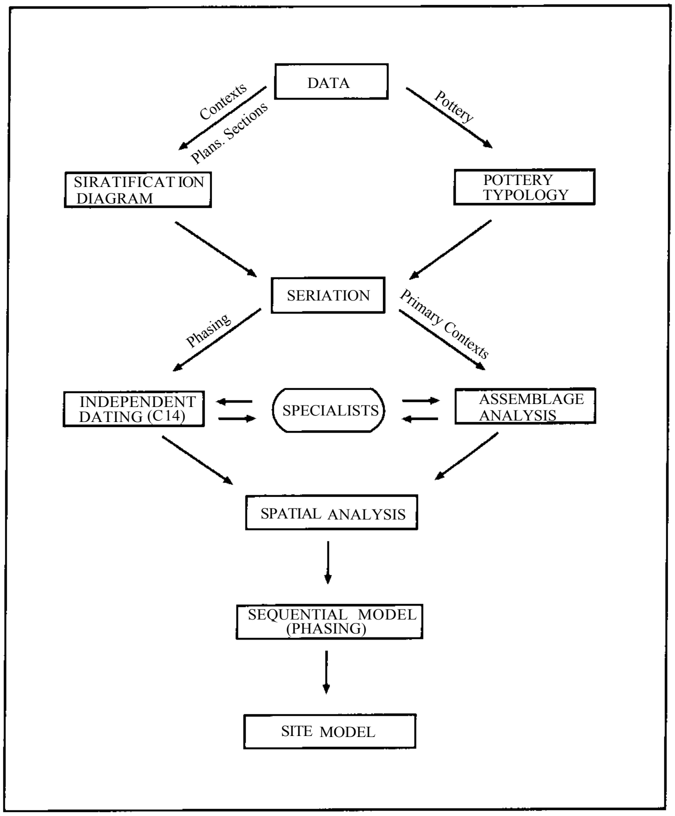

Figure 4.13 The 'analytical itinerary': all the data recovered on an excavation should be destined for a particular analysis; the analyses form a sequence or itinerary which leads to the site model. Source: Carver 1990.

establishing the sequence; defining the activities; providing a chronology; and placing the discoveries in their cultural context. The different operations of a typical itinerary are shown in Figure 4.13. Before the analytical programme begins, it is sensible to evaluate it (and cost it) in the light of the results of the fieldwork, especially the harvest of finds actually retrieved (English Heritage 1992). Then the sequence of operations must be managed so that the stages which depend on each other occur in the right order. Thus the process of ordering the contexts to give the *sequence model* can begin at once and may even have been completed on site. The sequence model may not depict the complete sequence, especially on sparsely stratified sites. Hence a *seriation* analysis is usually required, which shows the order of deposition of a dated species of find (such as flint or pottery). For the seriation analysis, a *typology* of pottery (or flint) is required. The sequence model and seriation taken together offer a rectified sequence, showing which groups of features are likely to have been contemporary. These features can then be mapped together to give a statement of the geography of the site at a particular time, variously called an 'event', a 'horizon', or—more commonly—a 'phase'.

The activities which characterize each phase are derived from another suite of analyses. Once it is established which contexts and features may have been contemporary, the records are searched for evidence that they formed *structures* which were not recognized on site. The *assemblages* of finds, both artefacts and biota, are the main source of evidence for *activity*. The activities relevant to a particular phase will be signalled by finds in use during that phase; but only a small fraction of the material recovered falls into this category: the grave-goods in a grave, for example, or the contemporary rubbish dumped in a rubbish pit, or the fragments of crucible left in a bronze-worker's hearth. These are 'primary contexts'. 'Secondary contexts' consist of material transported or displaced from an earlier phase: the packing for a post-hole, for example, or the soil and turf quarried to build an earthwork. Many, if not all the finds in a secondary context belong to an earlier phase of occupation and are said to be 'residual'. In deeply stratified sites residuality is a major problem, one being confronted by seriation analysis. The seriation produces a 'residuality threshold', which shows which pottery is likely to be residual in each context, and which contexts, having no residual pottery, are likely to be primary. Since secondary contexts contain the displaced pottery of earlier eras, it follows that they will also contain displaced animal bone, plant remains and insects too. The assemblages in primary contexts are therefore the key to absolute dating and the key to interpreting activity.

The contemporary activities can then be examined by *spatial analysis,* which studies their relationships in plan; and the last step on the itinerary is to assemble the sequence of phases and the changes that occurred between them. It should be recalled here that when comparing the variation of an activity through time, only assemblages gathered at the same recovery level are eligible. For example, if animal bone is being used as an indication of diet, the animals represented will depend on the sieves which were used (Payne 1972), which depend in turn on the recovery level (see Table 4.2) decided: a group of large mammal bones recovered with a shovel from a pit may suggest that the pit-diggers ate beef; but only sieving with the appropriate mesh will show whether they also ate fish and fruit. The sequence of phases provides the basic framework for the *site model,* which is the principal method of presenting the results of fieldwork. Some of these analyses can be briefly described.

The most commonly used form of *sequence model* is that developed and promoted by Harris (1975, 1989), in which each context number is placed in a box and the relationships between them shown by vertical and horizontal lines (Fig. 4.14). Another procedure (Carver 1979) begins by ordering the contexts in the same way, but then groups the contexts into their interpreted sets—features and structures— to provide a more 'narrative' model (Fig. 4.15). The second type of diagram can therefore be

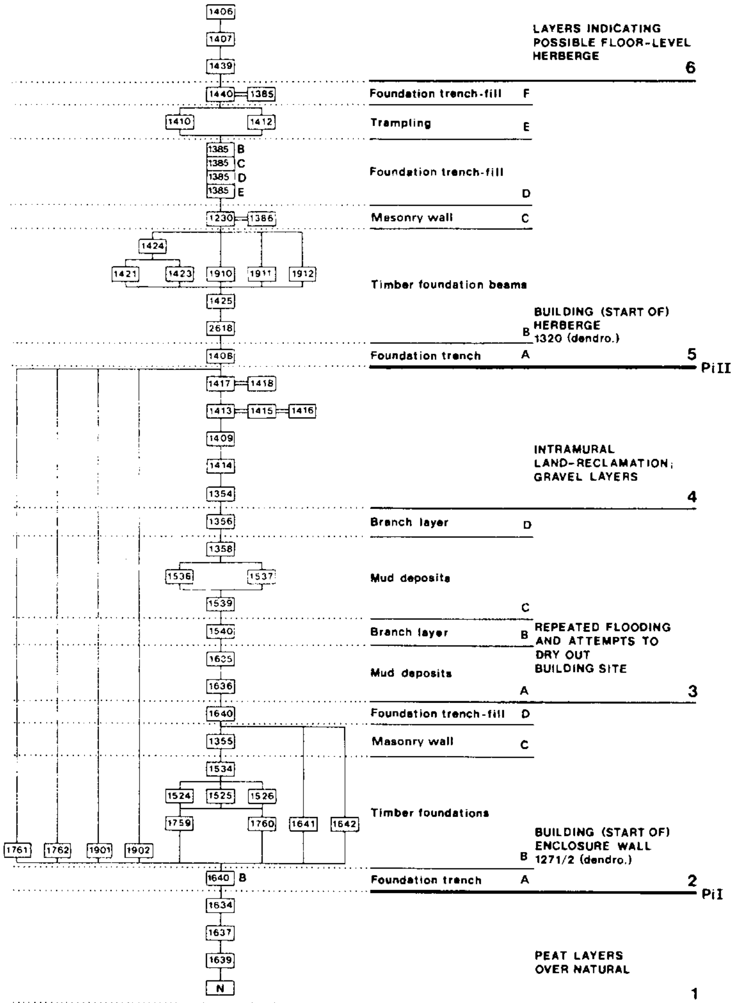

Figure 4.14 Stratification or sequence diagrams: the 'matrix' devised by Harris which uses contexts only, compared with the stratification diagram which uses contexts and features. Source: Bibby 1993, fig 7.10.

viewed as an interpretive version of the first. On large urban excavations where contexts can run to many thousands, these more summary diagrams, which carry a higher level of interpretation, can be easier to use for presenting the stratification in a publication and for supporting the synthesis. All contexts in the sequence model which can be grouped into features can be replaced by a feature signalled as a vertical arrow. This also indicates the 'life' of a feature, such as a wall or post, which may

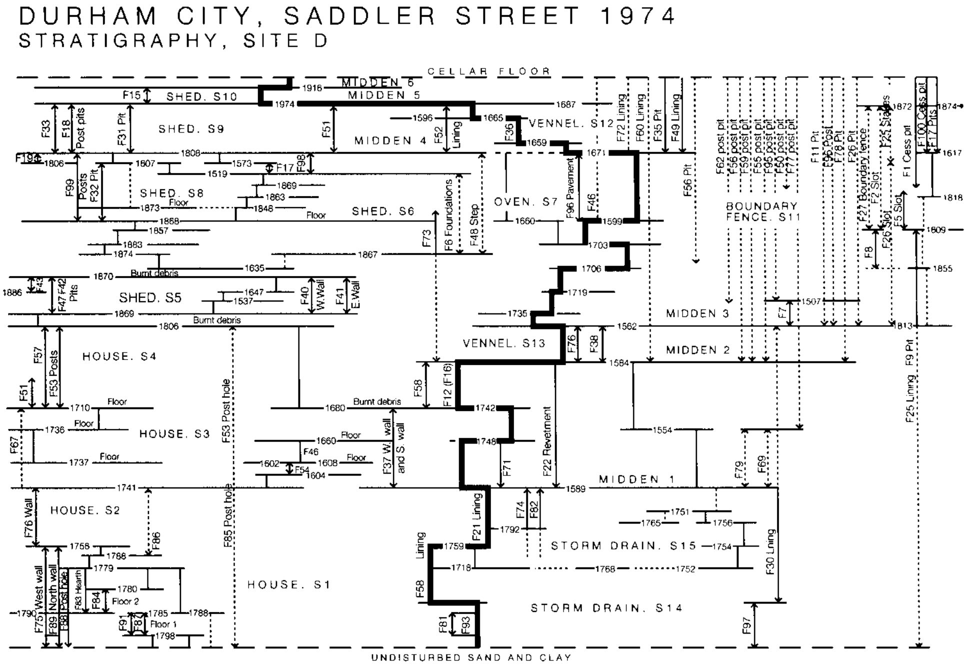

Figure 4.15 Stratification or sequence diagrams: stratification diagram for a complete site. The bold black line shows the train of contexts used in seriation. Dotted lines show where the stratified position was uncertain. The activities on site began at the bottom of the picture, and finished at the top. Source: Carver 1979.

endure during the deposition of many contexts. Other ways of presenting the stratification which match the physical sequence with the researchers' model of events are under continual development—for two recent examples see Paice (1991) and Hammond (1991). All types of stratification diagram can be 'rectified' —that is, redrawn to show their phasing and dating—following the seriation analysis.

Seriation is used to order contexts and features by virtue of the finds contained in them. Where a site is sparsely stratified, seriation can be the sole method of sequencing, as in the studies by Petrie (1904) of Egyptian pre-dynastic graves and by Hodson (1968) of iron age cemeteries in Europe described in the following chapter. In well-stratified sites, seriation is used in a slightly different way. A species of artefact is selected which runs right through the sequence—in Roman and later urban sites this will generally be pottery. Both the stratification and the typological sequence will be known, but in both cases imperfectly. The objective of the seriation analysis is to match the order of context deposition to the order of the manufacture of pottery types, in order to model the best order for each. The stratified contexts are placed along one axis of the diagram, and the pottery types along the other; the quantities

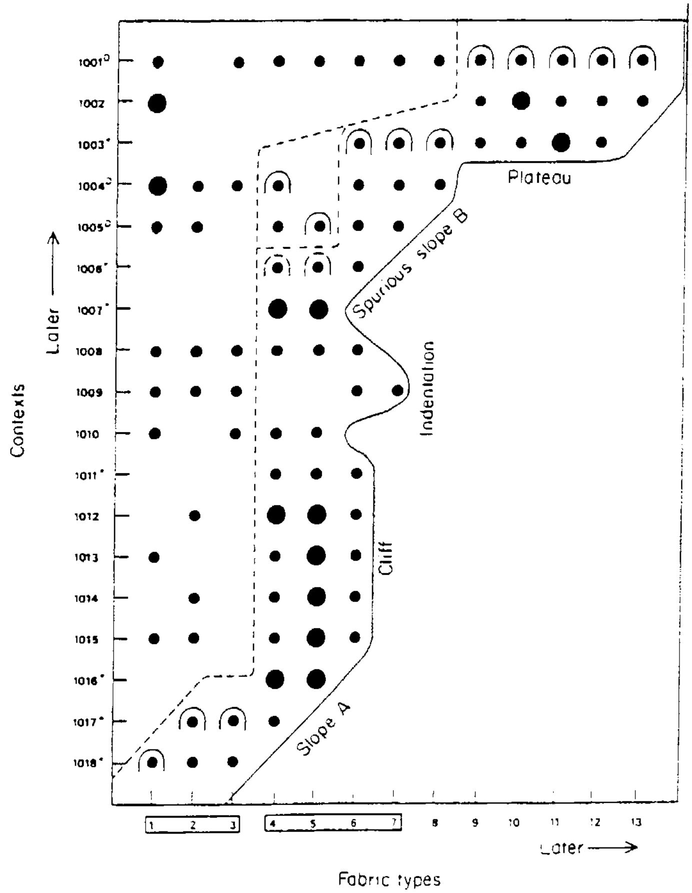

Figure 4.16 Seriation diagram for pottery assemblages in an urban sequence. The contexts are arranged in their best stratified order on the vertical axis of the diagram, and the quantity of pottery is given by the size of the spot. The different pottery fabrics are numbered along the horizontal axis. The interpretation of these diagrams is still being developed. A 'cliff' should mean that the contexts concerned are contemporary. A 'plateau' implies that some of the site has been removed by levelling. Slope A shows that one context is following another; but Slope B is spurious in that the contexts concerned can still be contemporary. Pottery fabrics in use at the same time are enclosed in a rectangle. The dashed line is the 'residuality threshold' connecting the 'fade points' for each fabric. Pottery to the left of this line is residual. Source: Carver 1985.

of pottery of each type in each context being indicated by a symbol (Fig. 4.16). The order of both parameters is then adjusted within the limits permitted by the stratification (context) or chronology (pottery) to give the best fit—usually a jagged diagonal. The rewards of the exercise are several. The shape of the diagonal shows which context, and which types of pottery, were in contemporary use on site. It also indicates episodes of levelling, where the strata have been removed. The diagram also indicates where residual pottery is present, and which contexts may be primary. Certain types of context may also be identified: for example, a layer containing small quantities of many different types of pottery ('high diversity') is likely to be a ploughsoil. The potential of seriation analysis for assisting in the interpretation of long stratified sequences is very great and invites further development (Carver 1985).

Before the *finds* can be used for the interpretation of on-site activities, they must be identified, dated, and placed in their cultural context. The different kinds of material recovered during excavation can be very numerous, and their examination will usually require the deployment of a large number of specialists. The management of collaborative finds analysis programmes is therefore a major component of the analysis as a whole. The majority of artefacts may be classified by their fabric, form and style, which can offer details of where they were manufactured, for what purpose and at what date (see Chapter 9). The *biological component* of the assemblage is similarly deployed to different specialists—experts in identifying and interpreting animal bones (Davis 1987), human remains (Brothwell 1986), plant remains (Keeley 1978; Renfrew 1973), insects (Kenward 1978) and sediment samples (Courty *et al.* 1990; Limbrey 1975). Other specialists will treat material for dating, for example by radio-carbon, thermoluminescence or dendrochronology (see Chapter 5).

Reading activity from an *assemblage,* even when all its components are primary and have been successfully identified, is by no means straightforward and is an important area for development. Much interpretation of activity relies on knowledge of the observed culture, or on experiments or on analogies drawn from cultures which can then be validated (for example, Bonnichsen 1973; Reynolds 1979). *Structures, and activities* can be partially read from the features and finds identified in a particular phase; but a still more powerful indication is given by their relationship in plan (Hietala 1984; Blankholm 1991). The search for pattern in the distribution of features and finds is therefore a major component in the analytical itinerary. On large flat rural sites with sparse stratification, such distributions may be decisive for determining the phasing. Many of these patterns will be recognized during excavation. An array of post-sockets, for example, may already have been designated as a building and recorded as such (Fig. 4.17a). Pits of similar structural type, or containing similar assemblages, can be clustered into occupation areas. Such spatial analyses can be carried out even with materials now invisible, such as the chemical map of a vanished body (Carver 1990:85). Areas exploited for particular purposes can also be derived from distribution patterns of finds, such as flint waste, iron slag and pottery. On thinly stratified sites, secondary finds are spatially useful: patterns can be discerned in the ploughsoil which covers the site, and the ploughsoil finds, although no longer in context, have often not moved far and still represent

Figure 4.17 (a) The Anglo-Saxon settlement at West Stow. Plan showing excavated features.

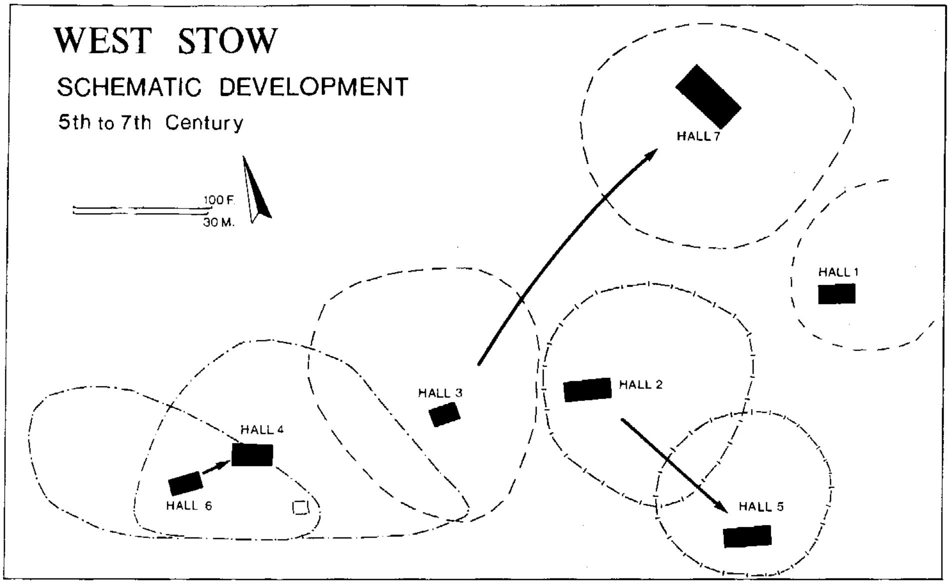

Figure 4.17 (b) Spatial analysis: phases of the settlement determined from the pottery found in the buildings. Copyright © Suffolk County Council.

the use-pattern beneath (Scholfield 1991). For this reason, the horizontal patterns given by dated material can also be used to indicate the phasing (Fig. 4.17b). Spatial analyses normally make use of three parameters, two of them the coordinates giving the location. The third parameter will be varied: height in the case of a topographical survey; parts per million for a phosphate survey; nanoteslars for a magnetic survey; grammes or vessel-equivalents for a pottery distribution plot. The third parameter may be presented in the form of contours, dot density, symbols or other devices.

Both modern surveys and excavations generate an immense quantity of data to be managed and analysed; and in field archaeology, as in other complex operations, the computer is playing an increasingly decisive role (Reilly and Rahtz 1992; Richards and Ryan 1985). Although much computer usage on site is unstructured, the computer being used as a large electronic notebook, it is widely recognized that the most appropriate use of computers is in handling data: that is, something measurable which has an analytical destiny. Many of the records made on site, for example the context records and finds records, fall into this category. These records may be carried in a *database management system,* written especially for archaeology, or adapted from one of the many proprietary brands.

Some field archaeologists have developed procedures for capturing data on site using battery-driven hand-held computers. Others are experimenting with digital mapping, which uses three-dimensional coordinates taken from the edge of a context, captured on site (for example by a total station theodolite) to construct an approximate plan. Many other analytical routines, which use the computerized data processing of site data, are in the course of being developed. Routines for enhancing contour surveys, geophysical maps and aerial photographs can bring structural and other use-patterns out of 'fuzzy' data (for example, O'Brien *et al.* 1982; Scollar 1978). Prototype software for constructing sequence models and seriation tables has been devised, but the most rapid progress is in the field of spatial analysis. Three-parameter maps can be generated by standard software (such as GINOSURF or Uniras), and the possibility of multi-parameter mapping using Geographic Information Systems will play an increasingly important role in field archaeology projects, particularly survey (Allen *et al.* 1990; Gaffney and Stancic 1991; Kvamme 1989; Peuquet and Marble 1990; Richards 1990).

SYNTHESIS AND PUBLICATION

The analytical stage generated a sequence of dated phase-plans, each phase with its varied activities, structures and use of space. This sequence is now presented in the form which is most accessible and attractive for the user, one which simultaneously demonstrates how the questions posed in the first place have been answered by the fieldwork.

The traditional method of presenting these conclusions is in phase- or period-plans, supported by a commentary in prose. Just as the prose commentary may imaginatively embellish the factual sequence to provide a lively narrative (famously, for example, in Wheeler's 1943 report on Maiden Castle), so the elements of each phase may be brought to life by imaginative, if authenticated, reconstruction or reenactment (Fig. 4.18). Such creative hypotheses of the human attributes of the sequence and its place in history are necessary for a discipline which undertakes to serve human society; but they must be kept separate from the analysis and cross-referenced to it. The reader can thereby distinguish analysed data from imagination, while recognizing the need for both.

It is an axiom of field archaeology in most countries that it is conducted not in the private but in the public interest, so the records of fieldwork are therefore to be regarded as public documents. However, there are some difficulties here in both centralized and deregulated communities: in countries with a centralized state archaeological service (the majority), the project records may be owed to the state and access restricted to its officers; in deregulated societies, where the fieldwork is sponsored not by the state but by private clients, the project records may be owed to the client, who may have reasons for keeping them confidential. These are serious matters for field archaeologists, since free public access to their discoveries is the main criterion which distinguishes their activity from that of treasure hunters. In societies which no longer have a centralized state archaeological service, therefore,

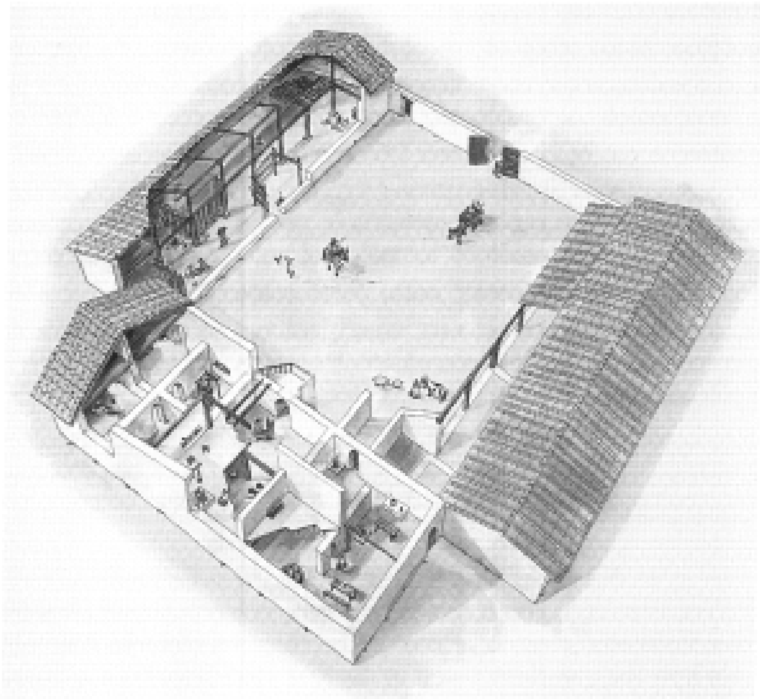

Figure 4.18 A site model: part of the sequence excavated at Monte Barro, northern Italy. Source: Brogiolo and Castelleti 1991, with permission.

professional organizations such as (in Britain) the Institute of Field Archaeologists or (in the USA) the Society of Professional Archaeologists are engaged in providing their own regulations for the protection of the profession's and the public's interests. Ideally, field records and field reports, however sponsored, should be placed in the public domain where they become part of the national heritage.

Full publication, the traditional method of providing public access, is usually now neither practical nor desirable, given the enormous increase in data generated by modern field projects. Since field projects are considered as primarily a vehicle for research—and this remains their necessary justification—it is logical to reassess the field reports produced from the analysis and publish selectively according to the demands of current research. Publication is therefore not a single goal, nor—as was once thought—an obligation: it is rather, as in many sciences, a range of options by which access may be managed. Thus the project records may be deposited in a museum, to be visited by the scholar, student or specialist. The field reports may be produced in a small number of copies, for the local heritage manager, for the national archive, and for appropriately specializing universities, libraries or archives.

An account of the synthesis, or of particular finds, or of particular analyses, may be selected for publication in nationally and internationally distributed monographs or journals.

But publication does not end even there. A project which has created wide public interest will be promulgated also in other media: museum displays, on television, in the press. And if the site itself has survived, its consolidation, curation and presentation also form part of the publication programme; for the fresh images of the past created by field archaeologists in the name of the public are destined to be enshrined not only in prose and pictures, but in the range of monuments and landscapes bequeathed to the generations which follow (see Chapter 10).

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The principles given in this summary article follow my papers 'Digging for Ideas', *Antiquity* 63 (1989), 666–74, and 'Digging for Data' in R.Francovich and D.Manacorda, *Lo Scavo Archeologico: dalla Diagnosi all'Edizione* (Florence 1990), 45–120. Since early field archaeology books tend to reflect their authors' experience and research culture, they remain useful over unexpectedly long periods, in spite of the effort they sometimes make to displace one another. Thus W.F.Petrie's *Methods and Aims in Archaeology* (London 1904) remains an inspiring work, containing prophetic accounts of systematic evaluation, photogrammetry, block-lifting of finds, seriation and other techniques of fieldwork and management combined with a stirring and by no means outdated ethical message. R.E.M.Wheeler's *Archaeology from the Earth* (Oxford 1954) and *Still Digging* (London 1956) are also essential reading for research-driven fieldworkers. J.Coles' *Field Archaeology in Britain* (London 1977) is full of good sense. P.A.Barker's *Techniques of Archaeological Excavation* (London 1977) emphasized stratigraphic recording, but was most notable for its empirical approach ('the only valid question to ask of an archaeological deposit is what is there') and its advocacy of large open area excavations such as he was conducting at Wroxeter and Hen Domen. These ethics were popular with fieldworkers and governments alike, although for rather different reasons. By the time of the publication of his *Understanding Archaeological Excavation* (London: Batsford 1986), however, there was more than a nod towards research-selectivity. An important European multi-authored work, incorporating evaluation, excavation, analysis and publication, is the aforementioned volume by R.Francovich and D.Manacorda, *Lo Scavo Archeologico: dalla Diagnosi all'Edizione*. In the USA, the wisdom and humour of Kent Flannery's comments on field methods (particularly survey) in *The Early Mesoamerican Village* (1976) have inspired a generation. A fine descriptive overview of staged field archaeology in the service of research is R.Sharer and W.Ashmore, *Fundamentals of Archaeology* (Menlo Park: Benjamin Cummins 1979). A fieldwork classic in its seventh edition is T.N.Hester, H.J.Shafer and R.F.Heizer, *Field Methods in Archaeology* (Palo Alto 1997). D.Hurst Thomas's *Archaeology* (Instructors Edition, Forth Worth 1989) is an exuberant and often stimulating textbook. M.Joukowsky's *A Complete Manual of Field Archaeology* (New Jersey: Prentice-Hall 1980) contains many useful practical details. *Archaeology: Theories, Methods and Practice* by P.Bahn and C.Renfrew (London and New York: Thames and Hudson 1991, 2nd edition 1996) treats many aspects of field research and is particularly good for the reconnaissance and analysis stages. S.Wass, *The Amateur Archaeologist* (London: Batsford 1992) offers a sympathetic reception to the part-timer who wants a chance to join in.

Articles, anecdotes and asides on the theory and practice of field archaeology will be found in reports on excavation and survey projects, and in mainstream journals such as *Antiquity, American Antiquity, World Archaeology, Journal of Archaeological Science, Helinium, Norwegian Archaeological Review, Nouvelles d'Archéologie, Archeologia Medievale,* and so on. Dedicated series are *Journal of Field Archaeology* (Boston, USA), *Archaeological Method and Theory* (Tucson) and *The Field Archaeologist* (Institute of Field Archaeologists, Reading, UK).

5

ESTABLISHING ARCHAEOLOGICAL CHRONOLOGIES

Anthony Harding

INTRODUCTION

All archaeologists are required to know something about the sequence of artefacts, cultures and sites which are their stock in trade, but most of them, most of the time, take the framework for the chronology of a given period or civilization for granted, on the grounds that it has been carefully built up over many years, and the foundations cannot constantly be questioned. But the ways in which that framework has been constructed may be many and various, not all of equal reliability. In this chapter the main sources for the construction of archaeological chronologies are presented, and some examples of reliable—and unreliable—chronologies discussed. To those brought up in the Judaeo-Christian tradition, the genealogical lists in the early books of the Old Testament serve as a vivid reminder of how time-depth could be expressed in the ancient world. This indeed was the basis for the calculation that has made James Ussher, Archbishop of Armagh between 1625 and 1656, famous to generations of archaeologists: that the Creation occurred in the year 4004 BC. The details of his calculation are unimportant, and the result itself merely of historical interest, but the method is significant. By assuming that a generation was of X years, and that there had been Y generations prior to defined historical events as recorded in the Bible, the years elapsed were X times Y, an absolute number of years that can be related to historical and thence to modern times.

The writings of the biblical genealogists and of Archbishop Ussher represent two quite separate aspects to the establishment of a chronology. On the one hand, the chronicler of ancient times was concerned to record the events of his or previous ages, in relation to certain fixed points, in a way which other people of his own or later generations could understand. On the other hand, the historian of later times needs to be able to 'read' the chronicle, and to reconstruct both the fixed points and the system of reference which alone will guarantee success in arriving at 'dates' — periods of time elapsed since the events in question. These two activities are quite different, though they are often collated or even confused in writings on the subject. If all ancient chronicles were immediately intelligible in their chronological aspects, the problem would hardly arise, but in fact archaeologists and historians have to spend much time simply in reconstructing the nature and meaning of ancient chronological systems before they can move on to matters of greater significance for the understanding of ancient societies.

The importance of exact dating varies considerably from period to period. For recent history, the exact day on which an event occurred is important, even the exact time or minute, mainly because international communications now mean that events occurring in one place are known of as they happen everywhere else on the globe. Prior to the advent of such simultaneous transmission of news, the speed of non-local reaction to events depended on the speed of transport, usually that of the horse, unless signals could be sent by other means. In such cases, the resolution with which events can be viewed is somewhat coarser: weeks and months, typically even years; only exceptionally days. Naturally the strength or otherwise of the written record plays an important part here. Where historical records, or artefacts such as coins or inscriptions, are available, archaeologists and historians demand a fine resolution to their dating. In the Roman period, for example, where the records are excellent, it is frequently possible to date events to an exact day, though it is more usual to deal in months and years (depending on area and period). In Archaic and classical Greece, written histories may give a chronicle of events in which things are recorded at the level of weeks or months, but archaeological artefacts are more likely to be referable to decades or quarter-centuries.

Before written history, the resolution available declines dramatically. In the European Iron Age, contemporary with the world of Classical Athens, the resolution is further reduced: where Greek imports are involved, a dating corresponding to that in Greece may be obtained, but otherwise the resolution may be down to anywhere from quarter-centuries to centuries. In the Bronze Age we are usually lucky to be able to deal in centuries, in the Neolithic in centuries to half-millennia; while before that, in the Mesolithic and Upper Palaeolithic, the millennium will be the usual time-bracket employed. As one goes further back still, tens or even hundreds of millennia become the closest approximations one can achieve, and at the dawn of human activity, several million years ago, the available methods only allow a chronological resolution at the level of hundreds of thousands of years. In each period of the past, therefore, very different possibilities and expectations prevail (Fig. 5.1).

It can be seen from this that different periods have different requirements as far as the construction of chronologies is concerned. A chronology that set out the events

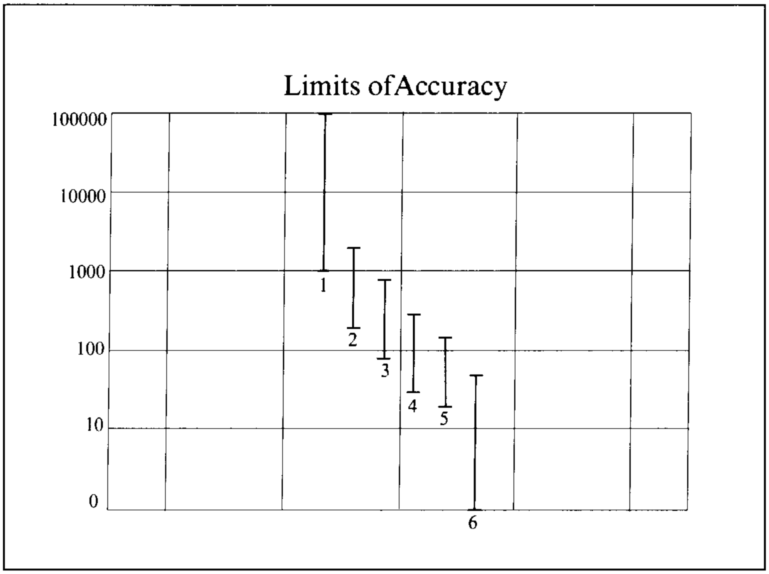

Figure 5.1 Limits of accuracy of dates for particular periods of the past (see text). Note the logarithmic scale: 1. Palaeolithic; 2. Mesolithic; 3. Neolithic; 4. Bronze Age; 5. Iron Age; 6. Egypt, Greece, Rome. Source: A.Harding.

of the Neolithic to an accuracy of ±50 years (an accuracy that is now attainable) would be regarded as highly satisfactory, though for a period with good historical evidence, for instance the Roman period, it would be regarded as barely worth having, and for the Lower Palaeolithic much too precise to be meaningful. In other words, archaeological chronologies depend for their usefulness on their context as much as if not more than on their potential precision. Deciding whether an attainable resolution is appropriate for the purposes of understanding the period under investigation will be a matter for each archaeologist to decide in the light of the context of the datable material.

THE APPRECIATION OF TIME-DEPTH IN THE ANCIENT PAST

The Greek and Roman historians realized that their nations had an ancient past, though they had no means of putting a precise date on distant events of which they were only vaguely aware. Thucydides, for example, writing around 400 BC, referred to the ancient past of Greece, though the main points of reference for him were events—such as the Trojan War—which were legendary rather than demonstrable historical fact. Many Greek and Roman writers used rough and ready systems of dating events in the past, and some (the Roman writer Censorinus, for example) were deeply interested in reconstructing the chronology of the historical past. The poets Hesiod and Lucretius both imagined a gradual progression through a remote antiquity to the times recorded by the historians known to them, and the same may be said for Chinese historians, who developed a lively sense of their own history from earliest times. The medieval period in Europe produced scholars who were concerned with chronological aspects of the human past, but on the whole these were seen within the theological framework of the Creation. Even the start of antiquarianism after the Renaissance brought with it little appreciation of time-depth, though the revival of interest in classical Antiquity did bring with it some understanding of the progress of history back to 500 BC.

The story of the development of an understanding of the true time-scale of the past is one that is interlinked with the story of discovery (Daniel 1975; see also Chapter 1). In Britain, antiquaries such as William Stukeley (1687–1765) had to glean what they could about the world of 'the ancient Britons' from classical sources. The gradual realization of a very long time-scale of the ancient past gathered steam in the early nineteenth century. Until then, belief in the literal truth of the Bible meant that the Flood was generally accepted as a, if not the, cause of landforms being what they were (the 'diluvial' theory), but observations by geologists, notably Charles Lyell (1797–1875), gradually led to an acceptance of 'uniformitarianism'; that is, that physical processes observable at present were the same ones which had caused changes to the earth's surface in the past as well, and had therefore taken place over a very long time-scale. *How* long was still very uncertain, and no one was really prepared to hazard a guess, so overlain was the topic with religious and philosophical implications, but uniformitarianism clearly had profound implications regarding the antiquity of stone tools associated with extinct faunas of the kind that were being widely reported from gravels and caves.

At the same time as such evidences of human antiquity were being produced, others had noted structure in the archaeological finds themselves, a process which had its best-known outcome in the invention of the Three Age system (Daniel 1943; Gräslund 1987). C.J.Thomsen is generally credited with the first formalization of such a scheme, though others were experimenting with it around the same time, and a general awareness of successive 'ages' can be found going back to classical Antiquity, to Lucretius for example. But a clear statement, and acceptance, that a Stone Age preceded a Bronze Age, which in turn preceded an Iron Age, helped engender a realization that different artefacts were of very different ages.

The missing link, which completed the conceptual framework for an understanding of prehistoric chronology, and enabled chronologists to advance with confidence, was the assertion of the evolutionary principle. Darwin's *Origin of Species* (1859) did two things for archaeology: it brought about a realization that humans were not always as they are today, but had developed physically over very long timespans; and it enabled people to realize that evolutionary development was not confined to biology, but could also be discerned in the works of our own species. In other words, progress was the natural state of things; objects changed over time, and the rate of change was in principle measurable.

In the latter part of the nineteenth century, detailed archaeological chronologies were provided by scholars such as the Swede Oscar Montelius (1843–1921), to whom we owe one of the first and still one of the best archaeological chronologies that exist (Montelius 1886; Fig. 5.2). The method adopted was a combination of *typology* and *association,* of which we shall have more to say below. *Typology*—literally the study of types—involved the recognition and definition of variant forms of the same functional class of object, *association* the occurrence of these objects with each other in collective finds (typically in graves). By this means, a series of steps or stages could be identified, characterized by groups of objects of particular types that regularly occurred together. Montelius's most famous application of the method was to the Scandinavian Bronze Age, but he worked on and produced schemes for other areas and periods as well. The success of Montelius's work can be judged from the fact that his six-part division of the Bronze Age, known as Periods I–VI, is still used today and is regarded as largely correct in its definitions.

The schemes that Montelius and others like him produced were *relative* schemes: they provided a chronology that defined the position of each stage relative to all the others. When Montelius came to put actual dates on his stages, he had to adopt a different method. For the Iron Age, he was able to refer to objects that linked in with known Roman material, or to Celtic coins, in order to provide an absolute chronology. For periods earlier than that, he developed the technique of *cross-dating*—seeking analogies for objects in northern Europe in areas where a dating system already existed, such as Italy, Greece and Egypt (Table 5.1; Fig. 5.3). In Italy, for instance, dates as far back as the Etruscan period could be arrived at through historical means; beyond that, things were in the realm of guesswork, and an estimate of 1500 BC for the start of the Bronze Age was made. Close comparisons were evident north and south of the Alps in the period covered by the great cemetery of Hallstatt in Austria, so that a dating could be arrived at for that area too; and enough similarities existed between northern Europe and central Europe for the entire northern chronology to be tied in to the Mediterranean world. This, together with the assumption that the Nordic stages or periods each lasted between 100 and 200 years, enabled Montelius in 1885 to set the start of the Scandinavian Bronze Age at 1500 BC, the same as in Italy.

But there was another source of chronological comparison: Egypt. The progress of discovery and research that culminated in the decipherment of the hieroglyphic script by Champollion in 1822, combined with detailed examination of textual material (for instance the writings of the Jewish scribe Manetho), brought about the production of a more or less complete Egyptian chronology as far back as the

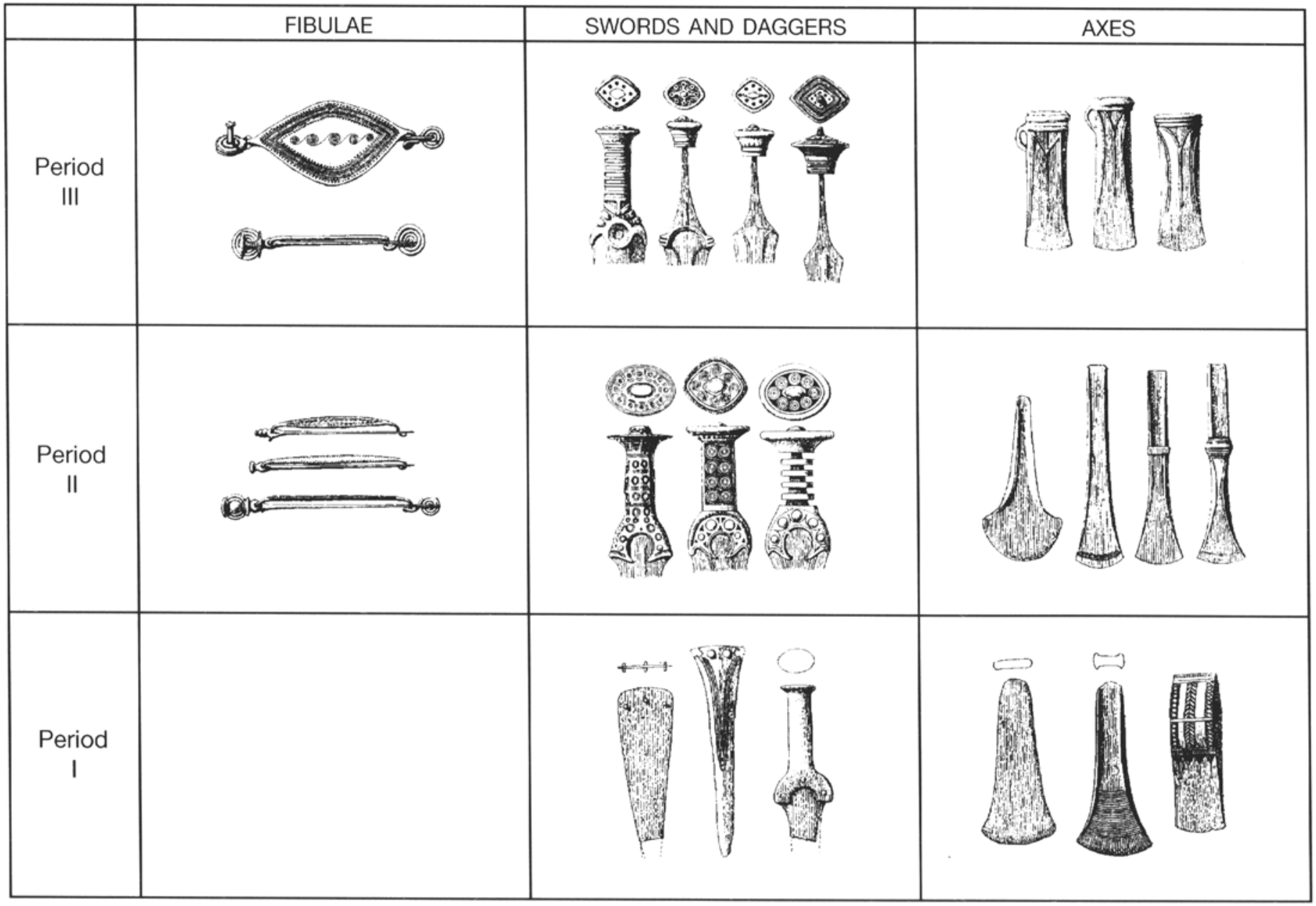

Figure 5.2 Typology as a means of constructing chronologies. The same functional types in each column develop in form from bottom to top. From their development, Oscar Montelius was able to distinguish succeeding periods of the Bronze Age in Scandinavia. Reproduced with permission of The Royal Swedish Academy of Letter, History and Antiquities.

Table 5.1 Cross-dating by means of artefacts: the reigns of Egyptian pharaohs; and correlations for the Aegean area by means of exported artefacts

Egypt			*Aegean correlations*
18th Dynasty pharaohs	*Reign length (Manetho)*	*Dates (Helck 1987)*	
Ahmosc	25y 4m	1530-1504	
Amenophis I	20y 7m	1504-1483	
Tuthmosis I	12y 9m	1483-1470	
Tuthmosis II	3y	1470-1467	
Hatshepsut	21y 9m	1467-1445	
Tuthmosis III	30y 10m	1445-1414	Late Minoan IB pot at Abydos
Amenophis II	25y 10m	1414-1388	
Tuthmosis IV	9y 8m	1388-1379	
Amenophis III	37y 7m	1379-1340	Scarab in Knossos tomb of Late Minoan IIIA1
Amenophis IV	16y 1m	1340-1324	Late Helladic IIIA2 pottery at El Amarna
Smenkhare	5y 5m	1324-1319	
Tutankhamun	9y	1319-1309	
Ai	4y 1m	1309-1305	
Horemheb	12y 3m	1305-1293	
Ramesses I	1y 4m	1293-1291	
Seti I	11y	1291-1279	
Ramesses II	66y 2m	1279-1213	LH IIIB pottery at Gurob tomb with his scarab

beginning of the Pharaonic period (about 3000 BC) (see p. 198). The correlation of Egyptian phases with Greek ones meant that dates could be derived for areas outside Egypt by the cross-dating technique via Greece to other areas of Europe. Comparable chronological systems were developed in the Near East. During the course of the nineteenth century, therefore, an Old World chronology that was roughly correct over the last 5,000 years came into being; the work of the twentieth century has largely been an enlargement and refinement of that chronology.

BUILDING UP CHRONOLOGICAL FRAMEWORKS

The evidence used to build up chronological frameworks can be either *internal* or *external*. Internal evidence is that deriving directly from the archaeological material, for instance its form, appearance, historical content (such as in an inscription), or its physical and chemical properties. External evidence is that deriving from its context, its find-spot and position, from its relationship to other material, or from its relationship to known outside events.

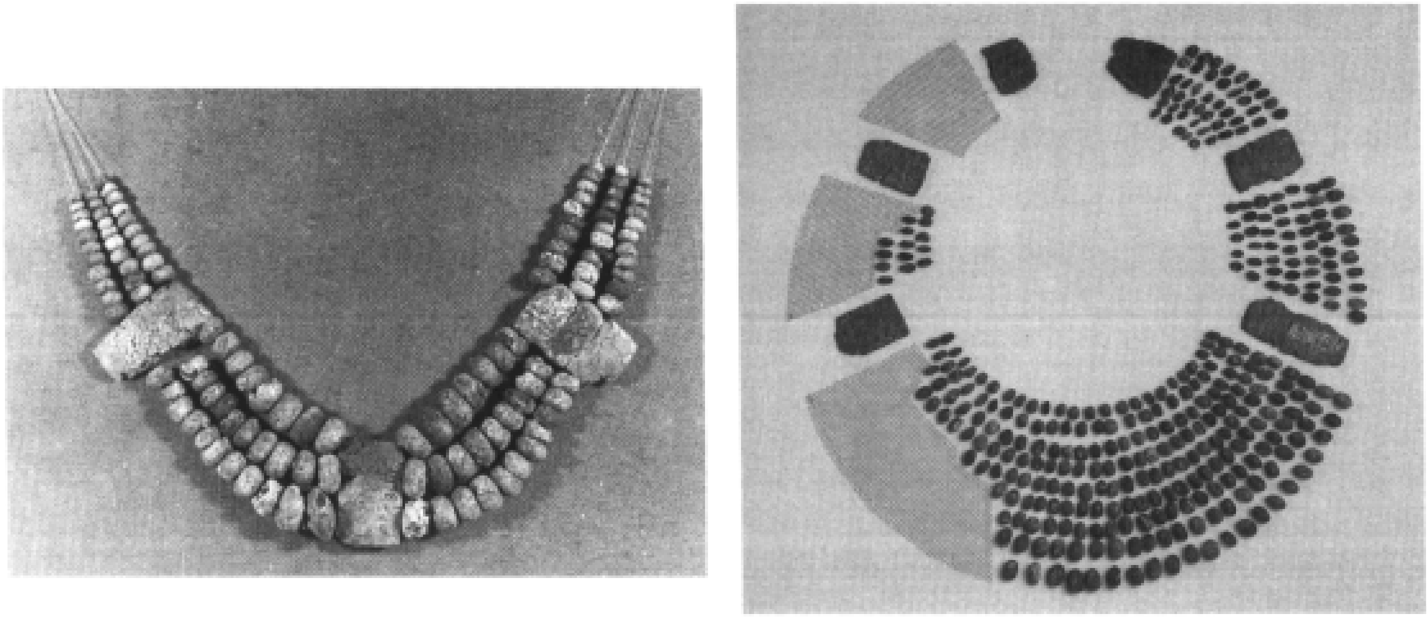

Figure 5.3 Cross-dating by means of artefacts: amber beads of identical form found in the Shaft Graves of Mycenae (left) and a burial mound in southern England (right), providing a chronological fixed point for the English material. Left: photograph of a recent reconstruction by K.Demakopoulou, appearing in O Mykinaikos Kosmos, *The Mycenean World,* catalogue no. 280 (Athens, National Archaeological Museum); right: reproduced with permission of Wiltshire Archaeological and Natural History Society.

Under the heading of internal evidence, it is possible to distinguish between *typological* evidence, which considers the form and appearance of an artefact, in whole or in part; *direct historical* evidence, where for instance an aspect of an artefact can be related directly to known historical events (for instance the head of an emperor on a coin, or an inscription on a building or tombstone); or *physical* evidence, such as the carbon-14 content of an object, or its luminescence properties. External evidence includes first and foremost *positional* evidence, referring to the context in which an object occurred—whether in a given stratigraphic layer, on a particular site, in a region or even a country. Positional evidence is heavily dependent on taphonomy, and depositional and post-depositional transformations critically affect its validity. There is also a category of *indirect historical* evidence, where known historical events may relate to archaeological phenomena, such as the possible identification of burning layers at Colchester with the sack of the town by Boudicca, queen of the Iceni, in AD 61.

RELATIVE CHRONOLOGIES

Relative chronologies place archaeological phenomena, and by implication events, in a particular relationship to each other: that is, before, contemporary with, or after. In some cases, such as stratigraphic succession, indications of priority or posteriority are all that can be determined, but with some classes of evidence, *terminus* dates are obtained (*terminus* meaning the end-point, the position beyond which an event cannot go). There are two sorts of *terminus* date: the *terminus ante quem* and the *terminus post quem*.

A *terminus ante quem* is a point *before* which something must be placed, or something occurred. If, for instance, a site is known to have been abandoned at a particular date and not reoccupied (such as Pompeii in AD 79), then all the material on that site must date prior to the abandonment, even if only by a few days. Such materials will probably have been manufactured at various times prior to this, however, but all that can be said in dating terms is that the abandonment date is the latest possible date when they could have been made: 24 August AD 79 thus represents a *terminus ante quem* for all the material found under the volcanic ash at Pompeii.

A *terminus post quem,* by contrast, represents a point *after* which an event must have occurred. Coins, and coin hoards in particular, are good examples of this: coins can remain in circulation for considerable lengths of time, and the finding of a coin in a given layer only tells us that the layer was laid down after the minting of the coin, but not by how much. Every coin in a coin hoard gives a *terminus post quem,* but only that of the latest issue in the hoard is really significant for establishing the date of deposition. A good example of this is the hoard of 1,925 silver *denarii* found near Falkirk, southern Scotland (Reece 1987:49–61). Of these, a few dated to the Republican period (before 27 BC), rather more to the early principate, large numbers to the Flavian period (69–96) and the second century AD, with a relatively small number belonging to the earlier third century—the latest is of Severus Alexander, who died in AD 235. This long time-span—well over 200 years—presents a problem for establishing dates, and to pin down a year of deposition a lot of unknowns need to be quantified, including frequency of minting in each year, purpose and destination of minted coins, value in metal terms of the coinage of different periods, distance from place of minting, and other factors. In this case it has been plausibly demonstrated that the bulk of the hoard is close in composition to a series of hoards buried in the period 193–217, and quite different to those of the period 222–38, suggesting that it had accumulated as a hoard destined for recycling in the former period, the time of the Emperor Septimius Severus. But it was not finally deposited then: it had some extra coins of the next period added and was eventually deposited after 235. What is important about this example is not the absolute dates involved, but their relative placing, and the demonstration that the deposition date was not necessarily the date of most interest.

Dating by typology

The principle of typological dating is that functionally identical artefacts vary in form over time. There are of course other aspects to this variation, most notably that variation in artefact form reflects geographical factors, for instance place of manufacture, or intentional variation on the part of the maker; that is, style— variation in style is as much a cultural trait as a temporal one. The crucial concern is to recognize meaningful variations of form; that is, variations that correspond to real variations of either time or production in Antiquity. In other words, typologies that are created by archaeologists must bear a real relationship to the intentions of the makers if spurious conclusions are not to be drawn.

Typology is the study of types, but 'types' are not a universally constant concept, and a famous article by Julian Steward (1954) was entitled 'Types of types' (see also Brown 1982; Hill and Evans 1972). His 'morphological', 'historical-index', 'functional' and 'cultural' types are of varying importance for chronological studies: 'morphological' types ('descriptive' in other workers' terminology) are defined in accordance with external appearance (that is, form) and are basically a descriptive means of reducing a given population to manageable categories. On the other hand, 'historical-index', or chronological, types also use form but in a chronological sense: form can change over time; analysis of the change enables the passage of time to be recorded. Distinguishing between change that occurs over time and diversity for other reasons, such as functional or cultural factors, is one of the weaknesses of the typological method.

Typology can be practised on any category of artefact, provided only that it shows enough variation for differences between artefacts to be studied (Fig. 5.4). It is not merely the shape or form of the object that is of interest, but also the material and its properties (for example, hardness, or chemical characteristics), the technology involved, and the context in which it occurred. Typological analysis treats objects as collections of traits or attributes (Clarke 1968) —length, colour, curvature, fabric and so on. The only elements which are not suitable are those that are common to all objects of the class; that is, are essential to an object being referred to a given functional class. For instance, we could not use the material 'clay' as a suitable attribute on which to base a typology of a pot, since all pots will be of clay, but we could take the type of temper, the treatment of the clay, or the inclusions in the clay, as being relevant to a typological analysis.

In theory a typological sequence can be constructed using almost any of these variables, but in practice it is usually the shape and decoration of an object which are used to construct a typology. In this it is important to take functionally identical objects so that, for example, plates are compared only with other plates, and not with saucers or bowls. Clarke's classic analysis of the prehistoric European pottery known as Beakers, for instance, relied partly on the change from sinuous S-shaped profile to the creation of a long neck on the vessel, and partly on the zonation and form of the decoration (Clarke 1970). A study of palaeolithic handaxes by Roe (1968) used both visual and statistical techniques to produce a series of groups and

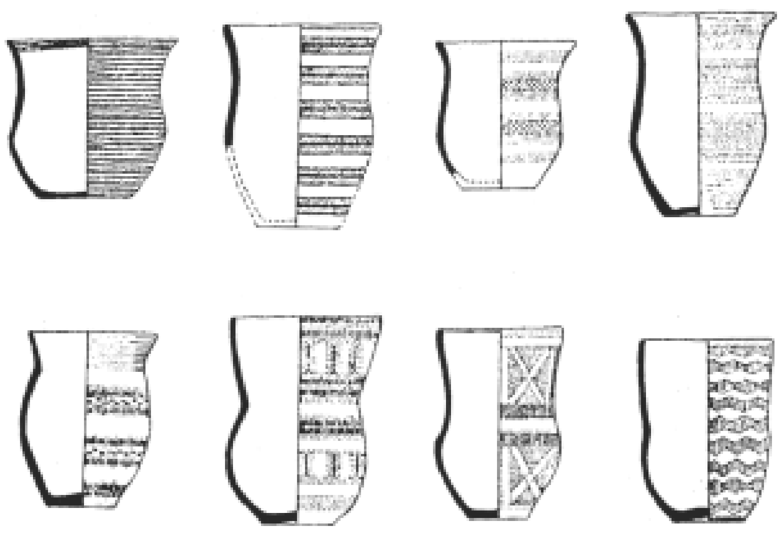

Figure 5.4 Typological series. The development of British Beaker pottery, twenty-eighth to seventeenth centuries BC. Source: Clarke 1970.

sub-groups of handaxes which had both internal consistency and chronological validity, and enabled both old and new finds to be placed in a likely chronological order.

It is reasonable to ask how types used for ordering (whether for chronological or other purposes) are recognized (Spaulding 1953; Whallon 1972). It would appear that the human eye picks out certain features that it regards as significant, and discards what it regards as incidental. Since humans vary, one can expect that typologies of identical artefact groups will also vary, and of course two people will not necessarily create identical typologies; but enough similarity exists for one to imagine that certain common pattern recognition traits exist in humans, so that the process of typologizing is not entirely a subjective art. An interesting experiment conducted by Hodson (1970) tested this suggestion: a group of archaeologists and a biologist were asked to place in order a series of Iron Age fibulae (safety pins). Although the results differed, both in detail and in basic approach, there were enough similarities between the different orderings of the material for the assumption of an in-built mechanism for pattern recognition to be reasonable.

A group of objects may be arranged so as to form a sequence of types, but without external information this cannot be dated, nor can the sequence be confirmed or modified in the light of other factors, principally stratigraphical position. This is the next step in the process of arriving at a typological dating framework. In itself, a typological sequence may be internally consistent, but it has no external reference points; one may not even know in which order the sequence goes. Comparison with contextual information may then enable such uncertainties to be resolved, though in practice it is likely that the creation of a typological sequence would have taken such information into account from the start. The incorporation of stratigraphic information into the typological sequence can thus provide a check and a calibration on the results of visual inspection.

Dating by seriation

Typology acquires an added importance when it can be combined with the techniques collectively called *seriation,* since by this means groups of individual typologies can be used together (Brainerd 1951; Cowgill 1972; Dempsey and Baumhoff 1963; LeBlanc 1975; Marquardt 1978; Robinson 1951). Seriation is the process of creating series, in this case type series, and its origin in an archaeological context is usually traced back to the Egyptologist Flinders Petrie, in his attempts to deal with the large quantities of pottery and other material found in Egyptian tombs of the prehistoric periods at sites such as Nagada and Abydos (Petrie 1899, 1901).

The method Petrie adopted was to create slips of paper a quarter of an inch wide and seven inches long, ruled in nine columns (one for each ‘kind’, or fabric type, of pottery), and to write the number of each form (or shape) of pot in the relevant fabric column for each grave, so that the whole of the pottery found in a given grave could be quickly compared with that from any other grave. He then arranged the slips into a 'seriated' order. Starting with a pot type (W, or wavy-handled vases) for which a typological sequence had already been established, those examples which occurred in graves together with another type (L, late) known to survive into later times were first segregated, and then the examples with each of the other contemporaneous types (B, black-topped; P, polished-red; and R, rough-faced), so that every example of W pottery was accounted for. Then in order to go back in time, the associations of a sixth type, C (white-cross lines), was correlated with B, P and R. Gradually more and more types were brought into play, until all 900 slips were sorted into an order that Petrie was convinced was the right one; at this stage Petrie divided all the material into fifty equal groups, and assigned to each a 'sequence date' or position in the seriated sequence.

Petrie had effectively discovered one of the main methods by which seriation of archaeological assemblages works: 'contextual seriation', which depends on the accompanying material of a given type rather than the frequency with which it is found. The alternative approach, sometimes called 'frequency seriation', depends on the principle that a given artefact type has a certain lifespan: when first introduced it is quite rare, then it gradually becomes commoner, until it reaches a peak of popularity, after which it declines and eventually dies out. If frequency is plotted on a graph against time, the resulting curve will be semi-lenticular, or lenticular (battleship-shaped) if one makes the frequency bars symmetrical about the axis on which they lie. From the succession of such frequency curves for different types, one can estimate the order and chronological position of deposits containing different pot types, and therefore make statements about the lifespan of each individual type. Naturally such a procedure will only work if there is sufficiently varied and copious material with which to work, but good success has been had especially on urban sites, where the volume of material is great and the number of closed-find deposits sufficiently large (Carver 1985; Crummy and Terry 1979).

Nowadays, of course, seriation is performed by computer analysis, but the principles which are involved are little different from those enunciated by Petrie (Ascher and Ascher 1963; Graham *et al.* 1976). There are many published examples of seriated sequences of finds data in European archaeology, ranging from the Bronze Age (Goldmann 1979) to the medieval period (Palm and Pind 1992). A typical example demonstrating the strength of the method is the work of Hodson on the Hallstatt cemetery in Austria (Hodson 1990) and the Münsingen-Rain cemetery in Switzerland (Hodson 1968); in both of these cases, a good overall sequence for the material was arrived at by judicious use of seriation, including the definition of 'horizons', and by an analysis of the horizontal stratigraphy of the cemeteries. Although these studies cannot be regarded as having established the definitive order

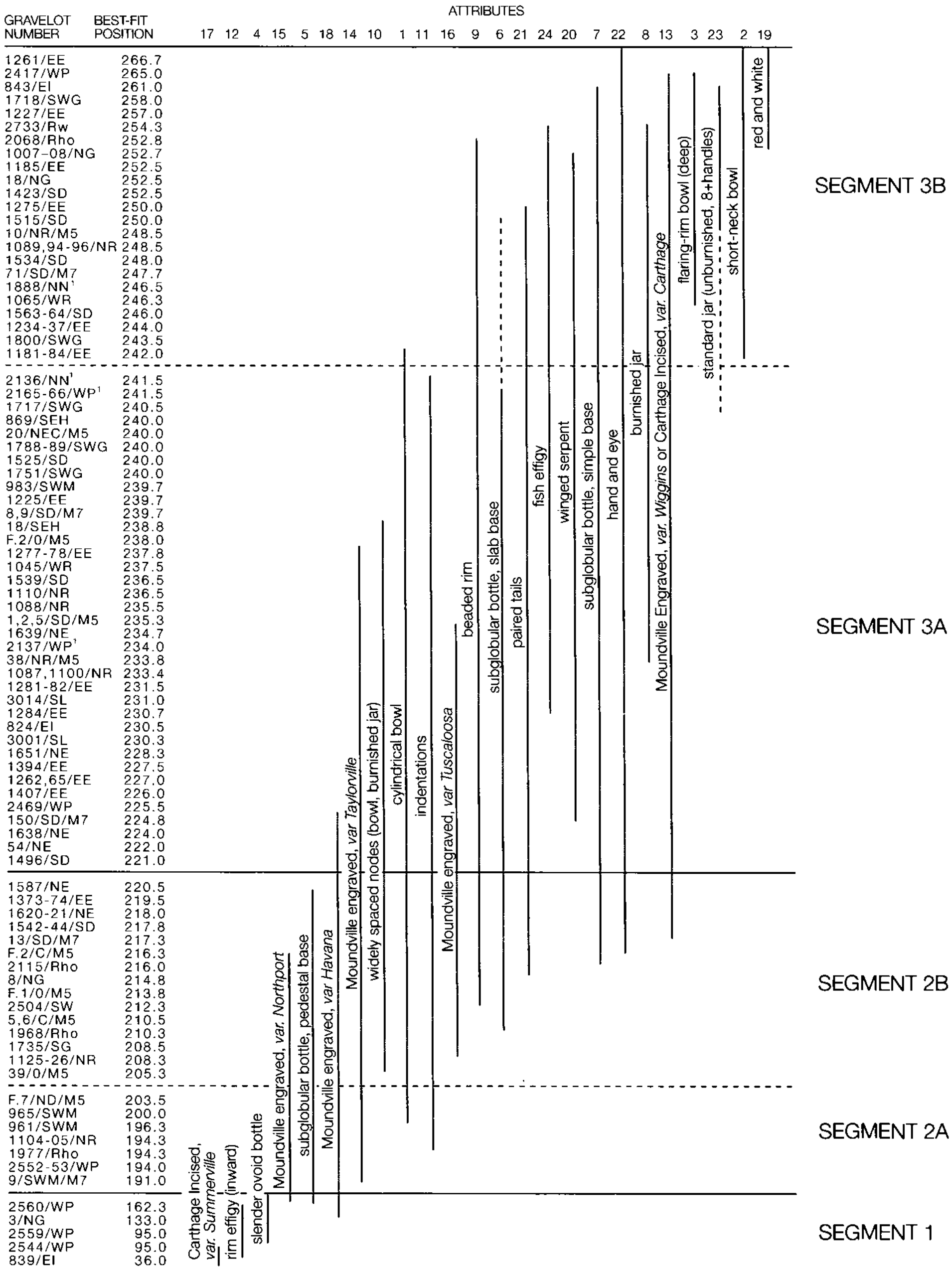

Figure 5.5 A seriated sequence of artefact attributes (pot decoration elements) from the Moundville cemetery, Alabama, the time-span of each attribute shown as a vertical line bracketing a series of graves. Source: Steponaitis 1983.

of the graves in them—that is, their real position in time—they are none the less extremely useful in pointing the way to how such things may be done in future.

A good example of seriation applied to pottery typology is the work done on the pottery from the Mississippian (pre-colonial) site at Moundville, Alabama, by Steponaitis (1983). From a detailed study of pot shapes, decoration, motifs and other features, twenty-four chronologically sensitive traits were chosen, and eighty-seven grave-groups were identified in which at least two of the traits were represented; the traits had to be present in not less than five grave-groups. Seriation was then carried out, first by calculating the 'distance' between the midpoints of each pair of traits, and then by using the technique of multi-dimensional scaling to arrange them into a relative sequence by taking the chronological 'distances' and fitting them to produce a 'map' which shows the approximate relative positions of the midpoints of the traits (Fig. 5.5). After this, the seriating or sequencing of the actual grave-groups was done by calculating a probable or best-fit position for each on the basis of the traits represented; the result was an incidence matrix of traits against graves. This was then compared with stratigraphic and radio-carbon results to produce a real chronology for the phases of the site.

ABSOLUTE DATING

The nature of the exercise of obtaining absolute dates, that is, dates fixed in time relative to the present day, is quite different from that involved in relative dating, even though as discussed above absolute dates are really only a special form of relative date. There are specific techniques and devices used for this process, which can be broadly divided into those based on calendars and those based on independent dating methods, usually those derived from the natural sciences.

Calendars

Calendars, formal devices for measuring the passage of time and fixing events in relation to each other past, present and future, must have had their origin in very simple methods of observation of natural events. Granted the need of all societies to adapt successfully to the environment so that subsistence and shelter requirements could be met, knowledge of daily, seasonal and annual natural events was essential. In many ancient societies, such natural events were early on associated with religious observations, which marked particular recurrent events in a highly formalized way. The observance of such religious focal points often became important in itself and was divorced from the natural events that gave rise to them; calendars thus provided a framework within which such observations could be carried out.

The apparent movement of sun, moon, planets and stars was for many societies an object of enduring fascination and a good guide to the seasons. A number of ancient societies acquired a good understanding of them and used them as crucial elements in calendrical systems; few ancient calendars, for instance, did not make use of lunations (the lunar cycle), and most reckoned on a system of twelve lunar months of twenty-nine or thirty days, plus a number of extra or intercalary days to make the year up to 365 days, in ancient times the commonest estimate of the length of the solar year. The advantage for modern scholars is that movements of the heavenly bodies in the past can be reconstructed, and where ancient sources record specific astronomical events such as eclipses, fixed points in the calendrical systems of the period can be obtained. Our own calendar owes its origin to the Roman, Greek and Egyptian calendars, and has evolved in unbroken succession since ancient times. In order to understand how dates are obtained for the ancient past, therefore, it is necessary to look briefly at some of the calendrical systems of the ancient world, and how they relate to our own usage.

The Christian calendar, Rome and Greece

The calculation of the date of Christ's birth was carried out by a seventh-century monk, Dionysius Exiguus, who knew that the crucifixion happened late in the reign of the Roman emperor Tiberius (died AD 37) and that Jesus must have been in his thirties at the time. He therefore set the incarnation (*Anno Domini* 1) fourteen years before the death of Augustus, 753 years from the date of the foundation of the city of Rome (see below). In fact we now know that Herod the Great died in 4 BC, so that Jesus must actually have been born in 5 or 6 BC. From the point of view of calendrical reckoning, however, what is important is the fact that all dates, ancient and modern, are calculated with reference to this point, no matter that it is incorrect and regardless of the fact that it is irrelevant to other faiths.

The birth of Christ is therefore fixed to Roman chronology, which depends partly on the Roman calendar and partly on the Roman dating system (Bickerman 1980; Michels 1967; Samuel 1972). According to tradition, the calendar originated in Rome itself soon after the city's foundation. It was based on months and therefore basically a lunar calendar, but until the Julian reform of 46–45 BC the rules for intercalating days were arbitrary, and the seasons increasingly liable to displacement from their expected position in the year. The rules adopted by Julius Caesar, which lasted until the reform under Pope Gregory XIII in 1582, also fixed the number and names of the months. The system by which the Romans fixed events in time was twofold: from early times the highest office at Rome was the consulship, held for a year at a time; the names of the consuls were recorded and gave a reference point to the historian for tying in other events. There is a complete list of consuls from 509 BC, regarded as the beginning of the Republic, compiled in definitive form during the reign of Augustus. Along with these lists there was a fixed point to which they were tied, by long tradition the founding of the city of Rome. There were various ways of reckoning this, but the consensus by the first century BC was that it fell in year 3 of the sixth Greek Olympiad, which equates with the year we call 753 BC— though some ancient authors preferred other dates.

Mention of the Greek Olympiad, the festival of Zeus held at Olympia every four years, brings further correlations. The list of victors at the Olympic Games was drawn up by the philosopher Hippias at the end of the fifth century BC. Since later authors referred datable events to Olympiad years, it was possible to reckon backwards to establish the first Olympiad at 776 BC. The fourth-century historian Eusebius, for instance, informs us that the fifteenth year of the Emperor Tiberius fell in the fourth year of the 201st Olympiad (that is, shortly before the 201st festival, in the fourth year after the 200th festival). Tiberius, we know by other means (see above) ruled from 14 AD to 37 AD, so that his fifteenth year is AD 28; 4× 200 is 800 plus 4 is 804; 804 years before AD 28 is 776 BC (comparable figures may be obtained from other calculations), which ties the Greek reckoning system into the Christian calendar. Like the Romans, some Greek cities had lists of officials, notably the Athenian archon lists which are fragmentary for the seventh and sixth centuries, but complete for the fifth and fourth centuries. Events tied in to the names of archons, as many recorded in the writings of ancient historians are, can thus be securely dated.

Egypt and the Ancient Near East

(Hornung 1964; Kitchen 1987; Neugebauer 1957, 1975; Parker 1950, 1978)

Although the origins of the Egyptian calendars are obscure, the basic elements appear to go back beyond the limits of recorded history. There were three different calendars in use: one (the civil calendar) based on day-counting and related to the annual flooding of the Nile; one based on lunar movements and regulated by the seasonal appearance of the star Sirius (Sothis); and a third, which was lunar but based on the civil calendar and used solely for religious purposes. Because of the different year-lengths involved in the civil and lunar calendars, there was a regular displacement between them. The civil year was 365 days long, divided into three seasons (Inundation, Spring or Going Forth, and Summer or Deficiency), each with four months of thirty days; five extra or intercalary days were added to make up the full year. The lunar year was, on the other hand, fixed by the appearance of the star Sirius (the 'heliacal rising': its appearance just before sunrise) which corresponds closely to the true astronomical or solar year of 365.25 days. The displacement of a quarter of a day per year, or one day in four years, led to a cycle of 1,460 years over which a given day in the civil calendar would go right through the year of the lunar calendar before returning to its original position. This is the so-called 'Sothic cycle', and it is of interest because heliacal risings of Sirius were often recorded by the Egyptians, though the cycle itself was not of such importance as was once thought. The Roman writer Censorinus records that civil New Year coincided with a heliacal rising of Sirius in the second year of the emperor Antoninus Pius, AD 139–40; this gives comparable coincidences in *c.* 1321 BC and 2781 BC (a cycle earlier, 4231 BC, falls in the prehistoric period and may well predate the system itself).

The calendars were used by the Egyptians in conjunction with record-keeping involving the regnal years and reign lengths of the kings. Three main sources inform us about these: monuments, such as a great inscription of Seti I at Abydos, where the king is shown making offerings to seventy-six of his ancestors (Fig. 5.6); papyri, of which much the most informative is the so-called Turin Canon which covers the kings of the Old Kingdom in the third millennium BC; and the writings of the third-century BC priest-scribe Manetho, preserved in the works of later writers. The combination of these sources, along with numerous shorter and more specific documents, is what leads to the establishment of the sequence of Egyptian history as we know it. Tying the sequence in to our own chronological system is a matter of some uncertainty. Two main methods are used: dead reckoning (reconstruction back from known points on the basis of reign lengths), and astronomical fixes.

The earliest securely fixed historical date that can be confirmed by independent sources is 664 BC, the accession date of the pharaoh Psammetichus I, founder of the 26th dynasty. Dead reckoning is then used to go back in time through the Early Iron Age into the Late and Middle Bronze Age, and even— with many uncertainties— the Early Bronze Age. There are numerous points in this system where for various reasons the record of regnal succession is unclear or was actually rewritten in ancient times, but for the first and second millennia BC a reasonable framework can be arrived at, which can vary only within certain fixed limits. Onto this system can be added the evidence of astronomical observations. The recording of a lunar date in the 52nd year of Ramesses II is usually regarded as reliable, and this indicates that he acceded to the throne in either 1304 or 1290 or 1279 BC; on historical grounds the first is very unlikely, and the last the most likely. Similar arguments apply to the accession of Tuthmosis III exactly 200 years earlier; and a heliacal rising of Sirius in the seventh year of Sesostris III can be pinned down to either 1872 or 1830 BC— depending on where one believes the observations were made (northern or southern Egypt).

Scepticism is expressed from time to time about the validity of this reconstruction, and it is true that it undergoes revisions from time to time; but these are generally

Image rights not available

Figure 5.6 Part of the king list in the temple of Seti I at Abydos, Egypt; each cartouche shows one king. © The British Museum.

fairly minor in nature and small in effect. It is interesting and important that available radio-carbon determinations, while not completely unambiguous, can be used perfectly satisfactorily to confirm this historical chronology. Its correctness — at least in general terms—is extremely important, as the chronology of much of the East Mediterranean area depends on it, including Bronze Age Greece where there is no independent dating system (Warren and Hankey 1989). This has led to considerable debate about the dating of certain major events.

Unlike Egypt, Mesopotamia never had a unified calendrical system; different cities had different systems, which themselves varied over time. Basically all calendars were in origin based on lunar months and solar years, with various subdivisions into seasons, which were frequently marked by festivals. Since for administrative purposes concepts such as 'harvest season' were inconvenient, years consisting of twelve months of fixed length were introduced, with a great variety of devices for intercalating days. Calculation by regnal years was also used, as were astronomical observations; the movements of the planet Venus, for instance, were a source of great fascination, and some headway has been made in reconstructing the calendar to which it gave rise, though reliable sequences back into the Bronze Age are hard to come by.

The Near East is also the part of the world where Islam originated, and the journey of the prophet Mohammed from Mecca to Medina in AD 622 (the Hegira) provides the origin point for the Muslim chronological system in just the same way as the birth of Christ does for the Christian system: thus AH *(Anno Hegirae)*.

Central America

The most famous and best understood of the American calendars is the Mayan (Lounsbury 1978); other Mesoamerican civilizations had variants of the basic structure of the Mayan calendar, notably the Aztec. The Inca calendar was based on astronomical observation, but too little is known about it for any meaningful discussion to be possible here.

The Mayan calendar consisted of a ritual cycle of 260 named days, and a year of 365 days divided into eighteen named months of twenty days each. The days of the ritual cycle *(Tzolkin)* are marked by a combination of number (1–13) and name (from a sequence of twenty). The cycle and the year ran concurrently, forming a longer cycle of 18,980 days or fifty-two years called a Calendar Round. A day would be designated by its numeral and name in the ritual cycle, along with the name of the month and the position within the month (a number from nought to nineteen, indicating days elapsed since the start of the month). Such a date occurs once in each Calendar Round. For longer periods—and the Maya were extremely interested in their past—the so-called 'Long Count' was established, using a series of periods of increasing size: one day *(kin)* —twenty days *(uinal)* —360 days *(tun)* —7,200 days *(katun)* —144,000 days *(baktun)*. Counts of these period units were then fixed to a base date, four Ahau eight Cumku, which marked the end of a round of thirteen *baktuns* in the remote past, and which can be tied in to the modern calendar to give a date of 13 August 3113 BC. The earliest date in the Mayan area, from Stela 29 at Tikal, can thus be expressed in our calendar as 6 July AD 292 (Fig. 5.7). The correlation with the Christian calendar is itself a matter both of importance and of uncertainty, the latter because notation by the time of the Spanish Conquest had changed, so that it can only be assumed and not known for sure that the sequence of *katuns* in the colonial period was continuous with that of earlier times. It is recorded that the *katun* 13 Ahau ended shortly before the foundation of Mérida in the Yucatan, and it is

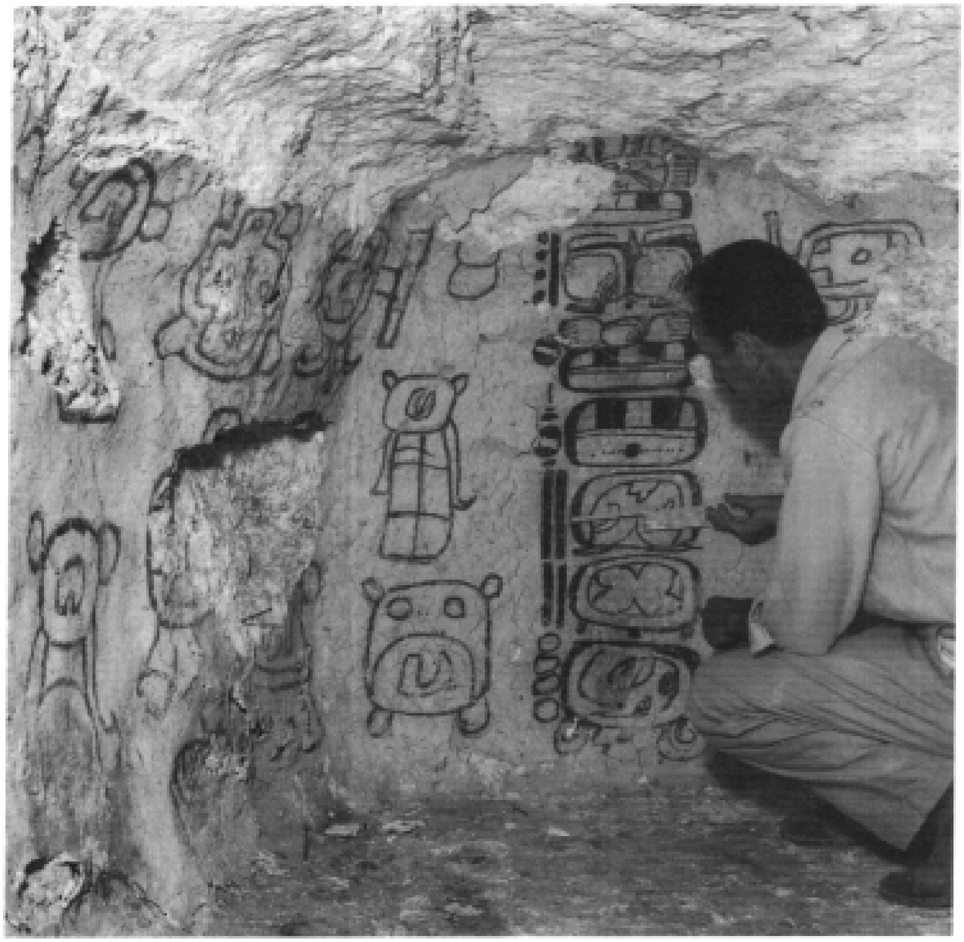

Figure 5.7 Stela 29 from Tikal, Guatemala, showing the date of 6 July AD 292. Reproduced with permission of University of Pennsylvania Museum (neg. #61–4–267).

believed by many that this corresponds to 14 November 1539 in the Christian calendar. Even allowing for such uncertainties, it is in principle possible to derive dates for historical events far back in the Mayan past by such means.

China

Calendars were established in China early, as inscriptions on 'oracle bones' of the Shang period (Bronze Age, sixteenth to eleventh centuries BC) show (Needham and Ling 1959). Both the solar year of 365.25 days and the lunar month of 29.5 days were established by this period, and a calendar based on seasons and phases of the moon with intercalary months was in use. Later, the 'meteorological cycle' was established, containing twenty-four points of seasonal significance and measured by the apparent movement of the sun through the stars. The means by which the passage of time was commonly computed was the day-count system, based on a sixty-year cycle. In this system, the Ten, or Celestial, Stems are combined with the Twelve, or Terrestrial, Branches: the Stems are repeated six times and the Branches five times (total sixty in each case), to give a unique two-character designation to each year in the cycle. This system has been in use since the Han period (206 BC–AD 200), and was combined by annalists with other indicators such as regnal years. Just as in Egypt, historiographic traditions divide rulers into groups, or dynasties, but unlike in Egypt these dynasties have continued into modern historical times, so that problems of correlation with the Christian calendar are less acute. There are many historical texts that enable this chronological system to be extended back in time. For example, the *Qian Han Shu* (History of the Former Han Dynasty) deals with the events of the last two centuries BC, and the *Spring and Autumn Annals* is the title of a chronological treatise covering major events in the eastern state of Lu between 721 and 475 BC, part of the Eastern Zhou (Chou) Dynasty (771–221 BC). There can be no more tangible example of the success of the Chinese chronological system than the way in which the mausoleum of Qin Shihuang, discovered in 1974, could immediately be correlated with its owner, who died in 210 BC.

As well as the dates in the sixty-year cycle, chronologies were also built up by 'year-periods' *(nianhaw),* basically subdivisions of an emperor's reign according to the occurrence of important events. The time elapsed since the inception of a *nianhaw* was indicated, along with the date in the sixty-year cycle, so that a double check on the absolute date is possible. Chinese historical texts regularly provide this information, so that reconstruction of chronologies is in principle quite straightforward.

Dating by historical methods

While calendars form the basis for the recording of the passage of time and therefore for the writing of histories, it is the application of histories and their accompanying calendars to archaeological material that is of greatest concern here. Dating by 'historical' methods is only possible where there is sufficient, and sufficiently precise, textual or other historical evidence with which to illuminate the archaeological material. These can include historical texts themselves—where the obvious problem is the lack of unambiguous association with archaeological contexts—or datable archaeological sources, such as coins and inscriptions.

Although there are problems associated with the use of coin dating in archaeology, there are many cases where the presence of a single closely datable object such as a coin can bring an element of chronological precision into a site or period that would otherwise be extremely hard to tie down. The medieval castle site of Hen Domen (Fig. 26.1), Montgomery (Powys) produced a single coin, a half-penny of King John (1199–1216), but the pottery indicates a wide span of time, from Romano-British (one sherd, presumably residual), through late eleventh-century Stamford ware to late thirteenth-century wares (Higham 1982). In such a wide span the coin does no more than confirm thirteenth-century occupation. On the other hand, a study of the iron age and Roman fort at Hod Hill, Dorset, shows that the sixty-two coins found on the site date mainly to the reigns of Gaius (AD 37– 41) and Claudius (41–54), with no later coins associated with the occupation of the fort (Todd 1982). While this might indicate an entirely early use of the site, caution is necessary because the emperor Nero struck no bronze coins until AD 64, with earlier issues forming the main currency up till that date; some of the pottery may indeed date later than the Claudian period. Nevertheless, granted that the Claudian invasion of Britain occurred in AD 43, the coins undoubtedly represent material brought to Hod Hill at the time of the early construction and garrisoning of the fort soon after the invasion; their only drawback is that they give no end date for this phase of occupation.

Inscriptions offer a less ambiguous source of dating, at least if they are reasonably complete: many of the difficulties associated with this area of study come from the uncertainties associated with fragmentary evidence. In the best

Figure 5.8 The Arch of Septimius Severus in Rome (left), with inscriptions datable from their contents to AD 203. Reproduced with permission of M.Millett.

Figure 5.9 Lead waterpipe from Chester, datable from the consular years to AD 79. Photograph: copyright Grosvenor Museum, Chester.

cases, as with those emanating from the Roman period, monuments can be dated precisely to their year of construction or inauguration by epigraphic evidence. Good examples may be seen in many Roman towns and cities, for instance on the several imperial arches in Rome: the Arch of Severus in the Forum (Fig. 5.8) bears on both sides inscriptions in honour of the emperor and his sons, and can be dated to AD 203 (Keppie 1991: 49–51). A less glorious but still very precisely dated example is that of a lead waterpipe from Chester (Fig. 5.9), bearing the legend 'Imp(eratore) Vesp(asiano) VIII T(ito) imp(eratore) VII co(n)s(ulibus) Cn(aeo) Iulio Agricola leg(ato) Aug(usti) pr(o)pr(aetore)': 'In the ninth consulship of the emperor Vespasian and in the seventh of Titus, Agricola being legate of the emperor with rank of propraetor' (Keppie 1991:27). This inscription is datable by the references of the consulships to an actual year (AD 79), and with its further reference to Agricola represents a significant point in the consolidation of Rome's hold over Britain in the first century AD.

DATING BY METHODS FROM THE NATURAL SCIENCES

The range of techniques now available to the archaeologist for absolute dating is considerable. Most of these techniques have been developed since the Second World War, though a few were in existence before: dendrochronology, for instance, was pioneered by A.E.Douglass in the 1910s and 1920s in the south-western United States, though its applicability to archaeology has only been exploited fully in more recent years. In practice, scientific dating techniques began in earnest with the invention of the radio-carbon dating technique by W.F.Libby between 1946 and 1950. This was soon followed by oxygen isotope dating (Emiliani 1955), archaeomagnetic dating (Thellier and Thellier 1959), thermoluminescence (Grögler *et al.* 1960), potassium-argon dating (Evernden and Curtis 1965), and a series of other methods whose value to everyday archaeology is rather less. Many introductory and advanced textbooks cover the details of these methods, and only a general outline will be provided here (Aitken 1990; Brothwell and Higgs 1969; Fleming 1976; Michael and Ralph 1971; Michels 1973; Zimmerman and Angel 1986).

Two general remarks need to be made about 'scientific' dating techniques. First, not all give absolute dates, since they themselves require some external reference point, often provided by archaeological or historical methods: archaeomagnetic dates, for example, depend on the construction of a reference curve which itself requires a chronology derived from dated contexts. Second, there is in many instances a discrepancy between the event being dated and the archaeological context under consideration. This is most obvious with radio-carbon dating, where the technique dates the point at which carbon-14 stopped accumulating in the material (typically wood), whereas what the archaeologist wishes to know is usually the date of the layer or construction in which the wood was found; the discrepancy involved can easily amount to scores or hundreds of years, or occasionally even more. This is in contrast to an 'inherent' technique such as thermoluminescence which depends on the setting of the relevant clock when the object of interest—typically pottery—was fired; this can usually be assumed to be close enough in time to the date of deposition for no difference to be discernible in practice, though in extreme cases it is possible that objects could be used for long periods, or re-deposited in much later layers, or refired.

For scientific dating techniques to be independent and absolute, they must contain the ability to be referred to an inherent 'clock', that is, a process occurring over time at a known rate, and if possible referable to terrestrial years and therefore a calendrical time-scale. One type of clock is that based on isotopic decay, the process by which unstable isotopes convert to other isotopes, stable or unstable, measured in terms of half-life (the time taken for half the original radioactivity to be achieved). Since this half-life is expressed in terrestrial years, absolute dates referable to human history may be obtained. Another type is cumulative, by which a given process on repetition brings about an increasing quantity or intensity of some phenomenon: patina or layering, for example, on the outside of some materials, or electron-trapping in the case of luminescence or electron spin resonance dating techniques. Provided that the amounts can be accurately assessed and the rate of increase is known, age estimates are possible, as in both cases the condition of the dating clock is proportional to age.

Dendrochronology

The principles of dendrochronology or tree-ring dating (Baillie 1982, 1995; Becker *et al.* 1985; Eckstein *et al.* 1984) are well-known and easily understood: most trees lay down a growth ring every year, the thickness of which depends on environmental factors prevailing at the time (principally temperature and precipitation). A series of year-rings thus constitutes a 'signature', and the greater the number of rings (that is, the longer the period), the less likely it is that the signature could be repeated by chance. By building up a series of overlapping signatures, a complete sequence has been established for a number of locations in western Europe and North America, going back between 7,000 and 10,000 years, depending on region. When wood of the appropriate species (in Europe usually oak), and with not less than 60–100 rings, is found in archaeological contexts in areas where a master curve exists, it can be tied in to the established sequence, often giving exact dates for the felling of the trees involved. The technique has shown its worth in a number of studies, for instance the analysis of Tsegi phase sites in north-eastern Arizona, in many studies of medieval buildings and artefacts, and in the chronological definition of the prehistoric sequence in the sub-Alpine region of Europe (see pp. 214–15).

Radio-carbon dating

The technique of dating using the radioactive isotope of carbon, carbon-14, is so much the most widespread of all scientific dating techniques in use today that it must inevitably take pride of place in any discussion of methods (Bowman 1990; Gillespie 1984; Gowlett and Hedges 1986; Libby 1955/1965; Mook and Waterbolk 1985; Taylor 1987). Although much depends on quality of context and suitability of samples, it is possible to obtain results that are fully satisfactory in terms of precision and accuracy for many periods of the past. The highest precision currently obtainable is usually quoted at ±0.25 per cent of age or better, though dates of this precision involve relatively large samples and long counting times, and are not carried out on routine archaeological samples. Such error terms are satisfactory for many periods, but not of course those where historical dating allows a more refined chronology, or where the calibration curve (see below) is very flat. In fact the uncertainties deriving from the archaeological context are often very much greater than the error terms on the date itself, and high precision dating is for this reason most often carried out on samples whose local context is not in doubt, for instance on the rings of sub-fossil trees as part of the process of establishing the radio-carbon time-scale (see below). Nevertheless, error terms of ±50 years in the radio-carbon age at the 68 per cent probability level provide perfectly acceptable dates for many periods of the past, especially the prehistoric and early medieval periods.

Carbon-14 is produced in the upper atmosphere as a result of the interaction of neutrons produced by cosmic rays with nitrogen-14. Thereafter it becomes mixed with ordinary carbon, carbon-12, and with carbon-13, and behaves chemically in a very similar way, so that it is taken up by all living organisms at a fixed proportion of the total carbon. Because the half-life of carbon-14 at 5,730 years is much greater than the lifespan of the organisms themselves, its decay back to nitrogen-14 provides an effective means of estimating the time elapsed since the formation of the organism, and by a fortunate chance, a half-life of around 5,000 years means that the method is well suited to estimating ages for the later prehistory and the historic periods of both Old and New Worlds—in other words, the last 20,000–30,000 years. In the laboratory, the amount of radioactive carbon is measured, either directly by means of atom counting using accelerator mass spectrometry, or indirectly by detecting the emission of beta particles, themselves a reflection of the amount of the unstable isotope C14 remaining in the sample. Since this in turn bears a fixed relation to age, an age estimate can be obtained.

Because the production of carbon-14 in the upper atmosphere has not been constant over time, the amount taken up by living organisms has also varied slightly and so the age estimates obtained are somewhat at variance with true calendrical ages, as known from tree-ring data. A correction, or rather calibration, therefore has to take place before the age can be used in conjunction with other sources of dates. Recent work on the radio-carbon technique has concentrated above all on refining the calibration curve, particularly by means of the high-precision dating of tree-ring samples (Pearson and Stuiver 1986; Stuiver and Pearson 1986). As a result, computer-based calibration programmes are now available so that, for at least the last 7,000 years, radio-carbon age estimates can be converted into historical age ranges at stated probability levels (Fig. 5.10). It is important to realize that radio-carbon dates produce age ranges and not absolute fixed dates, since the process of radioactive decay is a random one and the counting of beta emissions is therefore subject to statistical uncertainty. The process of calibration can also produce more than one possible age range, because the calibration curve is far from straight: it is 'wiggly', and in some periods where the wiggles are particularly pronounced a given radio-carbon age can provide several possible calendrical ages. An example is the period from 800 to 400 BC: any radio-carbon age of between about 2,500 and 2,400 years can only give a historical date within the 400-year time bracket 800–400 BC, a serious drawback for using the method in that period (the end of the Bronze Age and the first half of the Iron Age in Europe).

On the other hand, the very fact that the calibration curve is 'wiggly' means that where the samples to be dated can be placed in a fixed relationship to each other, the technique of 'wiggle-matching' can be used. For instance, if a piece of timber, whose absolute age cannot be determined dendrochronologically, is used to obtain radio-carbon ages, the resulting curve of plotted dates can then be fitted to the master calibration curve in the position where the wiggles best fit against each other. The same process can be carried out by dating samples from each phase of a long-lived site and making estimates of the length of the phases (Manning and Weninger 1992).

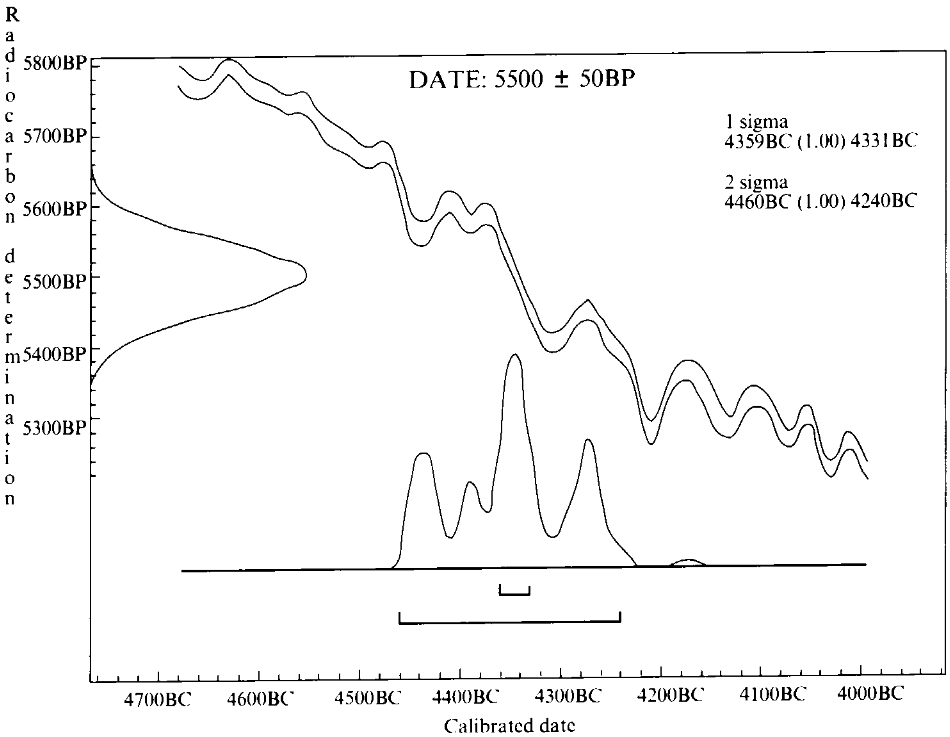

Figure 5.10 A segment of the radio-carbon calibration curve, illustrating the calibration of an age 5500 ±50 BP, according to the OxCal calibration programme. The calibration curve is represented by the double meandering line running top left to bottom right; on the left is the distribution of values obtained during the counting process, centring around 5500; at the bottom is the probability distribution of the calibrated date ranges indicated; below that, the bars represent 1 and 2 sigma standard deviation curves respectively, with the values they indicate shown top right. After M.Stuiver, A.Ling and R.S.Kra (eds) (1993) 'Calibration 1993', *Radiocarbon* 35 (1). Redrawn by D.Miles-Williams.

Luminescence dating

Luminescence dating (Aitken 1985; Fleming 1979) depends on the fact that minerals in archaeological materials, such as pottery, are exposed to a weak flux of nuclear radiation emitted by radioactive impurities in the materials themselves and in the surrounding soil. Electrons thus liberated within the crystal structure by the action of ionizing radiation are trapped in the crystal lattice of the material. If the material is then heated rapidly, a weak emission of light results—the so-called *thermoluminescence* (TL), which is proportional to the cumulative radiation dose and the sensitivity of the minerals in acquiring TL. In cases where one can assume that the TL 'clock' was set to zero by a previous heating, for instance the firing of the pot, burning of stone and so on, an estimate of age for an archaeological event can then follow. The eviction of electrons, zeroing the clock, can also be achieved by exposure to light such as sunlight, which means that the technique can be used on unburnt materials in certain circumstances, such as sediments (*optically stimulated luminescence,* or OSL).

This brief sketch does not do justice to the complexities of the technique, which are considerable. Over the last thousand years, however, the accuracy is comparable with radio-carbon, and beyond the limit of radio-carbon calibration (*c.* 10,000 years) the technique gives an absolute age estimate, which radio-carbon cannot. A good example of this is the series of dates for the Middle Palaeolithic which have allowed at any rate a partial solution to the chronological problems of that period (see pp. 213–14). One might also hope that for periods where the radio-carbon calibration curve allows several possible ages, luminescence dating will step into the breach, for instance the Early Iron Age in Europe. Notable success has been achieved in the dating of medieval pottery, notoriously difficult to pin down in terms of archaeological and historical context and lifespan.

The related technique of *electron spin resonance* (ESR) (Grün 1989) relies not on the eviction of electrons from traps in the crystal lattice, but on their response to high-frequency electromagnetic radiation in the presence of a strong magnetic field, which is slowly changed. For a given frequency the electrons resonate (and absorb electromagnetic power) at a certain value of magnetic field. The greater the absorption, the greater the age. Good results have been obtained by this method on flint, tooth enamel, bone, and stalactite and related material.

Magnetic dating

Magnetic dating (Eighmy and Sternberg 1990; Tarling 1983; Wolfman 1984) depends on the fact that archaeological materials such as clay contain iron oxides as impurities; these become weakly magnetized by the earth's magnetic field at the time of their last zeroing; that is, when last heated—in an archaeological context, this usually means firing or burning. Since the direction of the magnetic field changes slowly over time, a curve of varying direction can be built up and dates assigned to archaeological objects depending on where on the curve the magnetic direction of objects falls.

The technique does not produce absolute age estimates, but depends on the existence of an archaeologically calibrated curve, based on a series of closely dated samples. Unlike radio-carbon, the technique is geographically limited, so that a separate curve has to be built up for each separate area (1,000 kilometres is usually taken as the geographical limit of the method). It also suffers from the disadvantage that the same value can be obtained from samples of widely different age as the curve can cross back on itself. Nevertheless, in many instances good results have been obtained. It will be evident that, in order for a sample to be dated, its exact position during heating must be known, so that the magnetization acquired at that time can be assessed. This means that pots cannot themselves usually be used, since neither the inclination nor the declination of firing (that is, the angle or position in which the pot was put in the kiln) can be known. Instead, fixed installations such as kilns or hearths must be used, assuming that their bases and walls have remained intact since deposition. A series of kiln sites from the Iron Age to the medieval periods in Europe has been dated in this way, sometimes to a high degree of precision. Sediments also become magnetized in the same manner, though it will be evident that here it is much more difficult to obtain an independent dating framework to calibrate the curve of magnetic change. There have also been applications to coinage and other materials.

Other methods

A considerable number of other scientific dating methods have been utilized in the service of archaeology, but their details will not be presented here as for the most part they are either insufficiently reliable or insufficiently widely used for a detailed presentation to be worth while (Aitken 1990). Exceptions, where good results have been obtained even though the archaeological applicability is somewhat limited, include uranium-series dating, ice-core dating (preserving climatic data and records of volcanic eruptions, tephrochronology (Thorarinsson 1970), and varve and lake sediment dating, where the annual deposition of glacial meltwater or particulates from spring floodwater lead to the possibility of long datable sequences. Only rarely are archaeological materials directly associated with these phenomena, but they have been found to be useful in conjunction with other methods, particularly radiocarbon, for building up a detailed cross-correlated sequence.

APPLICATIONS, PROBLEMS AND SOLUTIONS

The various techniques outlined have enabled various long-standing problems to be solved, though others remain. In some cases, radical revisions of traditional chronologies have led to controversy, which only the discovery of fresh data is likely to resolve. Four important examples are illustrated below.

The peopling of the Americas

(Fiedel 1987:47–81)

Since the 1930s it has been known that hunters of big game were present in what is now the southern United States at a time that was contemporaneous with the latest period of the last Ice Age, when continental ice sheets covered the land further north. The finds from Blackwater Draw near Clovis in eastern New Mexico were regarded as typical of the cultural complex of these hunters of bison and mammoth, and no find complexes could be shown to be earlier, stratigraphically or otherwise. With the advent of radio-carbon dating, the start of sites of this complex could be attributed to the period between 12,000 and 11,000 before present—very late in global terms for the peopling of a huge continent, when much of the rest of the world had been occupied for hundreds of thousands, or even millions, of years. In general it is not in doubt that humans arrived in the Americas overland via the Bering Strait at a time when there was a land bridge between Siberia and Alaska. The question is, when? Since sea levels have fluctuated with climate, and the land bridge would have been present in glacial periods previous to the last one, why should the colonization not have taken place much earlier?

Over the years, a number of excavators have found remains that they have claimed to represent evidence of human presence earlier than the Clovis period. Of these, some are not very plausible and others can definitely be discounted, but the work at Meadowcroft rock shelter in south-west Pennsylvania is a different matter (Adovasio *et al.* 1990; Carlisle and Adovasio 1982). The site is well stratified and has been carefully excavated, yielding a sequence of radio-carbon dates in correct stratigraphical order. Dates for layers earlier than the first occupation are in the region of 31,000 BP, and those for the Palaeoindian layers with definite cultural associations lie shortly after 13,000 BP. Discussion centres on a small number of dates that fall earlier than this last date, going back to around 21,000 BP. Critics have remarked that the scarce material associated with these layers looks very like that found in much later layers, and have expressed surprise at the lack of big game bones that one would expect from a late Pleistocene site. Plant remains are also of types that grow in temperate areas, even though the ice sheet was no further away than 75 kilometres.

Another site that has been regarded as a likely candidate for an early presence of humans in the Americas is Monte Verde in southern Chile (Dillehay 1984), an open-air residential site with a series of huts. The upper layers seem to contain evidence of human habitation at about 13,000 before present, while the deeper layers contain possible artefacts dated at 33,000 BP. Needless to say, this association has attracted as much scepticism as all others of comparable age, and all that is safe to say is that Monte Verde and other sites like it have produced clear evidence of a pre-Clovis presence in South America.

The problem in these cases is not the accuracy or otherwise of the techniques being used: the only methodological doubt relates to the possibility of contamination of the samples involved by natural processes. What is at issue is the relevance of the dates to the layers and artefacts involved, and indeed the appropriateness of the artefact suites to the ages and cultures concerned. Establishing an archaeological chronology in these cases thus depends on the progress of excavation and discovery, though even then it is easier to see how the matter can be resolved positively than negatively: either undisputed early layers and artefacts will be found, in which case doubt will be removed; or they will not, and doubt will continue. In such a case it is up to archaeologists to ensure the maximum possible chance of unambiguous results being obtained through choice of site and efficiency of digging techniques.

The Middle Palaeolithic of France

The classic sequence of stone industries in France in the Middle Palaeolithic has been a matter of intense debate for a number of years (see Chapter 20). The various industries called Mousterian were originally defined by Bordes, and divided into the Ferrassie, Quina and Mousterian of Acheulian Tradition (MTA) industries, to which can be added 'typical' and 'denticulate' Mousterian. In the opinion of Laville (1973), these different aspects of the Mousterian were produced concurrently throughout the Mousterian and are to be attributed to the presence of different human groupings living in south-western France during the period, while the chronology of the period is to be reconstructed on the basis of 'chronostratigraphic' correlations using mainly sedimentological and other palaeoclimatic data. Mellars (1988), on the other hand, believes that there is a high degree of separation and chronological patterning in the occurrences of the three variants: in other words, that one succeeds another in chronological succession with relatively little overlap. The two interpretations imply radically different views of the Middle Palaeolithic, and strong arguments have been adduced on both sides. Which is correct?

Absolute age determinations using thermoluminescence have been obtained on the long sequence from the lower cave at Le Moustier, covering the whole of the period in question. The dates are internally consistent and agree closely with the stratigraphic sequence from which the samples came. They show that a relatively rapid deposition of sediments occurred, with MTA industries preceding the 'typical' Mousterian. In particular, they contradict the alleged evidence of sedimentological and palaeoclimatic data which purported to show that the main sequence of Ferrassie and Quina Mousterian industries at Combe Grenal was synchronous with the long sequence of MTA industries at Le Moustier. In fact, they agree well with the long stratigraphic sequence at Combe Grenal, with clear indications that the three Mousterian variants were stratigraphically separated. TL has thus been used to provide what seems to be a clear solution to a long-standing source of controversy.

Dendrochronology of the European Neolithic and Bronze Age, and of the Tsegi phase of Arizona

The rapid advances made in dendrochronology in recent years mean that a complete tree-ring sequence for central and western Europe has been developed back to 10,000 BP. With the finding of numerous timbers on sites of the Neolithic and Bronze Age, an accurate and agreed chronological framework is now possible (Becker *et al.* 1985). Some uncertainties remain, especially in periods from which few timbers emanate, but in general the picture is reasonably clear. This is due above all to work on sites in the sub-Alpine region, especially Switzerland and south-west Germany, where shallow lakes preserve hundreds of prehistoric settlements; good results have also been obtained from Ireland and Britain. The earliest Neolithic cultures in Switzerland were the Cortaillod in the west, Pfyn in the east. Felling dates for trees used in settlements of this period are between 3867 and 3507 BC, with an early and a late phase clearly distinguishable. The Late Neolithic Horgen culture falls between 3405 and 2958 BC, the Corded Ware culture between 2705 and 2499 BC, the Early Bronze Age (a late phase of it, according to the pottery) between 1665 and 1499 BC, and the Late Bronze Age between 1068 and 847 (divisible into an early phase, 1068–1033, and a late phase, 910–847).

These crude divisions may be seen in rather more detail when one looks at an individual site, where constructional phases may be assigned to close date ranges, or even individual years. At Zürich-Mozartstrasse, for instance, the early neolithic houses were constructed in 3661 BC, the Late Neolithic in 2883, the first Corded Ware houses in 2700, and a large number of such houses in 2697–2673, 2617, and 2604–2599. In the last case, none of the timbers was over fifty years old; presumably mature oaks were no longer available in the immediate vicinity of the site. At Auvernier on Lake Neuchâtel in west Switzerland it has also been possible to distinguish separate building phases according to the results of the dendrochronological analysis.

This type of work was pioneered in the USA, and a study by Jeffrey S.Dean (1969) is rightly seen as an example of what can be achieved in the building-up of site chronologies by this means. The extraordinary ‘cliff dwellings’ of the Tsegi Canyon of Arizona have much wood preserved; at Betatakin Cave, several hundred wood samples were taken and nearly three hundred were analysed dendrochronologically. As a result, it was possible to show that individual clusters of rooms were constructed in particular years: AD 1267–68, 1275, 1276, 1277, 1278, and after 1280. The phased plan thus shows that initially two concentrations of rooms existed, at either end of the site, perhaps as colonizer groups established occupancy at the cave; in 1269, much timber was felled but not used immediately; and then in the later 1270s the site was greatly enlarged and the stock-piled timber utilized. What tree-ring data cannot tell us is when the site was abandoned, but here other sources come to our aid, and a desertion date of around 1300 is likely to be close to the truth. These and other comparable examples have introduced an extraordinary degree of clarity into discussions of prehistoric and ahistoric settlement archaeology.

The dating of classical Greek archaeology

Classical archaeology depends more than most other forms of the art on the interrelationship between known and datable historical events and art styles, often those of an individual artist. The progress of research over many years has painstakingly built up valuable sequences for such differing artistic media as sculpture, architecture and vase painting. As Greece emerged into the historical Iron Age, a sequence of styles was created. Thus the Geometric style had given way to Protocorinthian by *c.* 725 BC, and to Corinthian by 625 BC. At the same time, the technique of Black Figure began to be used in Athens, lasting down to the first quarter of the fifth century BC. By around 530 BC the Red Figure technique was developed, and held sway throughout the fifth and into the fourth centuries. A comparable sequence is known for other art forms.

What is the basis of this chronology? It depends on a number of fixes provided by known historical events, such as the founding of Greek colonies, political events, or the creation of specific buildings. For many years one of the mainstays of the traditional scheme was the evidence of the great mound in the plain of Marathon in Attica, traditionally assumed to be the mound erected by the Athenians over their dead after the great battle with the Persians in 490 BC (Herodotus, *Histories* Book 6, 117.1). Excavation in the mound produced, along with ashes and human bones, Black Figure vases and a single Red Figure sherd, stylistically not among the earliest examples: 490 BC must be a *terminus ante quem* for these finds, assuming that they are undisturbed (not an altogether safe assumption). Another linchpin in the chronology is the foundation of the Siphnian Treasury at Delphi, which we know from Herodotus must have occurred around 525 BC. The architectural elements and finds of this building ought, if the building has been correctly identified (epigraphic evidence does not help with this), to date to the years before this.

That these matters are not foregone conclusions can be seen from the fact that through the 1980s controversy over the very foundations of classical chronology has raged, with the publication of a series of articles challenging these assumptions (Cook 1989; Francis and Vickers 1983, 1988). Although the consensus of opinion is that the traditional chronology is more likely to be correct than the revisionist (Biers 1992), it is none the less salutary to be reminded how flimsy the evidence for some parts of the dating really are. Even for so well known a period historically as fifth-century BC Greece, the evidence of typological dating is always capable of refinement; and unless there are secure synchronisms, for instance by means of coins or inscriptions, few absolute dates can be regarded as certain.

CONCLUSION

Establishing chronologies is considered a natural, indeed an indispensable, activity for an archaeologist, but as this chapter has described, is often far from being a straightforward matter. Depending on period and area, there are many potential methods that can be used, singly or in combination. What is essential for the creation of a durable chronology is not only luck in the discovery of appropriate material, but also a sufficient understanding of the methodological underpinning of the various techniques. The progress of research in recent years has meant that many previously impenetrable periods are now brightly illuminated. Although 'chronologizing' is still not a precise art, it is nevertheless a technique with sufficient ground rules and sufficient available independent sources of evidence for rapid progress to be possible wherever suitable material is found. One can expect many of the chronological problems of today to be solved quite quickly tomorrow as material becomes available for study. At that point, the study of chronology should assume its proper place—as a means to an end, not an end in itself.

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A useful book with chapters on various aspects of dating in archaeology is *Problems and Case Studies in Archaeological Dating,* edited by Bryony Orme (1982). Although not now the most up-to-date book on the various techniques, the four contributors offer exemplary analyses of their various special areas: the use of radio-carbon dates; dating in the Roman period, and specifically for Hadrian's Wall; and dating in medieval archaeology. A number of recent conference publications have dealt with specific chronological problems and the various ways of approaching them, including the three volumes of *High, Middle or Low*?, edited by Paul Åström (Gothenburg 1987) and the two volumes of *Chronologies du Proche Orient, Chronologies in the Near East, Relative Chronologies and Absolute Chronology 16,000–4,000 B.P.* (British Archaeological Reports International Series 379, 1987). Much more problematical, though at the same time with a much higher profile, is the book *Centuries of Darkness* by Peter James in collaboration with I.J.Thorpe, N.Kokkinos, R.Morkot and J.Frankish (London: Jonathan Cape 1991). The book proposes a radical down-dating of Egyptian chronology between 1300 and 800 BC, though these proposals have not found much acceptance in the scholarly world. Biers (1992) provides a very useful (if overly concise) introduction to the chronology of classical Greece and Rome, and see also Bickerman (1980) and Samuel (1972). Aitken (1990) is an excellent recent general guide to science-based dating techniques in archaeology, though simpler texts are those published by the European Science Foundation and the British Museum, such as Bowman (1990). Whallon and Brown (1982) provide a good collection of essays that discuss the principles behind the typologizing. Seriation techniques have mostly been presented in articles, but the accounts in chapter 5 of J.E.Doran and F.R.Hodson, *Mathematics and Computers in Archaeology* (Edinburgh: Edinburgh University Press 1975) and chapter 12 of S.Shennan, *Quantifying Archaeology* (Edinburgh: Edinburgh University Press 1988), provide convenient accounts in book form.

6

RECONSTRUCTING THE ENVIRONMENT AND NATURAL LANDSCAPE

Tony Brown

INTRODUCTION

The natural landscape is a relative concept: not only do cultures and individuals have differing views of what is natural and what is not, but these views have changed over time. The way we see our place in the 'natural order of things' is also culturally determined, as is demonstrated by differing views of calamity (Hewitt 1983). Although this affects how we conceptualize past nature-culture relationships, it does not prevent us from utilizing a battery of techniques derived from the natural sciences in order to reconstruct the physicality of past landscapes. This chapter aims to outline the many methods currently used in the reconstruction of natural landscapes and illustrate their archaeological application. Because this is a vast field of research, which includes many different disciplines, it is impossible to be comprehensive, either globally or temporally, so examples will be restricted to north-west Europe, the Mediterranean basin and North America.

An arbitrary but workable distinction between the natural and the cultural is that the natural is that which is not predominantly a human creation and which is not dependent upon human activity for its functional continuation. If we apply this definition in a temperate environment, heather moorland should be classified as cultural because it was created by human activity and requires regular management for its continuation, whereas most salt marshes would generally be regarded as natural. Although it can be argued that all environments have to some extent been influenced by human activity, the continuation of heather moorland, the salt marsh, and even the arable field, is also dependent upon ecological processes. This is why the techniques described in this chapter are not only useful for reconstructing past natural landscapes, but also past cultural landscapes: the argument is elaborated in Chapter 14 (Food and Farming), where the focus is more on the relationship of culture to nature, of human interactions with environment and landscape, but where the contribution of techniques developed from the natural sciences is again profound.

The traditional Western model of the nature-culture 'dichotomy' is evolutionary, with *Homo sapiens* evolving from a natural world; it is epitomized by our views of 'wilderness' as something outside and to be conquered (Ingold 1986). The gatherer-hunter is often portrayed as being in harmony with the natural landscape, with the development of agriculture often assumed to represent a retreat of the natural and an expansion of the cultural, the process further exaggerated by urbanization. Thus it needs to be appreciated that 'ecofacts', the data of environmental archaeology, just like other facts, do not speak for themselves: they have to be interpreted and related to paradigms of the past.

SITE POTENTIAL: ASKING ANSWERABLE QUESTIONS

Any attempt to reconstruct natural landscapes has to begin with two questions. First, what do we wish to know about the past, given that we cannot know everything? All reconstructions are partial, so we need to decide which parts of the natural landscape have most archaeological importance; the answer to this will depend upon our archaeological interests and models. Second, given the present or near-future state of technology, and the nature of the site or landscape, what *can* we reconstruct? Sites and landscapes have different potential for environmental reconstruction. The answers to these two questions will vary from generation to generation as archaeology changes and as new techniques become available. (The term 'site' is used here, and throughout this chapter, to refer to any location where geoarchaeological techniques have been, or could be, used which may or may not contain artefacts.)

The origins of environmental work in archaeology lie in Quaternary geology and biology, particularly interest in glaciation and climate change (West 1977). The significance of techniques such as macrofossil analysis, pollen analysis, molluscan analysis and so on was not widely appreciated by archaeologists until the 1950s and 1960s and the work of Zeuner, Butzer, Godwin, Dimbleby, Troels-Smith and others. From the late 1960s onwards, we can see a parallelism between environmental science and the New Archaeology through the emerging use of systems theory (Clarke 1972). The role of geography, including human geography, is important here, as it was one of the main stimulants to the uptake of quantification and pursuit of process that characterized the New Archaeology (Haggett 1965; Hodder and Orton 1976).

It is worth while looking at the reasons for undertaking work on environmental reconstruction. The first is to predict (*sic* retrodict) past environmental controls (which may be geological, biological or climatic) on human activity. The second is to describe the impact of past peoples on their landscapes. The two reasons are obviously not independent, since it is the manipulation of natural resources that changes human environments and creates landscapes. It is important to take a wide view of what constitutes a resource, and to include space (that is, land), plants and animals, soils, water and minerals. This presents a problem, because it is difficult to think of any natural substance that has not, at one time or another, been used by human beings for something—even hazards are best conceptualized as negative resources which affect human living conditions.

Ideally archaeologists would like to reconstruct most, or all, of the important resources available to a population at any one 'time-place'. This would include aspects of the geological/geomorphological environment, the flora and fauna, and the local climate—what Butzer (1982) has termed the 'primary study components of geoarchaeology'. This involves an understanding of site formation and destruction processes (Vita-Finzi 1978) and the reconstruction of local vegetation and faunal history. No site, or even set of sites, is ever likely to allow such a comprehensive approach, because the conditions favouring the survival of some evidence will invariably destroy other categories of evidence. There are three reasons for this: natural taphonomy, variations in the ecological information-content of species, and archaeological uncertainty. If we have no direct evidence of use, we can only reconstruct potential resources: a butchered reindeer carcass at a site is evidence of a resource, but a spring near a site is only a potential resource, as resources are 'subjective, relative and functional' (Zimmerman 1951).

In order to understand the potential of any site, the preservation potential (or taphonomic potential) of different data types must be known. This is of most relevance to biological materials. The norm is of course for organic matter not to be preserved, but to be continually broken down as part of biogeochemical cycles. Organic matter suffers physical destruction through abrasion and crushing, most commonly in high energy environments such as steep gravel-bed rivers, least commonly in low energy environments such as a lake or tar pit. However, many high energy environments are also very changeable and so if the item is large enough (a tree-trunk, for example) it may be preserved if burial is rapid. Thus tree trunks and dugout boats may be relatively common in river gravels, but fragile plant remains are rare except in low-energy traps such as abandoned channels.

All organic materials will decompose if the conditions are suitable, and after enough time. The process is accomplished initially by macro-organisms, and subsequently by micro-organisms such as bacteria and fungi. The result is the breakdown of complex organic molecules such as cellulose and proteins to simpler substances, a process called mineralization. Therefore the sites of particular value for environmental reconstruction are those where for some reason mineralization has been slowed down or effectively stopped. There are four major limits on microbiological activity: extreme cold, desiccation, waterlogging, and unfavourable chemical conditions.

As the frozen mammoths from Siberia illustrate, freezing can preserve carcasses for thousands of years, whilst the discovery of the prehistoric 'Ice Man' preserved in a glacier on the Italian/Austrian border shows how valuable a rather atypical combination of circumstances and environment may be (Spindler 1993). Since micro-organisms cannot survive without some water, desiccation also preserves organic matter. It is not accidental that most of the desiccated material that has been recovered had been naturally buried or hidden in tombs, such as human remains (see Chapter 7), or crop remains: the physical forces of destruction are also strong in these environments, and aridity produces low biological productivity. The most important processes for most archaeologists are those caused by waterlogging and to a lesser extent unfavourable soil/sediment chemistry. The preservation power of waterlogged environments has led to an explosion of interest in wetland archaeology in many countries during the last two decades (Coles 1992).

THE GEOMORPHOLOGICAL ENVIRONMENT: SEDIMENTS AND SOILS

Excavation uncovers the stratigraphy of the site, and while the geological law of superimposition forms the basis of our sequencing (phasing), many geomorphological environments and archaeological sites are rather more complicated than geological stratigraphy. Lateral accretion of sediments by rivers and coastal processes produces vertical rather than horizontal time-lines (Fig. 6.1). Stratigraphy is also complicated by processes such as burial, tree-throws, other bioturbation processes (Brown and Keough 1992a; Stein 1983) and wind deflation/deposition.

In order to tackle the complexity of sediments and the interpretation of their depositional environments, we use the *facies* concept. A facies is a regular set of deposits which are related together and controlled by systematic relationships between micro-environments. The alluvial facies, therefore, contains sediments formed by several micro-environments: cut-off, levee, backswamp, scroll-bars and point-bars (Fig. 6.2). A non-rocky coastal facies may include sediments deposited in the lower, middle or upper beach, a storm beach, mobile foreshore dunes, a lagoon or slack, mudflats, a fossil cliff and raised beach. The different sediments that make up the facies are produced by a set of micro-environments which are linked in together by the transfer of mass and energy. The mapping of the geomorphology around a site not only produces a standardized description of the terrain but also indicates the spatial distribution of processes which may have affected site formation or destruction. For

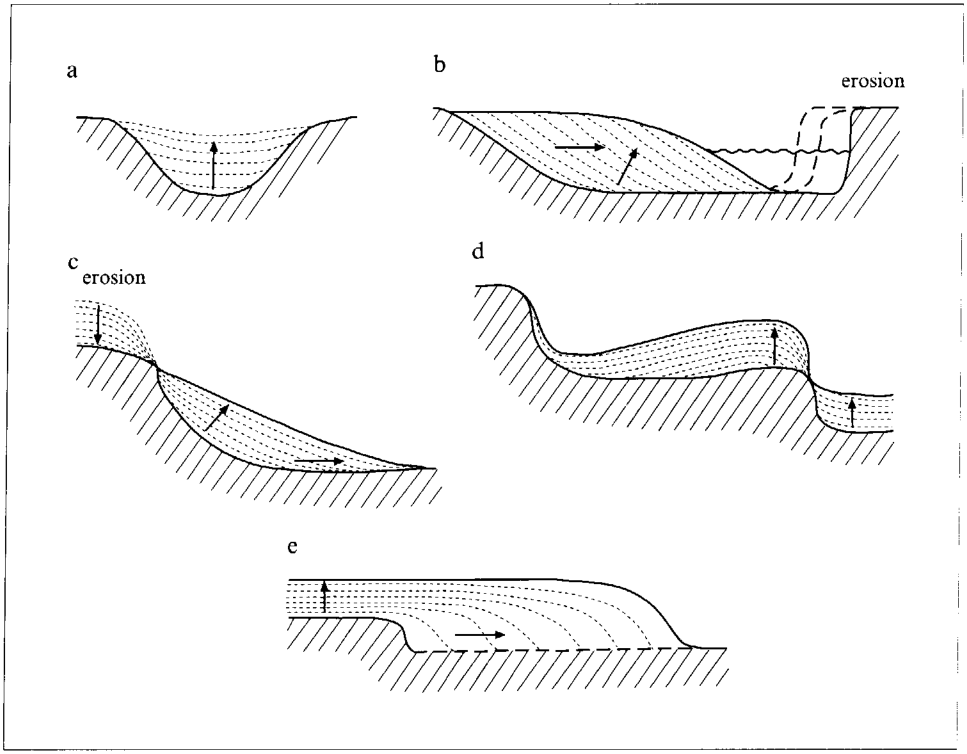


Figure 6.1 Time-lines in different geomorphological systems. Dotted lines are isochrones: (a) lake, pond or cut-off; (b) migrating river; (c) erosion of a scarp and colluviation; (d) overbank deposition on a floodplain and in-channel deposition; and (e) a prograding delta. Source: A.Brown.

the full interpretation of archaeological sites which are interstratified with natural sediments, a genetic interpretation of the lithostratigraphy is essential (Butzer 1982).

Earth surface processes are classified according to the energy involved and the transporting medium, both of which effect sediment texture, structure and architecture (Fig. 6.3). There is a wide variety of geomorphological agencies responsible for site destruction and burial, related to the climatic and geological regime. In wet temperate, tectonically stable, environments, for example, alluviation, colluviation and bog formation predominate, whilst in semi-arid environments alluvial fan formation, gully erosion and deflation are more important. Tectonically active areas are generally of greater relief, so mass-movements (such as landslides, mudslides and mudflows) are more common, as is coastal change, earthquake and volcanic activity. The identification of sedimentary processes is not always easy, especially with slope-related sediments (colluvium), where the processes may be alluvial (Newtonian flow), mudflow (non-Newtonian flow), or dry mass movements (gravity slides). In most

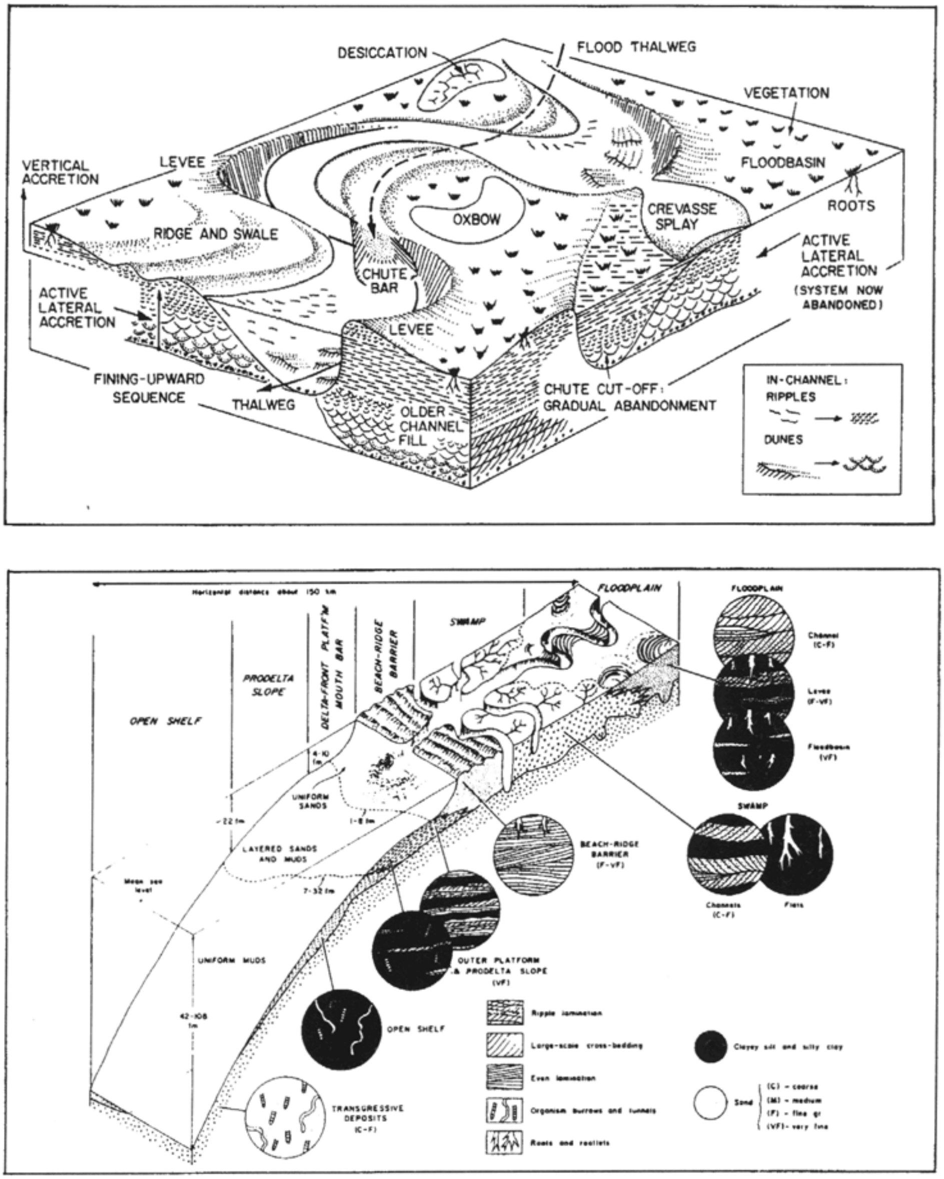


Figure 6.2 Facies: (above) floodplain of a meandering river; (below) a delta edge. Source: Walker, 'Facies models', *Geoscience Canada,* 2nd edition (Toronto: Geological Association of Canada, 1984). Copyright © Geological Association of Canada.

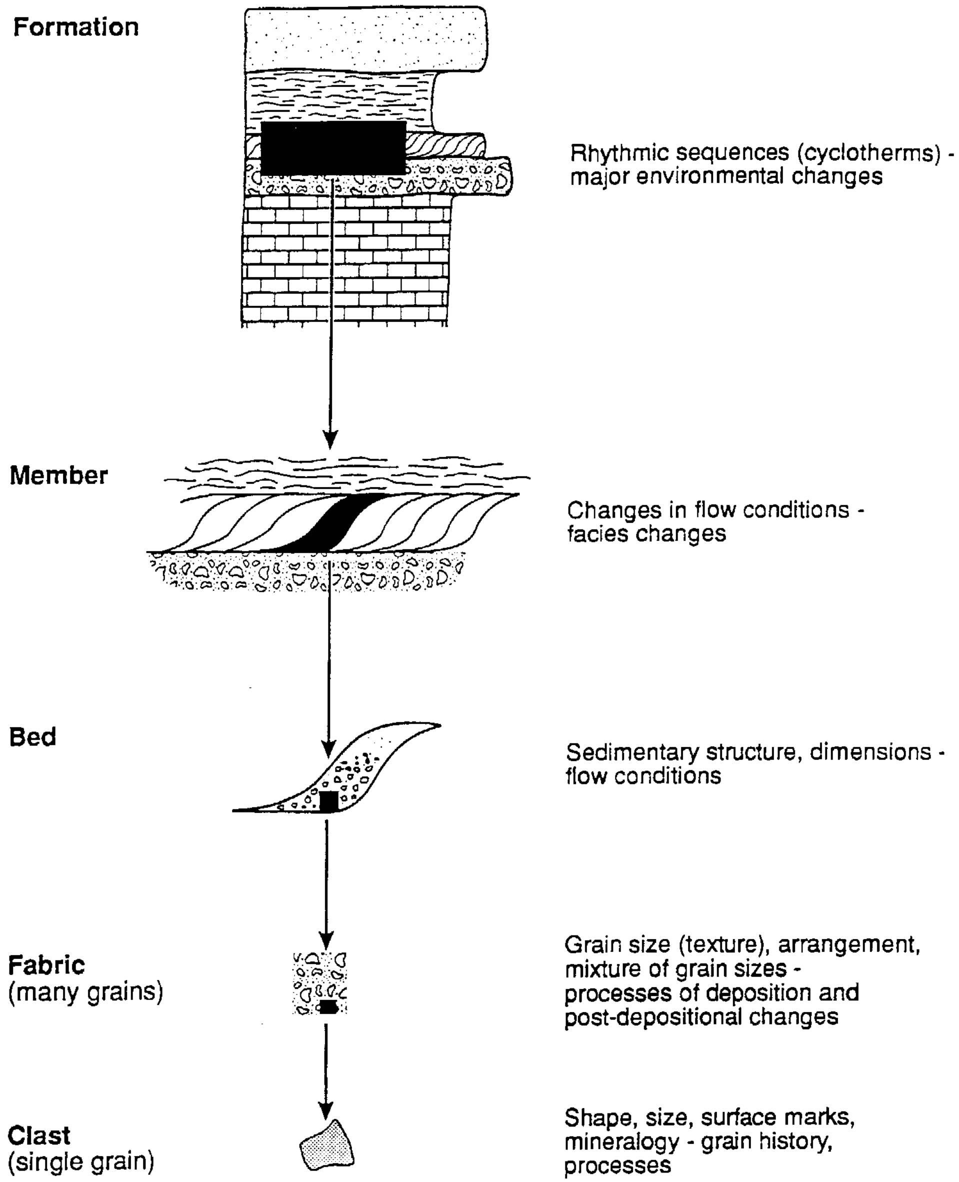


Figure 6.3 Sedimentary architecture: structures, fabric and texture.

alluvial and coastal contexts the lithostratigraphy can be highly informative in terms of the environmental constraints and resources available to human societies. Archaeologists must therefore be familiar with the morphological, locational, and sedimentary aspects of typical facies: it is essential that they 'get out of the trench' in order to appreciate the local and regional context.

Facies analysis is also applicable to culturally modified sediments. An example is the work by Hunt *et al.* (1986) on the infill of Wadi Mansur in Tripolitania, which is closely related to the development of a system of intensive floodwater farming which may have triggered-off accelerated erosion. The facies equivalent in the urban archaeological context, if related to human rather than environmental processes, is the Harris Context Model (see Chapter 4).

The lithostratigraphy of the sediments can also be used to identify sediment provenance. Although colour can indicate provenance, it is most sensitive to reducing/oxidizing conditions in the soil and iron mineralogy. Lithology can be traced using clast analysis of coarse deposits, heavy mineral analysis, thin section analysis, and analytical methods such as X-ray diffraction and X-ray fluorescence. As a general rule, finer sediments are more susceptible to post-depositional changes such as the loss of constituents through weathering and leaching, and the formation of new minerals (Table 6.1). The use of sediment magnetic signatures to identify source rocks is an extension of provenancing using sediment mineralogy (Thompson and Oldfield 1986). In addition, topsoil is magnetically enhanced by soil processes while subsoil and sediment is not, a phenomenon used to distinguish between contemporary and archaeological arable-field erosion and river-bank erosion (Brown 1992; Foster *et al.* 1990).

Although complicated by the conditions of the bed, grain shape and grain density, the grain size of a deposit is mathematically related to the power of the transporting flow (flow competence) as indeed is the volume of material that can be transported (flow capacity). Equations which relate grain size to flow parameters can be used to estimate past river discharges, a procedure known as palaeohydraulic modelling. While archaeologists rarely require quantitative estimates of this kind of environmental parameter, they do need to distinguish between different processes and this can be done using sediment architecture, sedimentary structures, sedimentary fabric and particle size and shape. Grain or particle size, which is relatively easy to measure by a variety of methods (Table 6.2), has frequently been used for this purpose through the comparison of the frequency distributions of particle sizes in deposits including contemporary sediments. The analytical methods include moment statistics, bi-variate (CM) plots (Brown 1985), log-hyperbolic models (Bagnold and Barndorf-Nielson 1980), and the log-skew Laplace model (Fieller *et al.* 1992). This last method has proved valuable in detailing the infill history of the harbour at Lepcis Magna in Libya, which involved both shoreline and lacustrine or lagoonal deposition (Fieller *et al.* 1990). Polymodal sediments can

Table 6.1 Common minerals formed in soils and unconsolidated sediments

Mineral	*Chemical formula*	*Environment of formation*
Calcite	$CaCO_3$	Precipitation from bicarbonate rich water, biomineralization, oxidation of acid sulphates - particularly in arid climates
Gibbsite	$Al(OH)_3$	Oxidation/reduction cycles in wet tropical soils
Greigite	cubic Fe_3S_4	Waterlogged sediments (transitional)
Gypsum	$CaSO_4$	Precipitation in arid and semi-arid soils and in acid sulphate soils
Haematite	αFe_2O_3	Inherited and formed under oxidizing conditions (especially in lateritic soils): weakly ferrimagnetic
Halite	NaCl	Precipitation in arid soils
Jarosite	$KFe_3(OH)_6(SO_4)_2$	Oxidation of waterlogged sediments and soils, especially estuarine
Lepidocrocite	FeO(OH)	Formed in reduced (gley) soils and sediments
Limonite	$Fe_2O_3.H_2O$	Oxidation/reduction cycles in temperate soils
Mackinawite	Fe_9S_8	Waterlogged sediments (transitional)
Maghemite	γFe_2O_3	An alteration product of magnetite and formed in soils due to oxidation/reduction cycles, burning and possibly microbial activity: strongly ferrimagnetic
Magnetite	Fe_2O_3	Inherited
Natrojarosite	$NaFe_3(OH)_6(SO_4)_2$	Oxidation of waterlogged sediments and soils
Pyrite	cubic FeS_2	Waterlogged sediments (reduction phase)
Pyrrhotite	FeS_{i+x}	Waterlogged sediments bacterial
Vivianite	$Fe,(P0_4)_2.8H_2O$	Waterlogged sediments and soils

be analysed by separating out the Gaussian components (Middleton 1976), or by multivariate similarity/difference methods (Brown 1985).

The sedimentology literature, combined with archaeological experience, suggests the need for some caution with grain size analysis, as many of these techniques seem to 'under-perform' in archaeological contexts. The reasons for this are probably threefold. First, grain size below the competence of the transporting medium is a function of grain type, availability and geomorphic history: as Burrin and Scaife (1984) have shown, the silt content of valley fills in southern England is high not only because silt is selectively transported as suspended load by rivers, but also because the Holocene soils of southern Britain were rich in loess (windblown silt: Catt 1986). Second, archaeologically related deposits have frequently been disturbed and mixed, and contain components transported by completely different media. Third, there do seem to be some fundamental particle sizes and shapes determined by crystal size and fracturing (Pettijohn 1949). While it is certainly possible to distinguish between extreme environments using shape and

Table 6.2 Methods of grain-size analysis

Methods applicable	*Microns*	*Phi*	*Classification (Wentworth)*
CC, SG, CF	0.24	12	
CC, SG, CF	0.49	11	
CC, SG, CF	1.00	10	Clay
CC, SG	1.26	9.6	
CC, SG	1.58	9.3	
CC, SG	2.00	9.0	
CC, SG	2.52	8.6	
CC, SG	3.17	8.3	Fine silt
CC, SG	4.00	8.0	
CC, SG	5.04	7.6	
CC, SG	6.35	7.3	
CC, SG	8.00	7.0	
CC, SG	10.08	6.7	Medium silt
CC, SG	12.70	6.3	
CC, SG	16.00	6.0	
CC, SG	20.16	5.6	
CC, SG	25.4	5.3	
CC, SG	32.0	5.0	Coarse silt
CC, SG	40.4	4.6	
CC, SG, WS	50.8	4.2	
CC, SG, WS	64.0	4.0	
CC, SG, WS, DS	80.6	3.5	Very fine sand
CC, SG, WS, DS	125	3.0	
WS, DS	180	2.5	Fine sand
WS, DS	250	2.0	
WS, DS	355	1.5	Medium sand
WS, DS	500	1.0	
WS, DS	710	0.5	Coarse sand
WS, DS	1,000	0.0	
DS	1,400	−0.5	Granules
DS	2,000	−1.0	(grit or pea
DS	2,800	−1.5	granules)
DS	4,000	−2.0	
DS	5,600	−2.5	Fine pebbles
DS	8,000	−3.0	
DS	11,200	−3.5	Medium pebbles
DS	16,000	−4.0	
DS	22,400	−4.5	
DS	32,000	−5.0	Coarse pebbles
DS	48,000	−5.5	
DS	64,000	−6.0	
DS, CA	128,000	−7.0	Cobbles
CA	256,000	−8.0	
T	512,000	−9.0	
T	1,024,000	−10.0	Boulders
T	2,048,000	−11.0	

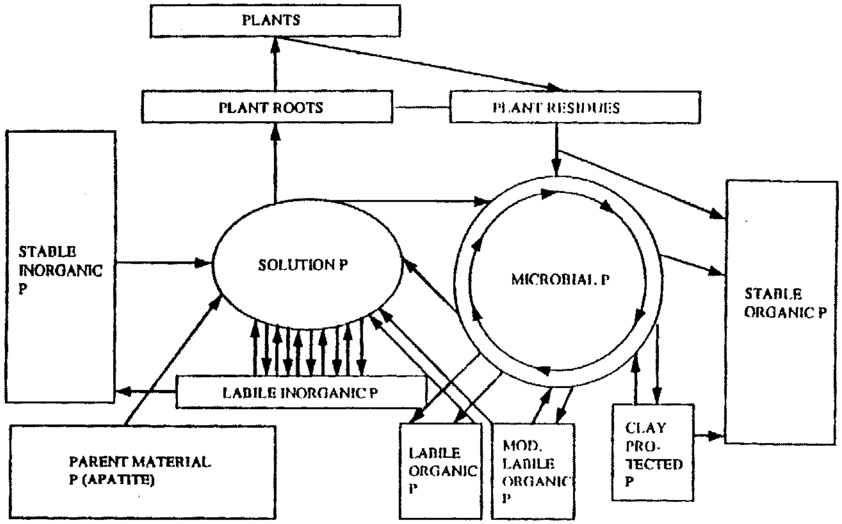
CC Coulter counter
SC Sedigraph (X-ray)
CF centrifugation
WS wet sieving
DS dry sieving
CA calipers
T tape measure

particle surface features, more subtle within-facies discrimination is often not possible, largely due to the reworking of sediments, especially in temperate slope-river systems.

An understanding of soil processes is essential in order to interpret local environmental conditions (Barham and Macphail 1995; Cornwall 1958; Limbrey 1975) and to explain site formation (Quine 1995). Soils, and sediments, display degrees of internal order in the arrangement of particles in relation to each other, their sedimentary or pedological 'fabric'. This can be analysed using impregnated thin sections and optical microscopy, electron microscopy and also the investigation of magnetic properties. In sedimentary studies, any 'anisotropy' or preferred particle orientation can indicate current strength and even direction or other sorting processes such as ground freezing (Ellis and Brown 1998; Kemp 1985).

The terminology of soil micromorphology is complex (Brewer 1976; Bullock *et al.* 1985; Courty *et al.* 1989; Fitzpatrick 1984; Kemp 1985), but the major characteristics that are investigated are: void spaces—the distribution, size and shape of soil pores; S-matrix—the matrix type, from matrix to clast supported (edge to edge contact of the large particles); organic components—organic residues, root material and so on; the composition and thickness of coatings; and pedofeatures such as concretions, depletions, crystal growth and slickensides. Soil micromorphology has been particularly valuable in investigating soil disturbance and history in relation to agriculture (French 1990) and rather enigmatic deposits such as the so-called 'dark earth' found in many urban contexts (Macphail 1981).

Soil and sediment geochemistry has always been important in relation to taphonomy and artefact conservation, but some of the more persistent elements and compounds in soils and sediments can also be useful in environmental reconstruction. Phosphorus has received by far the most attention from archaeologists because of its association with human and animal activity. It is concentrated in the soil by the addition of faecal matter, bone, refuse and organic matter and it can be depleted in the topsoil principally by surface erosion. Modern humans excrete around 6 g per person per year, which can add to the soil phosphorus by as much as 10 per cent annually (Briggs and Courtney 1989). Phosphorus (P) is held in the soil in several forms (Fig. 6.4): available, organic, and inorganic or mineral. Because of its high affinity with oxygen, phosphorus is mostly found as phosphates (PO_4, also called the orthophosphate ion). The techniques used to measure soil P vary from a qualitative field test, such as the Schwartz spot-test (Schwartz 1967), to laboratory methods for total P extraction (Page *et al.* 1982). As Keeley (1981) warns, the technique does not always work due to unfavourable soil conditions (very acidic or waterlogged conditions), insufficient concentrations, or modern contamination. It is very important to record the background concentration as well as the concentrations of the site, although this can be difficult especially in urban sites. The normal range in soils is 0.02–0.5 per cent. More particular human activities, such as site formation and



Inorganic Compounds
Apatite group ($Ca_2Ca_3(PO_4)_3(OH,F)$)
Aluminium phosphate (Al PO_4)
Iron phosphate (Fe PO_4)
Calcium phosphate (Ca PO_4)

Organic Compounds
Phospholipids
Sugar phosphates
Inusitol phosphates

Figure 6.4 Soil phosphorus phases and common natural phosphorus compounds. Adapted from Mansell, Selim and Fiskell 1977, with permission from Waverly and Wilkins.

metallurgy, can be investigated using trace elements such as lead (Pb), zinc (Zn), copper (Cu), silver (Ag) and tin (Sn) (Bintliff *et al.* 1992).

ALLUVIAL IMPACTS: ALLUVIAL CHRONOLOGIES AND ARCHAEOLOGY

One area of particular interest in the last thirty years has been alluvial environments, largely because floodplains that have undergone aggradation usually contain thick sequences of alluvial deposits: the latter, if they can be dated, can provide information on both floodplain conditions and catchment conditions, especially erosion (Brown 1997; Needham and Macklin 1992). Dating is generally by radio-carbon assay of organics, but recent methods that are emerging from the experimental stages include optical stimulation luminescence (Bailiff 1992) and palaeomagnetics (Batt and Noël 1991; Ellis and Brown 1998). A complete and accurate sedimentary budget approach is only possible with extremely good dating control. Studies on the Duck river, Tennessee, for example, have revealed alternations between periods of stability coinciding with early, middle and late Archaic artefacts, and periods of aggradation by vertical suspended-load accretion on channel banks and channel bars (Brackenridge 1984). The middle Archaic artefacts were *in situ* on a fossil floodplain surface, along with evidence of hearths, and pollen evidence from the same horizon suggested a drier climate than present *c*. 4400 BC. The result of this alternating regime is an episodically deposited stratigraphy dominated by vertical deposition but in spatially distinct units, creating complex sub-lateral time-lines and preserving archaeology of different periods at very similar levels (Fig. 6.5).

This stratigraphy is similar to the 'parcel' stratigraphy of the lower Thames (Needham 1989), and the sedimentological model is essentially the same as the stable-bed aggrading-banks model of floodplain evolution proposed by Brown *et al.* (1994). In a small lowland catchment in southern England, radio-carbon dating and pollen and diatom analysis show that deforestation and cultivation of the slopes in the Late Bronze Age/Early Iron Age produced a lagged sedimentary response which represented over a fivefold increase in erosion within the basin (Brown and Barber 1985; Fig. 6.6). An upper silty-clay unit found throughout lowland England can be regarded as the result of the widespread increase in deforestation and intensification of arable cultivation in Roman and medieval times (Lambrick and Robinson 1988; Shotton 1978). While there is undoubtedly a climatic signal in the record (Macklin and Lewin 1994), it is blurred in the lowlands by changes in the availability of sediment and catchment hydrology resulting from land-use change (Burrin and Scaife 1988; Robinson and Lambrick 1984). This means that individual basins have their own sedimentary history, but in time all underwent a metamorphosis of their channels and floodplains, often from an anastomosing system (one with multiple stable-channels) to a stable meandering pattern. The Trent, which is slightly more powerful than the majority of lowland British rivers, seems probably to have gone through a period of braiding, caused by climate but exacerbated by deforestation, before reverting to a single channel (Buckland and Dinnin 1992; Salisbury 1992). This metamorphosis also changed floodplain physiography, ecology and land-use capability (Brown and Keough 1992b).

The situation in the Mediterranean basin (and other semi-arid zones) is rather more complicated due to the semi-arid climate, its strong seasonal contrasts and its inter-annual variability, which combined with the effects of grazing, fire and rather erodible lithologies produces a high erosion potential. Recent work has built upon the pioneering studies of the Younger Fill by Vita-Finzi (1969) and shown that both climatic and land-use controls are important (Woodward *et al.* 1995).

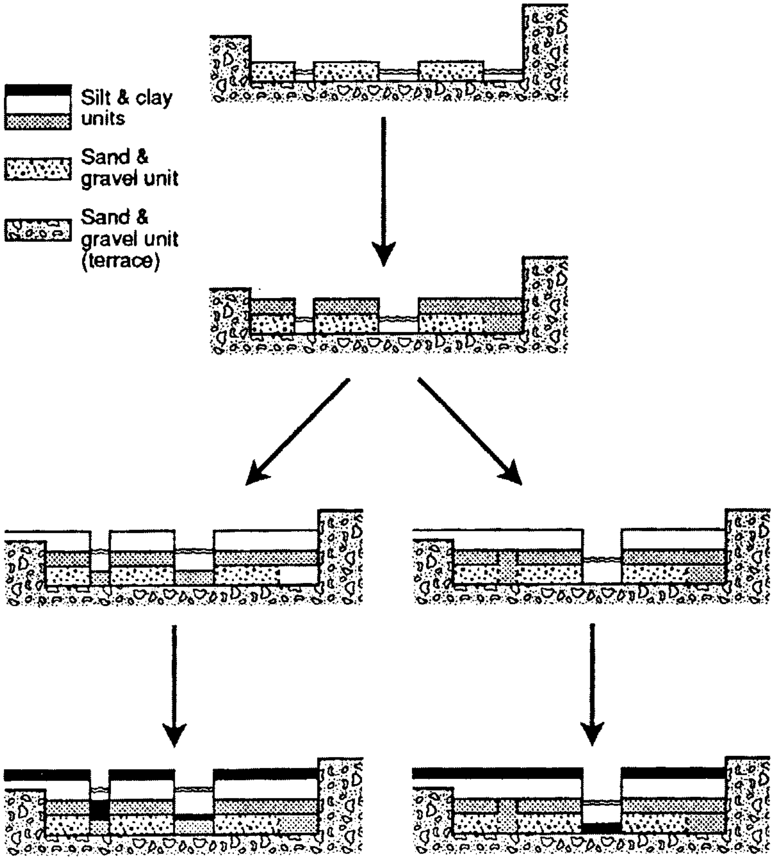


Figure 6.5 Low-energy floodplain evolution: (above) the SBAB model of floodplain aggradation. (Redrawn after Brown *et al.* 1994.) (over) the stratigraphy of the Duck river, Tennessee, USA. From 'Alluvial stratigraphy and radiocarbon dating along the Duck river Tennessee: implications regarding floodpath origin', *Bulletin of the American Geological Society,* No. 95:9–25 (1984), Brackenridge. Reproduced with permission of the publisher, the Geological Society of America, Boulder, Colorado USA. Copyright © 1984 Geological Society of America.

RECONSTRUCTING CLIMATE

The earth's climate has constantly changed when viewed over a variety of timescales. The last 2.3 million years have been dominated by marked and abrupt oscillations of climate, especially in the high latitudes, causing major expansions and contractions of land and sea ice. It is generally believed that the fundamental cause has been variations in the earth's orbit and tilt, known as the Milankovitch theory. Since this does not explain all the periodicities seen in the climate record, other factors such as

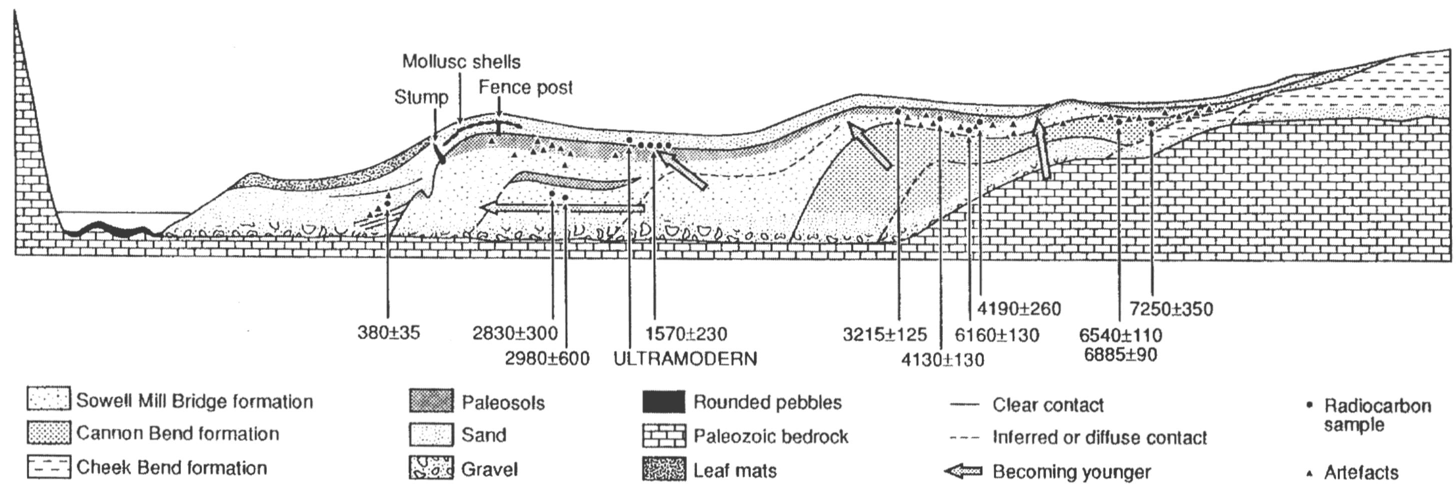


Figure 6.5 (continued)

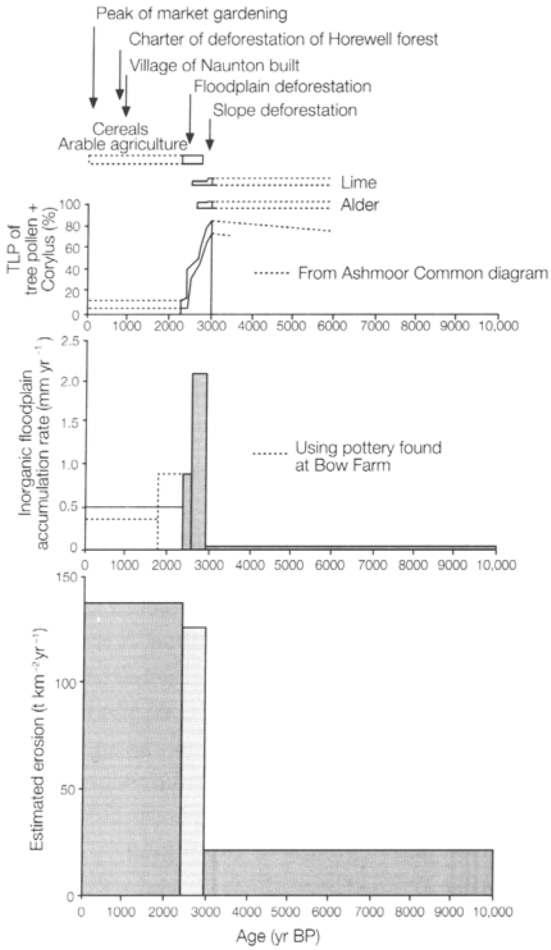


Figure 6.6 Alluvial response to land-use change in a small subcatchment of the river Severn in central England. Source: Brown and Barber 1985.

sun-spot activity and feedback mechanisms have also been implicated. The best record of these oscillations has come from the ocean floor sediments such as from core V28–238 in the Pacific Ocean (Bell and Walker 1992; Jones and Keen 1993; Lowe and Walker 1984). Unfortunately the ocean record, whilst providing a fundamental climatic yardstick, cannot tell us much about the effects of these global changes on regional climates and more subtle changes in magnitude and frequency. An important emerging technique is the analysis of the humic acid signal from speleothems luminescence, which has the potential to provide high-resolution climatic records (Baker *et al.* 1993).

Methods of climatic reconstruction which are appropriate in the landscape context can be grouped into two categories: sedimentary and biological. Both produce what is now referred to as proxy climate data (Frenzel 1991), such as the estimation of past river discharges from bed material and from palaeochannel form (Baker 1974; Cheetham 1976; Starkel *et al.* 1991). This methodology has been employed in archaeological contexts such as studies of Romano-Libyan farming systems in Tripolitania, where Gale *et al.* (1986) have used the Darcy-Weisbach flow equation to estimate the carrying capacity of a floodwater channel. Other palaeohydrological methods include studies of past flood heights from flood-slack deposits (Baker 1989) and more traditional studies of lake sediments and lake-level fluctuations (Street-Perrott *et al.* 1989).

Biological proxy methods of climatic reconstruction range from the inference of climatic regime from vegetation type or assemblage through to quantitative estimates from tree rings. In theory the best methods for natural vegetation would be eco-physiological, such as the estimation of past primary productivity, but unfortunately this is not possible from the partial evidence we have on land such as macrofossils, pollen or phytoliths. Instead, contemporary relationships between the fossil assemblage and climatic parameters are projected into the past, such as past ranges, regression equations and transfer functions. This seems to work well for coleoptera (beetles), which are highly temperature-sensitive and mobile, but is more problematic in vegetation studies. In fact, even the estimation of past rainfall from the annual wood increment of trees (dendroclimatology), which is based upon primary productivity, requires robust statistical models of the productivity/climate relationship (Fritts 1976). This method has the potential to provide estimates as far back as the tree-ring chronology extends in any region.

Barber (1981) has shown that the humification and species composition of raised peat bogs can indicate wet and dry surface conditions and so provide a high-resolution climate record (Barber *et al.* 1994) which can be correlated with historical records. At present there are international projects in most zones of the globe established with the object of deriving proxy climate data as inputs to general circulation models, which are then being used to simulate climate change in the past and future (for example: Pilcher 1996).

RECONSTRUCTING VEGETATION

The most obvious and functional element of any landscape is vegetation cover, so it is not surprising that floral palaeoecological methods have traditionally formed the backbone of environmental archaeology. The identification and interpretation of Pleistocene plant remains have a long history, forming the basis of early nineteenth-century vegetation histories such as Clement Reid's classic *The Origin of the British Flora* (1899) and similar work in Scandinavia. The use of databases and the Internet are now providing a valuable tool in the reconstruction of prehistoric food plants and ecology (Tomlinson and Hall 1996). Plant macrofossils range in size from tree trunks to small seeds, but the most common division is into woody and non-woody macrofossils.

Non-woody plant macrofossils

The preservation of non-woody macrofossils depends upon both the resistance of the fragment and environmental conditions. It is generally the structural elements of plants, along with organs that are adapted to withstand dormancy such as rhizomes and seeds, that are most easily preserved. The preservation potential of environments varies from peat bogs, where most of a rather restricted flora may be preserved, through waterlain deposits which have very variable preservation potential, to soils where only resistant fragments may persist. Permanently waterlogged alluvial sites such as palaeochannels can preserve a wide range of organics, including leaves, stems, seeds and nuts, and they share the same transporting processes as small lakes. On dry sites, preservation mechanisms are different and include desiccation, carbonization, seed impressions in pottery and daub, and silica skeletons (Pals *et al.* 1992).

While plant macrofossil sampling and extraction procedures will vary with the conditions and resources available, the most common method is the collection of bulk samples (5 kilograms or more) from a range of contexts, or the collection of monolith tins from exposures. The material may be sieved, or a flotation system used, either on-site or in the laboratory (Pearsall 1989). Identification is fundamentally reliant on the botanical knowledge of the analyst, aided by reference collections, atlases of macroscopic remains and some dichotomous keys. Because of the difficulty of equating different fragments from different plants, the most common form of data presentation is a taxa list, but extra information can, in appropriate circumstances, be gained from semi-quantitative analysis ('rare', 'occasional', 'frequent') or quantitative analysis using percentage sum of fragments or slide/dish cover from a known volume (Dickson 1970; Grosse-Brauckmann 1986).

Because most macrofossils are of local origin, there is a bias to the ecology of the preserving environment, which is often a *hydrosere* (succession of wetland plants). Although ecologists still recognize the existence of a tendency towards the systematic progression of plant communities (seres) from open water to dry land, work on both successional processes and macrofossils sequences themselves has shown us how variable is this process: not only do the pathways and sere types vary spatially, but retrogressive succession is common and the end-point is both temporally and spatially variable. On the north-west European seaboard the 'climax community' (assuming it can be identified) would probably be sphagnum bog rather than mixed oak forest (Walker 1970). Likewise in peat stratigraphy the replacement of the cyclic theory of bog-growth by the phasic theory (Barber 1981) has changed our perceptions of the environmental potential of these studies: in the raised bog in north-west England that became Lindow Man's grave, important changes in bog wetness and traversability occurred both before and after his death (Barber 1986). In the case of *ombogenous* (entirely rain-fed) bogs these changes were *allogenic* (externally forced), caused by changes in the precipitation/evapotranspiration ratio, but for hydroseres they can be due to *autogenic* (internally regulated) changes in the system (such as channel change or debris damming) and thus not be related to external variables.

We see the same problem of separating local/autogenic changes from wider environmental changes in studies of ditch fills, but, if this is allowed for, these sediment traps can provide excellent information on landscape change. An example is Lambrick and Robinson's (1988) study of the development of a floodplain agricultural landscape in the upper Thames valley in southern England. They grouped the seeds and other plant remains recovered from a series of waterlogged ditches of iron age to medieval date into pastureland species and hay meadow species. It was clear from the macrofossil diagrams that grassland areas had existed on the floodplain since clearance of the former alder woodland in places as early as *c.* 3000 BC; most of this pastureland could be described as *mesotrophic* (moderately mineral-rich) using the National Vegetation Classification for the British Isles (Rodwell *et al.* 1991–96) and much was similar to present-day unimproved pasture. Botanically rich hay meadows, however, had probably only existed since Roman times, as they were associated with seasonal flooding and deep alluvial profiles produced by Roman and post-Roman alluviation. Lambrick and Robinson (1988) suggest that the history of this grassland reflects a combination of management practices and changes in the natural environment.

Whilst plant macrofossils are less common in dry environments, van der Veen has recovered a considerable number of crop plants, predominantly by sampling trenches in middens, from the pre-desert region of Tripolitania (van der Veen *et al.* 1996). An extreme example is that of the packrat middens of the arid south-west US: these rodents collect all sorts of vegetation from a radius of about thirty metres to add to their middens, where it is preserved because it is cemented by their urine (Spaulding *et al.* 1983). This work shows that the Sonoran and southern Mojavi desert supported conifers, including pygmy pine, during the Late Pleistocene *c.* 20,000 years ago.

Wood and charcoal

Wood can also be preserved in a variety of ways, including waterlogging, desiccation, carbonization as charcoal, association with corrosion, and as impressions and stains (Taylor 1981). Wood is composed of two basic constituents: lignin, which is preserved; and cellulose, which is easily lost by conversion to sugars. In waterlogged environments, the cells are filled with water which must be replaced after excavation (using carbowax or polyethylene glycol) if shrinkage is not to occur on drying out, although improvements in freeze-drying have helped.

Wood and charcoal identification is based upon the internal structure or anatomy, which is controlled by the size, shape arrangement of vessels used for transporting water, salts, sugars and proteins. The wood is thin sectioned using a microtome revealing the anatomical features. Some conifers (such as pine) have resin canals, others (such as yew) do not, and hardwoods are divided into those which are ringporous, where the spring vessels are larger that the summer vessels (such as oak) and those which are diffuse-porous, where they are more uniform (such as beech). (For more detail, see standard manuals and identification works such as Cutter *et al.* 1987 and Schweingruber 1978; computerized keys are also now available such as GUESS 1986.) The detailed recording of wood *in situ* can provide valuable information on the population dynamics and patchy structure of ancient woodlands (Lageard *et al.* 1995).

The ecology of trees is relevant not only to the interpretation of wood remains but also for pollen analysis, since we often want to infer the origin of the wood and past environmental conditions. Care is needed since most trees are more catholic than one might expect, but there are gradients based on preferred habitats. Three of these are: pioneers/non-pioneers—early colonizers, fast growing, infertility tolerant/opposite; boreal/thermophilous—typical of the boreal zone/warm-loving; and wetland/dryland—non-rotting, often nitrogen-fixing/waterlogging intolerant. There are much more sophisticated ordinations and classifications based upon phytosociological studies and to a lesser extent upon autecological studies, but as mentioned earlier, caution needs to be exercised. Beech, for example, although often regarded as a tree of alkaline soils, can under both natural and managed conditions grow on acidic soils, as it does in the New Forest in Hampshire, England (Tubbs 1968). The species distribution in the 'wildwood' (*sensu* Rackham 1980) was not static because of differential migration rates, the location of refugia, disturbance, and competition.

The analysis of wood and charcoal can also provide unique information on early forest practices. The reinvestigation of the timbers at the mesolothic site of Star Carr in northern England suggested a close association between beaver activity and human activity (Legge and Rowley-Conwy 1988). Although coppicing and pollarding can occur naturally, there is strong evidence for human agency from the early Neolithic in the Somerset Levels in south-west England (Coles and Coles 1986). The concentration of archaeological and palaeoecological interest on a normative model of deforestation has to some extent hidden the importance of forest practices such as woodland grazing, the collection of dead timber, the prevention of regeneration, coppicing, pollarding and later charcoal production. Wood was not only the prime structural and energy resource in Antiquity: it also provided dyes, medicines and in some circumstances food (such as bark-bread from elm). Woodland was therefore a primary and multi-faceted resource, completely different to the modern concept of 'forestry'.

Plant microfossils

The distinction between plant macrofossils and microfossils is pragmatic: macrofossils are generally visible to the naked eye, whereas microfossils require the use of high-power microscopy. There are many types of plant microfossil now being used in archaeology but only the most popular will be discussed here. Although the principles of interpretation, including the uniformitarian assumptions and death assemblage concepts, hold true for all the different microfossil types, their detailed interpretation does not, and so they will be discussed separately.

Phytoliths

Phytoliths are the microscopic moulds of opaline (or biogenic) silica (Si) from certain plant cells, which because they can be associated with plant species, or more commonly with groups of plants and environmental conditions, are an increasingly important palaeoecological tool. Plants take up silica from soil water and store it in special cells, thereby increasing plant rigidity. Ancient plants tended to store it on the outside of their stems, but it is more commonly stored in internal cells and in cell walls (it is this silica that produces a use-gloss on harvesting implements); although this is particularly associated with grasses, most other species also store silica.

The importance of phytoliths for archaeologists lies in their high preservation potential in sandy and aerobic soils and sediments where pollen is rare. Extraction procedures are in theory relatively easy, involving the removal of organic matter by burning or wet oxidation and density separation (Powers and Gilbertson 1987). The most common problem is low concentration, but concentration itself may be indicative of land-use processes. High concentrations (up to 10^6 phytoliths per gram of sediment) occur in middens, cultivation deposits and animal faeces, while wind-blow sand concentrations are below 2^5 phytoliths per gram of sediment and often very much lower. The rudimentary typologies of the 1960s (Rovner 1971; Smithson 1958) have been refined (Brown 1984; Piperno 1988; Powers and Gilbertson 1987), although species identification is rarely possible and some form of association analysis is required to define the palaeoenvironment. Powers *et al.* (1989) have shown how phytoliths may be used to identify the origins and land use associated with sand dunes and machair sediments in northern Britain. Absolute analysis and the application of correspondence analysis can help distinguish aspects of human activity, including the contributions of cut peat, plant and animal wastes, and possibly the character of grazing systems.

Pollen and spores

The analysis of pollen and spores has probably been the single most important technique for the reconstruction of natural landscapes during the last forty years. Classic early studies were undertaken by Godwin, Iversen, Troels-Smith, Dimbleby and others of sites closely associated with archaeological excavations. Discussion here will be concerned with interpretation and use, rather than methodology, the latter being covered well in a number of texts (Berglund and Ralska-Jasiewiczowa 1986; Faegri and Iversen 1991; Moore *et al.* 1992). In brief, the most common extraction process involves disaggregation and the removal of carbonates; oxidation of organic matter (acetolysis); and removal of silicates using hydrofluoric acid. Recent innovations include micro-sieving, density separation, and the use of microwave digestion. Spikes can be added to a known sample volume to give concentration values, although most routine work still uses relative counting.

In order to interpret the results, whether a type/taxa list or a diagram, notice must be taken of the 'three-differentials' of pollen analysis. The first is the differential pollen productivity of plants. Gross variations correspond with mechanisms of pollen dispersal, so aerophilous (wind-pollinated) plants produce large amounts, while entomophilous (insect-pollinated) plants produce much smaller quantities. Correction factors have been produced by several palynologists including Anderson and Erdtman (Moore *et al.* 1992); their application has, for example, changed our model of the Atlantic forest composition in central and eastern England from one dominated by oak to one dominated in many areas by lime (Greig 1982). The second factor is differential preservation. Although the exines (external walls) of pollen and spores are constructed from a tough natural polymer (sporopollenin), the classic experiments of Sangster and Dale (1964) have shown that some are more resistant than others and that this varies with the chemistry of the environment. Certain types are known to be particularly resistant, such as the ferns and some of the daisy family, and so high quantities of these and a reduced diversity indicates poor preservation—this is a problem in many archaeological contexts such as buried soils, sandy contexts, cave deposits, pits, latrines and ditches. The third factor is differential transport: just as the transport vector may vary, so will the average distance travelled by grains. Several palynologists have produced models of pollen transport, two of which are the Tauber model (Tauber 1965), which distinguishes between different transportational pathways (such as rainout, canopy, trunk-space and local components), and the Jacobsen and Bradshaw (1981) model, which relates site size to the pollen-contributing area. This has been further developed by Sugita (1994), who has shown that sites over 1,500 metres above sea level show little site-to-site variation and inevitably indicate homogeneous vegetation.

These models can be adapted for small ponds, oxbow lakes (Fig. 6.7) and archaeological sites (such as ditches), illustrating that such sites should provide an accurate picture of the local and extra-local vegetation 50–300 metres from

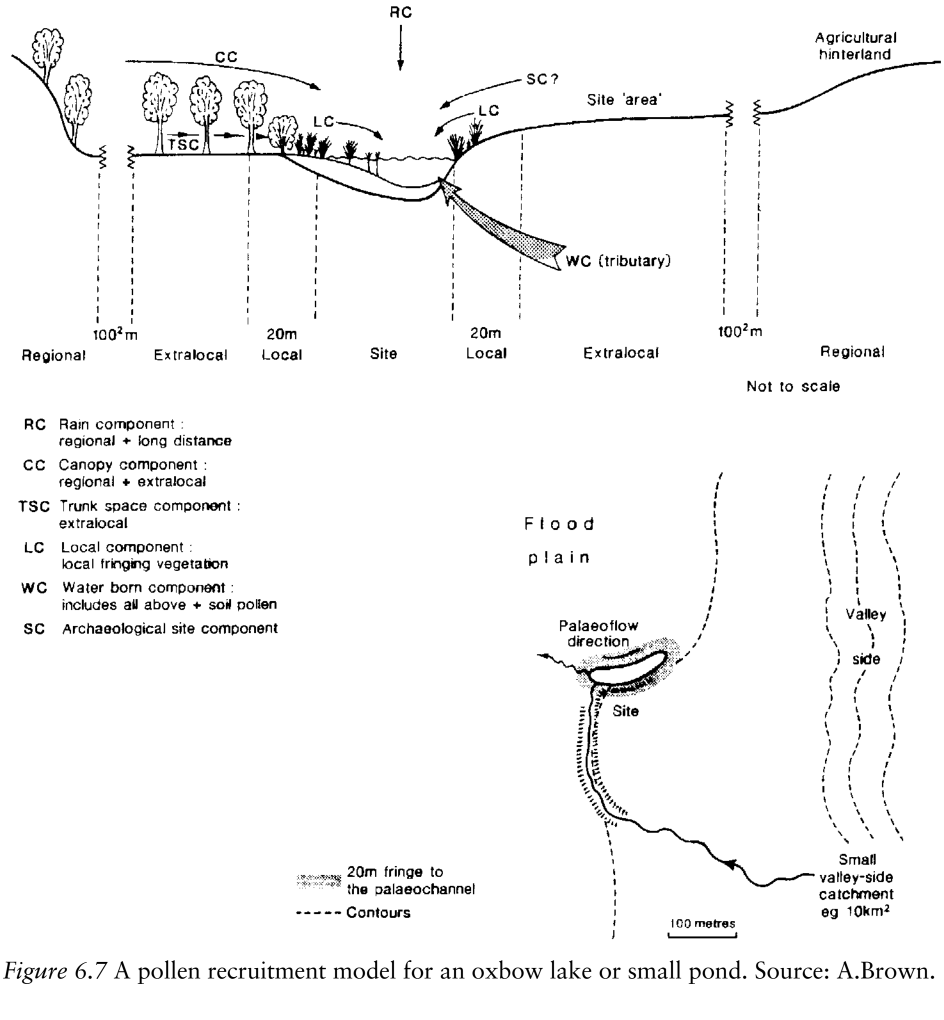


Figure 6.7 A pollen recruitment model for an oxbow lake or small pond. Source: A.Brown.

the site (Brown forthcoming). However, on-site palynology has additional problems in the many types of input. These can include digger bees, fodder, food remains and coprolites, making cave sites and urban sites particularly problematic. Archaeologists who want to reconstruct the natural resource-base using pollen analysis therefore need to be aware of the chain of inferences involved from the original pollen rain to the inferred ecology, with the evidence becoming progressively more ambiguous. There is also a great danger of the reinforcement syndrome operating, whereby a palynologist uses archaeological evidence to interpret the pollen data and subsequently the archaeologist uses that interpretation as evidence for a particular interpretation of the original archaeological data! Some of the complications can be illustrated if we take three problems with the interpretation of so-called 'clearance events': clearance events can have many causes such as disease, windthrow, fire, felling and so on, which may occur in combination; it is difficult to distinguish between a large clearance at some distance and smaller clearances nearby; blurring of the pollen signal may be caused by several clearances overlapping in time, producing what looks like one long event (Buckland and Edwards 1984).

There has recently been a partial re-evaluation of the palynological evidence of some important ecological changes in north-west Europe such as the 'elm decline', now thought to be a combination of disease and human activity on the basis of both pollen and coleopteran data (Girling 1988). However, detailed pollen analysis combined with waterlogged archaeology can provide valuable insights into woodland management, as at the neolithic pile dwelling at Alvastra in Sweden, where both pollen and macrofossil evidence indicate intensive coppicing of the surrounding woodland (Goransson 1987). Some of the earliest palynological work was done on buried soils, where there are particular problems of preservation and bioturbation (Dimbleby 1985). However, the potential of palynology for sub-structure soils has long been recognized and formed the original data for Dimbleby's model of soil degradation and podzol formation associated with human activity being responsible for the creation of lowland heaths in Britain (Dimbleby 1974).

Until recently much of the non-pollen material on the laboratory slides was left unidentified and discounted—generally zygospores, ascospores and insect remains. Their identification and use in palaeoenvironmental reconstruction has been worked upon by van Geel (1986), and more recently by archaeologists (Coles 1989). Some types have very particular ecological requirements and so make excellent indicator types.

It is important to realize what pollen and spore analysis cannot do. Its prime role is the reconstruction of past vegetation cover, rather than dating: in the absence of documented marker species, the latter is hazardous and theoretically unsound due to the diachrony (time-transgressive nature) of vegetation change. Second, while pollen analysis can illustrate it can rarely explain, except when supplemented by another data type.

Diatoms

Diatoms are single-celled algae with internal valves (called frustules), which are made of opaline silica and thus can be preserved in a variety of sedimentary environments. They are found in all fluvial, lacustrine, estuarine, and marine environments and the death assemblage can directly reflect original floristic composition and productivity. For details of methodology and identification, see Batterbee (1986). Because many diatom species are extremely sensitive to salt content, nutrient status and pH, they are extremely useful in the reconstruction of past environmental change, including flooding by sea or freshwater (Brown and Barber 1985), lake history and changes in the surrounding environment (Haworth 1976; Bradbury *et al.* 1981) and the pollution of water bodies including acidification and eutrophication (Batterbee 1978; Flower and Batterbee 1983). Apart from inferences of catchment status such as soil conditions, diatoms have great potential for the reconstruction of local conditions in water bodies in or near archaeological sites and where local conditions have changed. An early example is Foged's (1978) analysis of the diatoms from the Danish medieval town of Svenborg.

RECONSTRUCTING THE FAUNA

Although derived from a less visible component of the natural landscape, faunal remains can provide detailed indirect evidence of climate and vegetation as well as direct evidence of the trophic structure of the ecosystem. There are close parallels here with the routine analysis of faunal remains on site (Chapter 14).

Invertebrate microfossils

Many faunal micro-organisms can be preserved and can be used as environmental indicators in geoarchaeological studies. These include foraminifera (protozoa with calcareous shells), ostracods (crustacea with calcareous shells) and coccolithophores (unicellular autotrophic marine algae); more details can be found in Lowe and Walker (1997). Three microfossils which may be of particular potential in archaeological studies are rhizopods, cladocera and chironomids.

Testate amoebae (rhizopods)

Testate amoebae or rhizopods are the shells (or tests) of freshwater amoeba (protozoa) found in lakes, peat bogs and soils. In wetland environments they can indicate local vegetation and nutrient status. In general they are most useful in the absence of plant macrofossils and in conjunction with other microfossil analyses, a specific example being the changes in raised bog surface conditions caused by climatic change (Frey 1964; Warner and Charman 1994). For an introduction to rhizopod analysis, see Tolonen (1986). The archaeological potential of rhizopods is greatest in wetland environments, although more work on soil rhizopods may broaden their use (Warner 1988).

Chironomids and cladocera

Chironomids are freshwater midges which can be identified from their larval head capsules. They have proved to be good indicators of ecological conditions (Amoros and van Urk 1989). Studies of Rhine sediments of medieval and post-medieval age have shown that much of the past river entomology can be reconstructed documenting changing river and floodplain habitats associated with human settlement and exploitation (Klinke 1989). Similar results can be obtained from the analysis of cladoceran, water flees (Amoros and van Urk 1989; Roux *et al.* 1989). Both of these microfaunal techniques have considerable potential, not only in natural and semi-natural wetland habitats but also in anthropogenic habitats such as waterfronts, ditches, cisterns and ponds. Methods and further details can be found in Hoffman (1986) and Frey (1986).

Faunal invertebrate macrofossils

Coleoptera

The most common insect remains used in the reconstruction of natural environments in archaeology are from beetles (coleoptera). Beetles are almost ideal environmental indicators because species distribution is closely related to temperature, many are also host-specific, and they are highly mobile, thus reducing the lag effects so marked in vegetation response to climate change (Coope 1986).

Coleopteran analysis has provided a temperature curve for the last 15,000 years from Britain using the mutual climatic range method (Atkinson *et al.* 1986), although there is some debate as to the reliability of this method with past species distributions (Anderson 1993). In Europe the use of beetles as climatic indicators becomes more difficult from the Neolithic onwards, as their geographical ranges are affected by human landscape change, particularly deforestation, and the creation of internal climates. This response to human activity forms the basis of their use in environmental archaeology. They have been used to construct detailed pictures of local environmental changes associated with archaeological sites (Buckland 1979; Buckland and Kenward 1973). Coleoptera can be well preserved in alluvial contexts, if water levels have been maintained, and can give valuable evidence of changing river and floodplain conditions which in some cases are the result of human activities such as deforestation (Buckland and Dinnin 1992). The close association of some species with wood and woodland management makes them of great potential for the reconstruction of natural environments: an excellent example is the discovery of *Scolytus scolytus* (the Dutch elm bark beetle) at 'elm decline' levels in southern England (Girling 1988). Although this discovery is open to several interpretations, it does suggest a link between the human impact on the wildwood and pathogen spread. Coleopteran analysis undoubtedly has great potential for studies of both site conditions and changing landscapes (Ashworth *et al.* 1997; Osborne 1988).

Mollusca

The analysis of sub-fossil snail shells (mollusca excluding the cephalopoda) is one of the oldest and most practised methods of palaeoenvironmental reconstruction used in archaeology (Evans 1972; Sparks 1969). Snails are often preserved where pollen is not: in dry alkaline deposits and soils. It is not, however, a homologous technique, as molluscan analysis produces different evidence at different scales of past climate, soils and vegetation conditions. Also, molluscs are organisms which have become closely associated with humans through colonization of human habitats and through direct human exploitation as a resource. The two groups of mollusca of relevance here, the gastropods (snails) and bivalves (mussels and clams), have shells made of aragonite, a form of calcium carbonate. Identification of adults to species level is relatively easy with the aid of keys and a reference collection. They are generally restricted to lime-rich environments (required for shell construction), and many are calcicoles (lime-'lovers'), although there are a few which can be found in less-calcareous environments. A very few are even calcifuges (lime-'haters'), but they are small and poorly preserved. The shells are prone to dissolution by acidic water, a process which may be selective on those with the thinnest shells. Large soil or sediment samples are wet sieved and the sorted and counted snails expressed as a presence/absence table or a histogram of taxon percentages.

A substantial amount is known about the distribution and ecology of land snails, on the basis of which Sparks (1961) identified four fluvial habitat groups: (1) slum group—individuals tolerant of poor water conditions, ephemeral or stagnant pools, such as *Lymneae truncatula;* (2) catholic group—individuals that will tolerate a wide range of habitats except the worst slums, such as *Lymnaea peregra;* (3) ditch group—species found in ditches with clean slow water with abundant macrophytes (vegetation), such as *Planorbis planorbis;* (4) moving water group—species typical of larger water bodies such as lakes and streams, for example *Valvata piscinalis* and the larger freshwater bivalves such as the Swan mussel *(Anodonta cygnea)*. Similarly, land snails can be divided into four groups: (1) marsh group—associated with fens and marshes, such as *Vallonia pulchella;* (2) dryland group, such as *Pupilla muscorum;* (3) open country group, such as *Vallonia* sp.; (4) woodland group—shade loving species such as *Discus rotundatus*. It is from the dryland and open country groups that the snails which adapted to agricultural land originally came. In addition, there are some species which adapted to other humanly created habitats (that is, they became 'synanthropic'), including carnivorous snails found in cemeteries.

The broad groupings above have been used to document land cover changes associated with prehistoric woodland clearance at many sites (Evans 1972). Some snails are sensitive to climate and this has been used in Quaternary palaeoenvironmental reconstruction and correlation. Along with lake sediments, pollen and diatoms, lacustrine mollusca have revealed how the early Holocene in the eastern Sahara was a far wetter and greener environment than the hyper-arid desert it is today (Petit-Maire and Riser 1983), a finding of great significance for the study of the predynastic cultures of the Nile valley. Similarly, the widespread presence throughout Britain between *c.* 6000 BC and *c.* 3000 BC of three land snails now absent from northern Britain *(Pomatia elegans, Lauria cylindracea* and *Ena montana),* along with the regional extinction of the European freshwater tortoise *(Emys orbicularis),* may reflect the warmer conditions of the European climatic optimum. Recent work on land snails has involved the use of numerical methods and ecological analogues in the reconstruction of what Evans calls past 'taxocenes' (Evans *et al.* 1992).

Marine mollusca come from a range of littoral habitats, from the rocks and pools of the intertidal zone to the edge of the continental shelf. They often make up a significant component of beach and marine sediments (such as crag deposits). Ecological groupings have been constructed based upon salinity, water depth and water temperature. Some species of whelk even vary in shape in response to the exposure of the coast and this has been used to map the gathering activity of mesolithic peoples in the Outer Hebrides and to indicate changes in storminess (Andrews *et al.* 1985). Because middens are rich sources of mollusca, considerable care is needed in the separation of any assemblage changes caused by local environmental change from those caused by social factors that might have effected procurement preferences and/or the location of procurement activity.

Vertebrates

Although their principal importance in archaeology is for palaeoeconomic studies (Chapter 14), animal bones do occur in natural contexts and their interpretation in part concerns the reconstruction of landscape. Whether for palaeoeconomic or environmental reconstruction, the use of vertebrate remains relies on knowledge of the biases of the samples. During the last thirty years vertebrate taphonomy has been the focus of considerable research, and this has allowed archaeologists to say far more about not only cause of death but also the sequence of events prior to and after death (Behrensmeyer and Hill 1980; Lyman 1994; Weigelt 1989).

Fish

Fish remains have generally been under-researched, and have until recently only been seen as of interest in relation to past diet (Brinkhuizen and Clason 1986; Casteel 1976). Casteel (1976) gives details of methodologies. There are serious problems of sampling and preservation involved: the surprising lack of fish bones from mesolithic sites in Britain as noted by Simmons *et al.* (1981) probably reflects both of these. Preservation is differential: the bones of salmonids and eels are less well preserved than those of the primary freshwater fish such as pike and perch (Simmons *et al.* 1981). Some progress has been made on the natural spread of fish across the northern continents after deglaciation. It is believed that all indigenous freshwater fish entered Britain via the continental land bridge severed by the English Channel *c.* 5500 BC, populating only the river catchments draining to the eastern English channel and the southern North Sea (Wheeler 1977). This means that in catchments outside this area, including all those further north than the Yorkshire Ouse, freshwater primary fish (but not eels and salmonids) were probably introduced. Unglaciated continental regions can probably be assumed to have had less variable fish ecologies, although there is some evidence that Holocene climate change has had some effect on the fish fauna of Russia (Casteel 1976).

Birds and small mammals

The sieving and/or flotation of sediments for small bones has now become routine practice, reducing the bias towards large herbivores and providing more information on the local natural and cultural landscape; details of methods, procedures, identification and report preparation can be found in Schmidt (1972), Grigson (1978) and Davis (1987). Bird remains are only commonly found in either human contexts or from cave deposits; as with other mammals, their recolonization of

Europe and North America in the Holocene occurred as their habitats moved north. One of the caves at Creswell Crags, in central/northern England, did not contain any evidence of human occupation and so could be regarded as a baseline for late glacial and early Holocene environmental data (Gilbertson and Jenkinson 1984). Seven species of falcon and five species of owl have been recovered from this cave, and these raptors are the main accumulating agency for small mammal remains.

Studies of bird bones show clearly how the range and diversity of wild birds have changed during the last 10,000 years. A few species known from archaeological sites have become extinct, a north-west European example being the great auk *(Pinguinus impennis),* which seems to have been a significant food source in the Neolithic in coastal areas (Smith *et al.* 1981). The hunting of birds in coastal high latitudes was a highly seasonal activity and integrated with the hunting of other mammals (Munzel 1983).

Nearly all the wild fauna that had reached Britain by the early Holocene survived into the mid and late Holocene (with the exception of the elk, *Alces alces*), and this seems also to hold true for southern Europe and North America. In the mammal record in Britain, we do, however, see a reduction in diversity after the Iron Age, clearly associated with the disappearance of natural habitats probably exacerbated by hunting. A critical threshold may have been reached, although at different times in different regions, when the landscape changed from a 'wildwood' with isolated, even if large, clearings, to a landscape of isolated woodland separated by open land as today—a change which would have isolated breeding groups of woodland mammals, making them more susceptible to local extinction. The same fragmentation occurred where tropical forests were replaced by prairies and savannahs, with or without human assistance.

Small mammals are particularly well preserved in cave sites due to a variety of accumulating agencies. In addition to the common native mammals, we see some which have now become rare in Britain. Bones of Bechstein's bat *(Selysius bech-steinii)* have been recovered from neolithic levels at Dowel Cave in Derbyshire (Smith *et al.* 1981) and the pine marten *(Martes martes)* is recorded from the neolithic barrow of Nutbane in Hampshire. Although nearly all small European mammals were associated with woodland conditions, most adapted to landscape and habitat change more easily than the large mammals. This was probably helped by the fact that they do not seem to have been significant food resources and did not provide obvious competition with domesticated animals for food. Those that died out were generally the larger species, valuable for their fur, such as the European beaver *(Castor fiber)* and/or those requiring large territories.

Larger mammals

Due to the importance of domesticates in later prehistoric archaeology, large wild animals have received most attention in palaeolithic studies in Europe and in the New World. Between about 14,000 and 10,000 years ago we see an acceleration of mammal extinctions in both the New and Old Worlds. Although the largest mammals (the 'megafauna') were most affected, so were some birds and small mammals. In northern Europe, late glacial/early Holocene extinctions included the woolly rhino *(Coleodonta antiquitatis),* the giant deer (*Megaloceras* sp.), the sabre-toothed tiger *(Smilodon)* and the mammoth *(Mammuthus primigenius)*. In North America, the extinctions included the native American horse *(Equus occidentalis),* the mastodont *(Mammuth americanum)* and the American shasta ground-sloth *(Northrotheriops shastense)*. The North American extinction event had more effect on the native fauna than anything during the preceding four million years (Martin and Klein 1984). This was a period of great environmental change and, especially in the New World, great cultural change as well. One explanation for the extinctions is the 'overkill' hypothesis: that new cultures massacred wild animals unused to human contact, in the same way that island extinctions in recent times were caused by the first arrival of humans. A second hypothesis is that the extinctions were related to climatic change. However, neither the climatic nor the overkill hypothesis seem adequate alone, as despite the cavalier approach to wildlife resources seemingly exhibited by cultures such as the Clovis in North America and evidence of similar 'game-drives' at this time in Europe, many abundant species did survive. It is most likely that it was the combination of climatic stress and the indirect effects of cultural change, such as habitat alterations, that marginalized and finally caused the extinction of these animals (Roberts 1998). The fact that the plentiful species that survived in North America, such as the bison, were important game species further weakens the overkill hypothesis.

Different regions obviously have very different Holocene faunal histories: even the history of large mammals in Ireland is different to that of mainland Britain, which is different again from that of continental Europe. Since large mammal bones are recovered from sites of human activity or rare natural traps, the records may only indicate presence in the region and tell us little about abundance. Although this limits their potential as records of landscape change, the large mammals are not simply important as indicators of human subsistence behaviour: for example, the effects on the environment of the introduction of domesticates, especially sheep and goats, have been devastating in the Mediterranean and in parts of the New World, whilst the history of recent introductions to Britain, such as the rabbit, mink and coypu, illustrate that environmental impacts can be dramatic and not always predictable.

RESOURCES AND THE NATURAL LANDSCAPE

Since practically every natural material is a potential resource, the history of resource use is the history of the transformation of nature through human labour. It is therefore possible to subdivide natural resources by use and labour input (processing) as well as by nature: that is, those related to subsistence (food, drink, medicines), agricultural resources, and settlement (space, soil fertility and water); and those related to industry (raw materials for the production of artefacts and new materials).

Until very recent times, wood has been by far the most important resource for the majority of structures. Wood was also the only fuel available in large quantities until relatively recently, and was also needed for tools or parts of tools (Taylor 1981). The archaeology of wood has been revolutionized by wetland archaeology, which has revealed that in some parts of Britain sophisticated wood technology and woodland management have existed certainly since neolithic times. Work in the wetlands of Florida has also revealed accomplished woodworking from the Archaic and other periods (Purdy 1992). Fuelwood was another fundamental locationally fixed resource for pre-industrial societies: in Europe, complex rights concerning the allocation of fuelwood had come into being by medieval times, in effect rationing the resource.

The relative importance of plants and animals in gatherer-hunter communities of the past has long been a matter of debate (Chapters 14 and 20). Ethnoarchaeological studies have shown how in some areas with low population densities, gathering-hunting lifestyles are both dependable and easier than agricultural lifestyles (Sahlins 1972) and that agriculturalists often revert, with ease, to gathering-hunting in times of poor harvest. When allowance is made for the bias in the record in favour of animal remains, it seems that many early farming communities were still partially dependent on wild food resources (Brothwell 1969; Dennell 1987; Zvelebil 1994). Ethnohistorical studies also provide examples of communities which span the continuum from vegetarian societies to those where the diet is predominantly meat. The taphonomic bias towards bones and agricultural plants in most environments places an extra premium on wetland sites, where wild plant foods may be preserved. Macrofossil databases (including some on the Internet: see Tomlinson and Hall 1996) illustrate how patchy the record is, both in time and space.

From the first use of stone tools, humans have sought rocks and minerals for industrial use. We can divide geological resources into those that occur in veins and bands (including gangue minerals), placer deposits and building materials which can be collected or quarried. How these resources were first located is virtually impossible to determine, but presumably natural outcrops in cliffs, stream beds, animal burrows and geobotanical knowledge all played a part. The large size of many early industrial sites suggests that the exploitation of the resources involved considerable organization of labour. In many low-lying or soft rock areas stone had to be imported.

Because soils are viewed as a resource today there has been a tendency to look at soil development and change in the Holocene in terms of the increase and decrease of an agricultural resource. The problem here is that fertility, which is controlled by many factors including natural soil chemistry, organic cycling and human additions, is only one of the controls on crop yield—others include crop species/variety, cultivation practices, weather and harvesting techniques. At the local scale the main control on soil processes is land use, so soil history is intimately connected to vegetation history. The construction of large areas of *plaggen* or human-made soils in north-west Europe shows how fertility is closely related to farming activity.

Water increases in value as a resource as its supply decreases since, for any farming other than dry farming, demand is essentially non-elastic. Especially in climates with a pronounced dry season this has led to major environmental modifications in areas of moisture deficit in order to gather and store water, whilst in wet temperate environments many societies have invested considerable expenditure on water engineering projects such as fish ponds, weirs and mill ponds.

It is through the analysis of resources and potential resources that the reconstruction of natural landscapes enters fully into social and economic archaeology. Indeed environmental archaeology is in large part a history of the what and where: the identification, location and conversion of potential to realized resources through innovation (Chapter 14).

HAZARDS AND THE NATURAL LANDSCAPE

The influence of natural hazards on culture and settlement formed a popular theme in archaeology up to the 1960s—classic, if often flawed, examples include the possible impact of flooding on the Indus and other civilizations (Raikes 1965, 1967) and the indisputable effect on Pompeii of the eruption of Vesuvius. More recently, the role of natural events has been somewhat marginalized as freak and of little importance in relation to the normative models of processual and post-processual archaeology.

However, work in environmental archaeology has progressed alongside the development of quantitative palaeoecology, with an increased interest in the role of climate change. The effects of unusual natural phenomena on past human societies can be assumed to have been greater than on modern westernized society. Physically, economically, and psychologically, people in Antiquity were less insulated from extreme events than today, even if this insulation was counteracted to a degree by cultural incorporation and geoteleological beliefs. If we take the extreme case of lightning-strikes, still today unpredictable and legally regarded as an act of God, many areas of the earth receive hundreds or thousands of strikes per year and death and injury are not as rare as might be expected. Before the invention of the lightning conductors, lightning-strikes would have been a common cause of settlement fires as well as the creation of forest clearings. While models of purposive forest clearance by the use of fire are well established, the opportunistic use of natural clearings has been neglected, despite ethnographic studies which show a range of fire-related behaviours from purposive and competent, through purposive and incompetent, to opportunistic (Pyne 1982).

Work is now underway on a wide range of environmental hazards, including storm surges (Bell 1992), earthquakes and floods (Brown 1996). This work is far more critical than previous 'catastrophe' studies and takes on board socio-economic work on human and institutional responses to hazards. It is in a sense ironic that one of the best ways to strengthen the current emphasis on models of socio-cultural causation for cultural change is to disprove any environmental causation, which can only be done through detailed environmental work.

RECONSTRUCTING NATURAL LANDSCAPES: FUTURE AGENDAS

The conceptualization of the landscape in archaeology has changed from a simplistic and determinist one in the early part of this century to the base of social, economic, and cognitive models. The increase in the variety of techniques available has led to a *gestalt*-like (sum—greater than its parts) gain in information, as these techniques not only complement each other but can generate completely new hypotheses. There have been significant advances in the power and use of environmental techniques to make useful statements about past landscapes. Whether these statements are archaeologically useful or not depends upon the purposes and paradigms of archaeology.

The use of ecological models has focused attention on the resource base and average conditions, but too often theories of adaptation have amounted to little more than descriptions of change (Shanks and Tilley 1987). They need not. One problem has been that anything more than this was tarred with the brush of environmental determinism.

Several areas of neo-deterministic work which seek to understand some of the complexities of the relationship between social processes and the natural environment and its perturbations are (re)emerging. This work seeks to avoid our predominantly western dichotomization of nature and culture and as such is neither atheoretical nor non-political. The agenda includes three areas of investigation. The first consists of studies of social and political response to natural events: a variety of perspectives can be taken, ranging from institutional, to the structural-Marxist, though all rest upon the processual linkage of event with response. Second are attempts to reconstruct aspects of cognitive processes important in the perception of nature (Renfrew and Zubrow 1990): one example is the 'meaning' of palaeolithic art and its relation to hunting and gathering activity and intentionality (Mithen 1991), along with the incorporation of uncertainty, risk and non-average behaviour (Allen 1989). Third are studies of the environmental effects of past social and political change, including migration, imperialism, and colonialism (MacKenzie 1990) —the biological expansion of Europe in the last thousand years can be regarded as only the latest chapter in a history of ecological imperialism (Crosby 1986). While these directions of research may, or may not, help to silence critics of environmental archaeology and environmental reconstruction (for example: Thomas 1990), there is no doubt that innovations in techniques and methodology will continue unabated, allowing more layers of the palimpsest that is the landscape to be revealed and related to history and contextualized social change.

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There are a number of textbooks on environmental archaeology but they are all rather dated now, which is not surprising due to the fast-changing nature of the subject over the last two decades. The recent books divide into two groups, those on Quaternary Palaeoenvironments and specialist texts on selected techniques or groups of techniques. In the former category there are now some excellent books for the British Isles, including Bell and Walker (1992), Jones and Keen (1993) and Chambers (1993). An excellent global perspective is given by Williams *et al.* (1993). The techniques-oriented texts are cited in the main body of this chapter but reviews of techniques applicable to certain environments exist and can be helpful, examples being Brown (1997) for alluvial environments or Cox *et al.* (1995) for wetlands, and there are several manuals for different types of environmental data, good examples being Lyman (1994) for vertebrate taphonomy or Courty *et al.* (1989) for soils.

In addition there are now a number of regional syntheses which deal with palaeobotanical or general Quaternary and/or geoarchaeological studies, two obvious examples being a palynological review of Europe or Berglund *et al.* (1996) and Quaternary river studies in the Mediterranean by Lewin *et al.* (1995).

7

STUDYING PEOPLE

Simon Hillson

INTRODUCTION

This chapter is about the ways in which the physical remains of people can be studied and interpreted. Its aims are to outline the types of information that may be derived from the study of human remains; to show how they relate to the biology of the once-living people that they represent; to introduce enough of the methodology to allow a critical appraisal of reported results; and to assess the archaeological relevance of the results.

FORMS OF BURIAL

The archaeological record shows a variety of methods for disposing of the dead. Today's most common methods, *inhumation* and *cremation,* are also the most common in Antiquity, but many different rituals and processes can take place before bodies end up in the ground or the fire. In some cultures the dead are exposed before eventual disposal either on the ground or on a raised platform, the soft tissue allowed to decompose, and the bones and teeth then collected for burial: placed in a jar, in an earth grave, or a chamber which contains the remains of other individuals. Such exposure results in the loss of bones and may cause some weathering even before they are buried.

In inhumations, the body may have been buried straight in the ground, it may originally have been wrapped in fabric or skin, or it may have been encased in a coffin. Burials without a coffin may be extended (with trunk and legs straight out), flexed (somewhat bent at the hip), and contracted or tightly flexed (with the knees tightly tucked up to the chest). Extended inhumations are usually stretched out horizontal in a long grave, but may be vertical in a deep pit. Many burials contain only one individual, but others contain several and, where these have been disturbed, it can be a difficult job to distinguish them. Some cemeteries include burials of men, women and children, whilst others may be adults of one sex only. In some, there is little evidence of organization of burials, whereas others may be highly ordered. In most cemeteries, there is a preferred orientation of graves, but this is not always the case. In addition, human burials are not confined to cemeteries, and settlement sites frequently include them. Burial of children under the house floor is well known in a number of cultures, and isolated human bone or tooth fragments are common finds in the deposits of most archaeological sites.

Cremations are very variable in nature. A modern crematorium uses a high and constant furnace temperature, followed by mechanical crushing of the remaining burned bone to produce a consistent type and quantity of ash. An open pyre cannot be controlled in this way, and the efficiency of crushing by hand after the actual cremation varies greatly. It is therefore not surprising that both fire damage and size of fragments in ancient cremations vary a great deal. Some can yield almost as much information as an inhumation, whilst others contain almost nothing that is recognizable.

PRESERVATION CONDITIONS

Bones and teeth survive well under most conditions of burial—whilst the organic components that they contain are lost to a widely varying extent, the calcium phosphates that make up their mineral component are very stable. After all, teeth can survive in the hostile environment of the mouth for a century or more during life, and conditions in the soil are not so different—abrasive, wet and acidic! The main enemy is acid groundwater, with pH 4 being the critical point, but only peat bogs and the poor soils of moors and heaths become as acid as this and it is only in such situations that the mineral component is lost.

The larger and more robust bones such as the long bones of the legs and arms are usually the best preserved, with the least fragmentation. The small bones of the wrists and ankles are less commonly found, partly due to poorer survival but also poorer recovery during excavation, although the two larger ankle bones (talus and calcaneus) and some of the foot and finger bones do commonly survive. Vertebrae are usually recovered in a moderately complete state, whereas the innominate bones of the pelvis are often present but tend to be heavily fragmented and damaged. The sheet-like bones of the cranial vault survive well, as does the heavily constructed petrous temporal which encases the inner ear—the latter may be the only recognizable part of the skull to survive under severe conditions of burial. Jaws and teeth survive well, but the thin bones of the upper face are often crushed.

Cremation fires have clearly recognizable effects. For example, in teeth which were present in the mouth at the time of death, the enamel rapidly fractures away and almost never survives, but in children whose teeth were still developing inside the jaws there is a measure of protection which can allow the enamel to survive (McKinley 1989, 1994). In the dentine of the tooth roots and the bone of the skeleton, the collagen fibres that they both contain shrink, first producing a characteristic crazing of the surface and then twisting bones out of shape and causing them to fracture into characteristically shaped fragments. The mineral phase of bone and dentine also changes, especially at higher temperatures, and there are some colour changes, although these may be modified during burial in the soil (Shipman *et al.* 1984).

Soft tissues—skin, muscle, tendon, hair, nails, the tissues of the viscera and so on —survive only in archaeological contexts where the fungi and bacteria that would normally break them down are suppressed. Most mummies, for example, are preserved by drying, freezing, freeze-drying, or a combination of these processes. The most dramatic instances probably result from freeze-drying which preserved, for example, several Inuit women and infants who had been buried in a rock crevice at Qilakitsoq, West Greenland, in AD 1475 (Hart Hansen *et al.* 1991). The very cold, dry, conditions preserved not only skin but also internal organs with microscopic histological details intact, hair, and seal-skin clothing. One of the world's oldest mummified bodies, the late neolithic 'Ice Man' from Hauslabjoch in the Ötztal Alps bordering Austria and Italy, was also preserved in dry, cold, conditions, although it was discovered frozen into a glacier. The body was desiccated, hard and leathery, as were the skin clothes worn at the time of death (Spindler 1993). By contrast, the bodies of sixth- to fourth-century BC chieftains buried under mounds in the High Altai mountains of southern Siberia were frozen damp, although they had also been partially mummified before burial: the muscles had been removed through slits in the skin, the cavities stuffed with grass and the skin sewn up again (Rudenko 1970). The body of a young Inca girl, sacrificed and buried at the summit of the volcano Ampato in the Peruvian Andes, was also largely frozen in the intense cold above 20,000 feet, though the head was desiccated (Reinhard 1996).

Survival of soft tissues in Egypt and Nubia is instead due to drying alone, where natural mummies are common at all periods because the hot desert sand dried out the body rapidly. Deliberate mummification as practised in Egypt involved the removal of rapidly perishable organs, followed by drying achieved by covering the body with natron (sodium carbonate), which drew out the water by osmosis. The mummies were then coated with oils and resins, which would have helped to exclude water once the body had been dried. Mummification reached its height during the 21st Dynasty, with careful packing of body spaces, fitting of prostheses and elaborate wrapping (Spencer 1982). The Chinchorro people of Chile had their own unique system of mummification, dating from around 6500 BC. In its most developed form, the body was skinned, its soft tissues removed, and a clay model built up around the skeleton, re-covered with the skin to make a doll-like figure (Arriaza 1995).

Soft tissues are also preserved where waterlogging in the soil excludes oxygen to the extent that microbial activity is greatly reduced. Under these conditions, preservation of soft tissues is enhanced if the groundwater is acid or high in phenols. The tissues best preserved in these circumstances are those which contain large proportions of the proteins collagen (which occurs in tendon, bone, dentine and cement) or keratin (which occurs in the surface layers of the skin, in the hair and in the nails). In highly acid conditions, the bones and teeth are lost completely, whilst the soft tissues are well preserved. Still other conditions promote the survival of keratin rather than collagen and here all that remains may be the hair and nails. The peat bogs of north-west Europe have yielded large numbers of 'bog bodies'. In some, preserved in acid peats, the bones and teeth have been entirely lost, leaving the skin, connective tissue and internal organs compressed into a thin layer. Lindow Man, discovered in 1986 in Cheshire, England, was of this type (Stead *et al.* 1986; Turner and Scaife 1996). In other bog bodies, such as that of Tollund Man in Denmark, the bone survived under less acid conditions to give almost perfect preservation (Glob 1969).

The same special conditions that promote soft tissue survival also allow the preservation of clothing, body decoration, hair and so on. The dry conditions of Egypt have preserved the world's earliest linen dress, dating to the I Dynasty at around 3000 BC. In Pazyryk, the most famous of the High Altai barrows, one of the bodies was preserved complete with heavily tattooed skin—vigorous sweeping animal designs in black material introduced through deep pricks in the skin; there were also shirts made of hemp fabric, and various other items of clothing made of woollen felt and serge fabrics. Similar frozen ground conditions preserved the woollen clothes of the Norse inhabitants of Greenland buried in the churchyard of Herjolfsnes, including robes, stockings and hoods (Krogh 1967). Face tattoos, sealskin parkas, boots and leggings were preserved in the women from Qilakitsoq, and the Ice Man had a leather shirt, loincloth and belt (complete with 'bumbag'), leggings and shoes, with a woven grass cloak, along with his weapons and tools. Clothes have also been preserved in the waterlogged conditions underneath the bronze age barrows of Jutland in Denmark; coffins made from split oak trunks also protected these burials and, whilst little remains of the bodies themselves, a whole variety of woollen cloaks, hats, dresses and footwear has been found (Glob 1974).

CONSERVATION

The conservation of soft tissues is a highly specialist job and a complete body represents a major problem but, fortunately in some ways, most remains are skeletonized. Where they are solid enough, bones and teeth are simply washed after excavation over a fine (1 mm) mesh to catch small fragments. They should be rinsed gently, never soaked, and should ideally be laid out to dry on trays lined with newspaper in an unheated but covered area. Particular care needs to be exercised around the ear region (to retain the tiny ear bones) and the jaws of children (to retain the developing teeth). For fine cleaning, an absolute alcohol or acetone soaked cotton wool bud is best (though both are highly flammable). At some sites, the bones are so fragmentary that conventional cleaning is impossible, and the remaining fragments have to be either lifted along with their supporting matrix, or gently excavated with wooden points before treatment by a conservator. When clean, the bones and teeth need careful storage and, in an ideal world, they would be maintained at the same level of humidity in which they were buried. This is rarely practicable, but the dry air of many heated stores is likely to cause some cracking. Normally, skeletons are packed into stout cardboard boxes with acid-free tissue paper.

COLLECTIONS AND POPULATIONS

Archaeological collections of human remains are often studied in a statistical way—that is, measurements and other observations of the individual remains in the surviving group are used to suggest the morphology, demography and health of the living human population from which they came (see pp. 281–5 below and Chapter 17). To do this it is necessary to assume that the process by which the individuals were selected from the living population was a random one. For this to be so, each person living in the population during a given time period would need to have had an equal chance of dying, then being buried in that cemetery and subsequently being excavated and joining the collection.

There are severe difficulties in this assumption. Reasoning backwards from the remains on the laboratory bench, these are unlikely to include all the remains of all the individuals contained in the cemetery from which they came. It is unusual for a whole site to be excavated and, even if this were the case, the skill of individual excavators varies widely and recovery could well be better in some parts of the site than others. It is not even safe to assume that the process of recovery was a random one: as described above, some elements have a distinctly poorer chance of recovery than others. Even if it were possible to recover all of the remains contained in the cemetery, it would still not include all the individuals buried there because sites become eroded, graves are disturbed (for example during periodic reorganizations or clearances of a cemetery) and the remains are weathered. Once again, many aspects of the process are likely to be non-random as adult remains generally survive better than juvenile remains because they are more robust, and some parts of the skeleton are more heavily constructed, and therefore more resistant, than others.

It is also difficult to determine the extent to which a cemetery really does represent any particular once-living population. The catchment area of a cemetery might well have included more than one distinct population and, if it were in use over some hundreds of years, then the characteristics of the population or populations included could well have changed. It is also not possible to say that the process of burial represents a random selection of individuals from the population/s, because there is ample archaeological evidence throughout the world of funerary segregation of the sexes, children and adults, and different classes (indeed, this is one of the interests in studying cemeteries). Furthermore, the individuals who die, and thus end up in the potential cemetery catchment, are a highly selected sub-set of a population—the very young, the elderly, the infirm and so on (see pp. 281–5).

Thus, it is almost never possible to say that a collection of human remains from a cemetery represents one population only. If, however, the collection is taken as representative of the general condition of populations within a broad area and time period, then this is an arguable position and supporting evidence can be gathered. Comparison with collections from other cemeteries nearby and in widely differing regions will make it possible to suggest the extent to which the collection under study fits into a regional trend. The homogeneity of skeleton size and shape within the collection may suggest the relatedness of the populations included, and the age and sex distributions of the individuals in the collection can yield evidence about their derivation (see p. 283). In all areas of work with human remains, however, a single collection from one cemetery can yield little reliable data on its own. It is when comparisons are made with other sites that more confident interpretations can be made and there is still insufficient attention given to comparative material. It should form part of project design at the planning stage.

SIZE, SHAPE, GENETICS AND POPULATION

There are about two hundred bones and thirty-two teeth in the average adult (Bass 1979; Brothwell 1981; Berkovitz and Moxham 1989; Hillson 1996). Young children have only twenty teeth but considerably more than two hundred separate bone elements, because many bones grow from separate centres. Even in adults, the total number of bones varies because there are many small additional bones that may be found in some people: someone with a really complicated set of these extra bones in their skull might add another thirty or so to the total. Similarly, although the normal number of teeth in the adult is thirty-two, the third molars (wisdom teeth) fail to develop in a large proportion of people, other teeth may be missing, and in some cases there are additional teeth.

All in all, the bones that make up the skeleton and the teeth that make up the dentition vary a great deal in size, shape and detailed features. In any one collection of material, this will partly be due to differences between males and females, or to the presence of both adults and children at different stages of the growth process. Adults of the same sex also, however, show considerable variation amongst themselves because people throughout the world look different and have differently shaped bodies, and this is reflected in their skeletons and dentition. Any one feature in an individual's bones or teeth is controlled by both the set of genes that they have inherited and the environment (in its widest sense) in which they grew up. Whilst physiological features such as blood groups can readily be related to individual genes, independent of environment, anatomical features in general are thought to be related to hundreds of genes and are quite strongly affected by the environment in which they developed. The exact balance between the two controlling factors is uncertain, and must vary for different features between individuals and between populations.

Metrical variation

For over one hundred years, the description and measurement of skull form have been a major area of research. Literally hundreds of measurements have been defined and a range of specialized equipment for taking them developed, including computer-controlled instruments that allow rapid measurement and reduce a skull to a set of three-dimensional coordinates. Until about 1945 many anthropologists believed that any skull could be classified into a 'racial type' on the basis of its form. Few would hold this view now, but most physical anthropologists would accept that there are general patterns in skeletal and dental form amongst the indigenous populations of the world. The largest studies of this kind are those of W.W. Howells (1973, 1989, 1995), who has shown that there are three main groupings of human skull shape: Africa south of the Sahara; Australasia; and Europe, Asia and the Americas combined. These groupings are paralleled quite closely by patterns of tooth crown morphology, and in the distribution of blood groups today. Dental and skeletal form are therefore routinely used to investigate the biological affinities of ancient populations.

One difficulty in analysing skull shape is its sheer complexity. The curved surface, with the variable joints between bones, makes it difficult to define measurements that can be repeated over and over again, and by different researchers, giving the same result. There is also the problem of what the measurements mean and what the most important aspects of skull shape are that need to be captured by them. Some measurements, for example, give general dimensions of major structures, like the cranium or brain box. Others just give the dimensions of individual bones within the main structures of the skull. Traditionally, linear measurements are taken between 'landmarks' defined on the skull surface, and most measurements are taken independent of one another—they literally are just single dimensions. It is possible to consider each one on its own, but to gain a record of overall shape it is clearly better to consider many together. This branch of statistics, termed multivariate analysis, in fact has many of its origins in the study of skull measurements (Marriott 1974).

Karl Pearson invented one of the first multivariate statistics, the coefficient of racial likeness, largely for use on skulls brought back to University College London from the excavations of Flinders Petrie at the end of the nineteenth century. Barnard similarly carried out one of the classical applications of discriminant analysis on four series of Egyptian skulls (Kendall 1975). Discriminant analysis is frequently used nowadays to demonstrate the extent to which groups of skulls can be distinguished solely on the basis of their measurements. The more reliably this can be done, the more divergent the groups as a whole are in skull form. The main difficulty in applying multivariate analysis to archaeological material is that the fragmentary nature of the skeleton often does not allow the same set of measurements to be taken for each individual. This is known as the problem of missing data or incomplete information and, whilst it is not confined to archaeology, causes particularly severe problems because none of the standard multivariate techniques will tolerate any missing data (Scott and Hillson 1988).

Non-metrical variation

Such measurements are known as continuous variants—that is, they vary continuously over a range, and any value of measurement within that range is possible. In addition to continuous variants, there is a large variety of small features in the skeleton and dentition which are not normally measured, termed non-metrical variants. These include anomalies in the sutures of the skull, or the presence of more than one foramen (a hole in a bone for the passage of nerve of blood vessels) where normally there is one, or an extra cusp on a tooth. They are recorded either as present or absent, or by some scale of scores expressing how strongly developed the feature is. Some of the features that are normally classified as non-metrical variants are really nothing more than continuous variants for which it is difficult to define a measurement. Other variants, however, behave in a different way. Whilst they do vary continuously when they are present, they can be absent completely.

The most extensively researched example of this is the presence and size of the third molar. This tooth is the most variable in the dentition, both in size and in form. It is also the tooth which is most often congenitally absent—up to one-third of the population may lack one third molar (or more) (Hillson 1996). This type of variation is called quasi-continuous. There is an underlying variation in third molar size which only becomes expressed when it reaches a certain threshold size. Above the threshold, the teeth vary continuously, whilst below the threshold they are not formed at all. Other dental variants such as presence and form of cusps or fissures in the crown probably function in a similar way, and have been carefully defined as a series of plaster models which form the Arizona State University system (Turner *et al.* 1991).

The interpretation of the frequencies of non-metrical variants is difficult. Dental variants have yielded consistent results, for example showing relationships between groups of Native Americans which are matched by other evidence for their affinities (Hillson 1996). Skeletal variants have so far tended to produce anomalous results, both when compared with skull measurements and other data (Berry and Berry 1967, 1972). It could well be that the systems for scoring them are simply recording the wrong aspect of them. Rather than their presence or absence, the continuous part of their variation might be the important thing.

Facial reconstruction

The underlying skull morphology does have an influence on the form of the face in living people, but the relationship is complex. First attempts to reconstruct facial appearance during the 1880s and 1890s included the skulls of Johann Sebastian Bach and Josef Haydn (Iscan and Helmer 1993) and used drawings based on skull profile, or clay modelling on a cast of the skull. With the addition of photographic superimposition and computer modelling techniques, these have remained the main methods. During the twentieth century, one centre for development of facial reconstruction for forensic purposes has been Russia, with the work of Gerasimov (1971) and colleagues. Their work included reconstructions based on archaeological skulls and, more recently, the British medical artist Neave (Prag and Neave 1997) has reconstructed heads from Egyptian mummies (David 1978; Neave 1979), Lindow Man (Stead *et al.* 1986) and Phillip of Macedon (Prag *et al.* 1984). Most reconstructions use figures for average thickness of soft tissue overlying particular landmarks on the skull, combined with a knowledge of the different muscles and other structures. Tests of reconstructions against photographs in forensic cases have yielded mixed results (Iscan and Helmer 1993) and, as might be expected, whereas the general form of the main features can be established in many cases, the important features of subcutaneous fat, hair, eyebrows, beard, ears, eyes and set of mouth are very difficult to determine. In a forensic case there may be other evidence to suggest these features, but in archaeology this is only possible when the reconstruction is of an identifiable historical figure, with associated portraits or statues.

MEN, WOMEN, AND DON'T KNOWS

All the primates, including humans, show sexual dimorphism, or a difference in form between males and females (Aiello and Dean 1990). It is more prominent amongst the Old World Monkeys, the Great Apes and ourselves, but amongst this group is greatest amongst the baboons and least in humans. Men are none the less noticeably larger and more bulky than women, and men's bones tend to be both bigger and more heavily built, with larger and more sharply demarcated areas for the attachment of bulkier muscles. Men also have larger and more heavily buttressed jaws, containing larger teeth—the canine, for example, is about 6 per cent larger in men than in women.

Length of long bones is highly correlated with stature, and for any long bone there is usually a statistically significant difference between men and women in one population (Brothwell 1981; Sjøvold 1988). There are similarly significant differences in the diameter of long bone shafts at their mid-point, and the major joints at the ends of long bones are also more robustly constructed in men. Measurements of the hip joint are amongst the more reliable discriminators, and the width of the knee joint is also strongly dimorphic, together with the size of the patella. Measurements of joint surfaces are more useful in archaeology than long-bone lengths or mid-shaft diameters, because bones often break along their length.

As well as differences in size and robustness that can be measured, some bones show differences that are evident with the naked eye. The best examples of this are the bones of the pelvis, the sacrum and the two innominate bones, which in humans form a bowl-like structure, broader and shallower in women than in men. The innominate bone in women is more 'stretched out', leading to differences in the shape of the pubis, the narrowness of the sciatic notch and the rotation of the auricular area (the joint surface for the sacrum). Similarly, the sacrum in women is broader and shorter, and its own auricular area is relatively short because of the rotation of the joint. Whilst these differences are easy to see when comparing two bones directly, they are much more difficult to assess objectively. Measurements have been developed but, lacking any well-defined landmarks, they are not very repeatable and measurements of long bones are more reliable.

The skull, including the lower jaw, is another traditional part of the skeleton for sex discrimination. The muscle groups that support the head on the neck are on average bulkier in men than in women and their areas for attachment on the base of the skull are larger and more prominently defined. The larger size of the jaws in men is shown in the greater robustness of the mandible and in measurable differences in the size of the palate. The teeth themselves are larger, if only by fractions of a millimetre, and tooth measurements can distinguish correctly between males and females in more than 80 per cent of cases. The buttressing of the upper jaw, which passes around the side of the eye sockets and up the front of the cranium, or brain box, is more pronounced in men than in women. In addition, the main muscles which operate the jaw, the temporalis and masseter, are bulkier in men than in women and their areas of attachment on the cranium and mandible are more extensive and more strongly defined.

In all of these features, however, there is considerable overlap between men and women, so that any study of human remains will inevitably have a group of individuals whose sex cannot be established. This may be due to damage which has removed the most diagnostic parts, but there are also always some individuals who are genuinely intermediate in form. Because of this, it is unwise to imagine that sex can be ‘diagnosed’ definitely one way or the other: it is always a balance of probabilities and, for this reason, it is generally better to carry out a statistical study of measurements. The usual technique is discriminant analysis, which makes it possible to assess the reliability of the measurements taken in a ‘baseline group’ of individuals from the collection under study whose apparent sex is particularly clear from the pelvis and skull. Where the measurements do seem to be reliable discriminators, the same techniques can be used to classify the remaining individuals from their measurements.

One remaining difficulty is in the distinction between skeletons of girls and boys, rather than adults. The main skeletal differences between men and women develop only after puberty and any discrimination developed from measurements on the skeletons of adults could not be applied to children. One answer is to use dental measurements (Hillson 1996) as teeth, once formed, do not change in size—their crowns are full-sized as soon as they are completed and can therefore properly be used to distinguish between males and females even amongst children. Another possibility for sex identification in the remains of children is to attempt to amplify DNA from the X and Y chromosomes, which has now been demonstrated in some archaeological infant remains (see pp. 299–301).

GROWTH AND AGEING

The process of growth in children and young adults leads to a whole range of changes in the skeleton and dentition, which can be seen clearly in archaeological material. A great deal is known, largely from X-ray studies of living children, about the pattern and timing of these changes, and they form the basis of a variety of methods for estimating age at death. On the whole, development of the dentition is thought to vary less from individual to individual than is skeletal growth, and the earlier stages vary less than the later stages of development, so that estimates for young children are more precise than those for older children, adolescents or young adults.

In most parts of the skeleton (the limbs, the vertebral column, the ribcage, and the base of the skull), the bones grow in the first place as cartilage, an organic tissue which is later replaced by bone—a process called endochondral ossification. A few weeks before birth, a small patch of bone starts to form in the 'primary centre' of ossification within the cartilage precursor of the bone and then, in the first year after birth, 'secondary centres' appear for the joint areas at the ends. Some years later, more secondary centres may appear at major bony extensions for the attachment of muscles. Eventually, the whole structure is replaced by bone, except for thin, convoluted plates of cartilage between the various centres of ossification. Growth still occurs in these plates until, at varying ages depending upon which part of the skeleton is involved, they are replaced by bone themselves (Fig. 7.1).

This process is gradual and varies between individuals, not only due to inherited characteristics but also to dietary differences, medical history and so on. It is, however, possible to gain an approximate idea of age at death by comparing the state of fusion of bones in a skeleton with standard tables derived from X-ray studies of living children (Bass 1979; Brothwell 1981). In very young children, where secondary centres are little developed, or so small that they are not easily recovered, it is possible to gain some idea of age at death from the dimensions of the primary centres of ossification of the main long bones. The various elements of growing bones look quite different to the adult form.

Between 1912 and 1938, T.Wingate Todd and colleagues assembled a large collection of skeletons dissected from cadavers from two hospitals in Cleveland, Ohio. This Hamann—Todd collection is most well known for the demonstration of a relationship between age and the form of the bony joint surfaces of the pubic symphysis (the joint at the front of the pelvis). In young individuals, these surfaces are crossed by a series of ridges and furrows (Todd 1920, 1921). With increasing age, the furrows are filled in until a relatively flat, smooth surface is produced, with well-defined edges. These edges then become more prominent, until a marked rim is produced, with a concave surface inside. In later adulthood the surface starts to break down into irregular pits and nodules. Todd's original work has been challenged and new age estimation schemes have been developed. The first of these arose from a study of the bodies of young men shipped home to the USA from the Korean War (McKern and Stewart 1957). Studies of women followed (Gilbert and McKern 1973), and still more studies were carried out by Judy Myers Suchey and colleagues using specimens collected from well-documented cadavers in the Los Angeles County Department of the Chief Medical Examiner-Coroner (Katz and Suchey 1986; Suchey

Figure 7.1 Line of epiphyseal fusion in the distal end of a human femur, with the surface of the knee joint downwards. The bone is from a modern anatomy collection, and has been sectioned to show the internal trabecular structure and thin outer jacket of compact bone. Source: S.Hillson.

1979). A series of casts is available, showing different phases of development for males and females, with affiliated age ranges. These age ranges are still quite large and, as with most methods of ageing adults, only a broad estimate can be achieved.

Other age estimation methods are based on the auricular area of the innominate bone (Lovejoy *et al.* 1985), and the joints between the sternum and ribs (Iscan and Loth 1986a, 1986b), but one traditional method, fusion of the skull sutures, has had a chequered history. Sutures are the closely fitting joints between the flat bones that make up the skull vault. It used to be thought that, with increasing age, these joints were obliterated in a clear sequence. The reliability of this method was challenged by the work on the Korean War dead and, although recent research has taken sutures seriously again (Meindl and Lovejoy 1985), it does not seem possible to make precise estimates of age.

Whilst the formation of tooth crowns and roots takes place in clearly defined stages, eruption (their gradual movement through the jaws and gums into the mouth) is a continuous process, without clear stages, and carries on into adult life. It follows that tooth formation is the more reliable indicator of age at death. The timings of start of formation, completion of the crown, and completion of the root are known for different teeth from X-ray studies of living children, although these are difficult to apply to archaeological material. It is easy to see in archaeological jaws (Fig. 7.2) when the crown or the root have been completed, but these events are difficult to recognize on X-rays and have, in any case, to be interpolated between X-rays taken at intervals of months or years. Nevertheless, standard tables are available, and the development of the two dentitions is regarded as one of the best guides to age at death in children and young adults.

All the deciduous or milk teeth start to form before birth, and all their crowns are completed within the first year after birth. Their roots are completed by two or three years of age. The permanent teeth can be divided into three groups. The first molars start

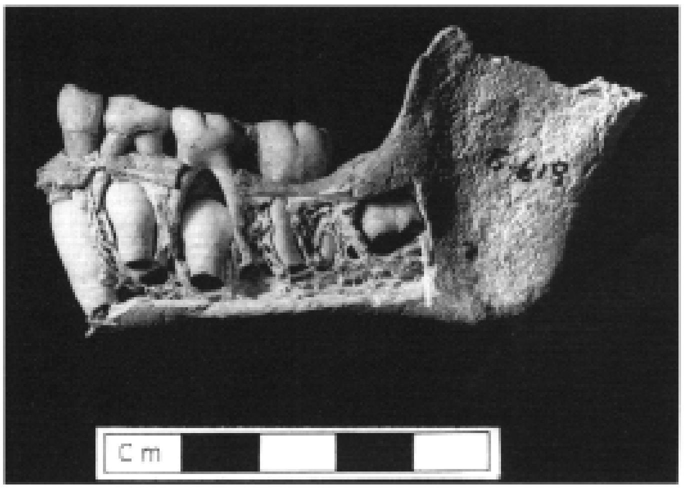

Figure 7.2 Developing teeth in the lower jaw of a child, around 7 years of age at death. The outer plate of bone has been dissected away to show the developing permanent canine, premolars and second molar still in their crypts. The deciduous canine and molars, and the permanent first molar, are erupted and worn. Source: S.Hillson.

to form just before birth, and the incisors (except the upper second) and canines start early in the first year after birth, their crowns being completed between two and six years of age. Next come the second upper incisor, the premolars and second molars, which start to form from the end of the first year to the third year, their crowns being completed between four and eight years of age. Last are the third molars, or wisdom teeth, which only start to form between seven and fourteen years of age or so, and their growth is so variable that it is difficult to use for precise age estimates, but completion of the third molar roots during the twenties marks the last phase in dental growth.

The timing for dental growth becomes more variable with increasing age, so the earlier forming and erupting teeth show less variation between children than the later forming teeth. Similarly, for any one tooth type, the start of crown formation is less variable than the completion of the crown, which is in turn less variable than the completion of the roots and the timing of the appearance of the tooth crown in the mouth. It follows that age estimates based upon the growth of the crown, in particular, are better than those based upon root formation and eruption of the teeth. The eruption state of teeth in relation to each other, and to the bone of the jaw is, however, still less variable than skeletal growth changes and forms part of several standard age estimation tables (Smith 1991). In practice, the sequence of dental development varies from individual to individual, and some dentitions are difficult to place in one of the standard stages. Decisions of this kind can be made clearer by seriating the dentitions in a collection, from least to most developed.

It is important to realize that standard tables summarize developmental age, which is not the same thing as chronological age. It so happens that the dental development stages correspond with chronological ages more closely than do skeletal development stages, but diet, medical history, genetics and social factors all combine still to produce variation. The age standards have been developed largely from X-ray studies of healthy, well-nourished children from prosperous communities in the USA and Europe. They will not be representative of children in a death assemblage, who are much more likely to have suffered ill health and therefore to have had a more interrupted and slower development. The suggested ages are likely to be too young for them, even if the death assemblage is that of the population in which the growth studies were carried out. This will be doubly so if the archaeological material represents a population which did not have the health care and lavish diet of the middle class in the modern West.

Tooth wear is also an important method of age estimation (Hillson 1996). Molars are normally used, because the extent of 'occlusal attrition' (the wear produced by the upper and lower teeth rubbing together) can be monitored by the changing pattern of internal structure exposed in the facet. Most of the molars have four main cusps, and as the layer of enamel is penetrated, small dots of the yellower dentine show in the facet: first one, then two, three and four (Fig. 7.3). The dots increase in size until two of them coalesce, then three and then all four, so that a 'peninsula' of enamel is isolated in the middle of the facet. Finally, the enamel is confined to a rim around

Figure 7.3 Occlusal attrition in lower teeth of an adult; the enamel surfaces of the molars have been worn down flat to expose areas of softer dentine. Source: S.Hillson.

the circumference of the facet and the softer dentine forms a dished area in the middle. Wear may proceed until only remnants of the roots are left.

One of the most widely used methods for estimating dental attrition age is that of Brothwell (1981): a standard series of diagrams is used to assign molars to one of four stages, which have broad age ranges attached to them. The method was developed for pre-medieval British remains, but has been used throughout the world. Another method is that of Miles (1962), developed for an Anglo-Saxon cemetery in England, involving seriation of jaws in terms of severity of molar occlusal attrition. In the younger individuals, the development of roots, compared between first, second and third molars, can be used to calibrate the rate of attrition. If this rate is assumed to remain constant, then the remainder of individuals in the series can be assigned an age. In spite of this untestable assumption, the Miles method also seems to perform consistently (Kieser *et al.* 1983).

RECONSTRUCTING DEMOGRAPHY

In general biological terms, the course of our lives can thus be split into two phases —growth and maintenance. During the growth phase the skeleton and dentition gradually attain their mature form. During the ensuing maintenance phase the mature forms of the skeleton and dentition are actively maintained and there are progressive changes due to the processes of disease and ageing. In terms of modern populations, the dividing line between growth and maintenance occurs between twenty and thirty years of age. As we have seen, the age estimation methods available for the growth phase yield much more precise ages than those available for the maintenance phase. The difficulties posed by these contrasts are apparent if one compares the graph of age at death for a modern population with the graph estimated for ancient communities from their skeletal and dental remains (Waldron 1994).

Figure 7.4 shows the distribution of age at death for the people of rural Egypt who died during the year 1971–72. First, it must be remembered that, in any age at death graph, the individuals included cannot represent a cross-section of the ages of people in the living population concerned: they are a particular section of the population, and the diseases, accidents and conflict that they died from do not affect all sectors of the population in the same way, and some age groups are more likely to suffer than others. The most common age at death in the graph is between birth and five years—the 'early childhood peak'. This is followed by a period between five and fifty years, when death is much less common—the 'mid-life trough'. After fifty years of age there is a gradual rise to a peak at seventy-five or more years—the 'late adulthood rise'. This pattern is the same the world over. The early childhood peak may be much smaller, but it is always there. The mid-life trough may be deeper, shorter or longer, but it is always followed by a late adulthood rise. This arrangement is not only biological fact, but also makes common sense. Young children are vulnerable, especially where there are problems with nutrition and health care, and,

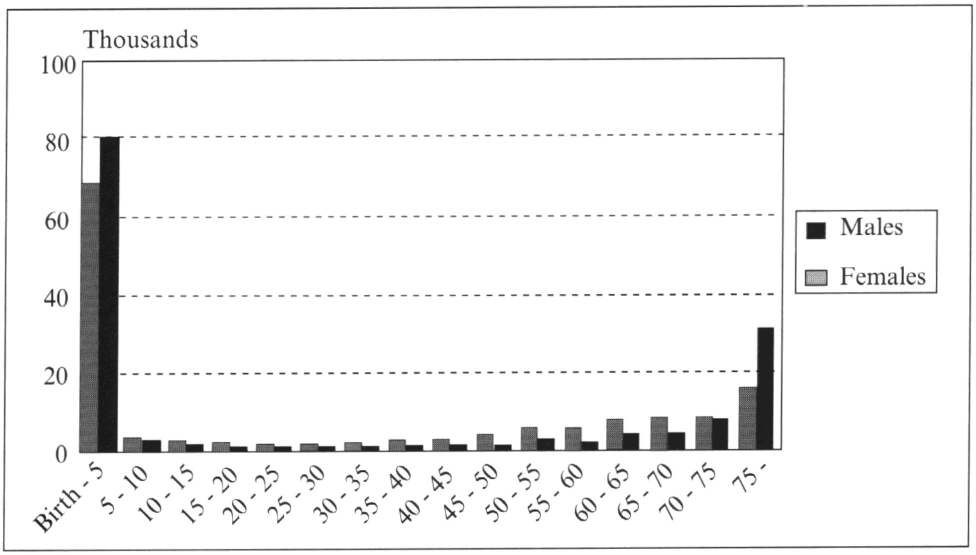

Figure 7.4 Age-at-death distribution for Egypt outside major cities, 1971–72. (Data from *Demographic Yearbook 1974,* 26th issue, New York: United Nations, 1975.) Source: S.Hillson.

similarly, the elderly become progressively more at risk with advancing age. It is apparent that the often-quoted average age at death of a population has little to do with the most likely age at death. For the graph in Figure 7.4 the average age at death is thirty-one years for both males and females—right in the middle of the mid-life trough when fewest people died.

Figure 7.5 compares the modern distribution with a graph of age at death estimated for 941 individuals collected from thirteen ancient Egyptian and Nubian cemeteries. It is an entirely different graph. There are very few children at all, let alone 0–5 year olds. The main peak is between thirty and forty years of age, and the estimated ages fall off rapidly after this. Most of the sites were excavated during the late nineteenth and early twentieth centuries, when recovery methods may not have been ideal, but many more recently excavated sites show a similar pattern, entirely contrary to what might be expected from any study of recent populations. Whilst it must be admitted that the difference could be due to a strongly contrasting biology in the ancient populations from which the cemetery collections were derived, this seems on the face of it to be very unlikely; a simpler explanation is that either the collection studied does not represent the original death assemblage, or that the methods for estimating age are faulty, or both.

Accepting that a death assemblage cannot be a cross-section of the living population, the human contents of a cemetery cannot represent a completely unbiased sample even of the death assemblage. In recent Egypt, it was common practice for young children to be buried under the house instead. This could partly explain the low frequencies of children in ancient cemeteries, but another factor may be the delicate nature of young skeletons and dentitions. They are less well preserved, are harder to recover and harder to study.

What of the paucity of older adult remains? The age standards for them are largely derived from post-mortem material and are thus likely to be applicable to a death assemblage, but the difficulty probably lies in their low precision. In dental attrition, joint surface changes or histological changes, the correlation with age is never very high and the variation between individuals becomes ever larger with increasing age. Age estimates for elderly individuals are therefore much less precise than for younger adults. There is only a limited number of broad age categories that individuals can be fitted into, and the oldest is likely to be very broad indeed—'forty-five years or older' for example. It is not surprising, therefore, that age estimates for adults tend very much to be underestimates.

The balance between males and females seems to be affected less by archaeological processes. Roughly the same proportions of boys and girls are born in most populations, with a slight preponderance of boys to give ratios from 101:100 up to 113:100. The age at death graph in Figure 7.4 contains 148,463 boys and men, and 149,390 girls or women—a ratio of approximately 100:100. During the same year (1972), 614,159 boys and 573,127 girls were born, or a ratio of nearly

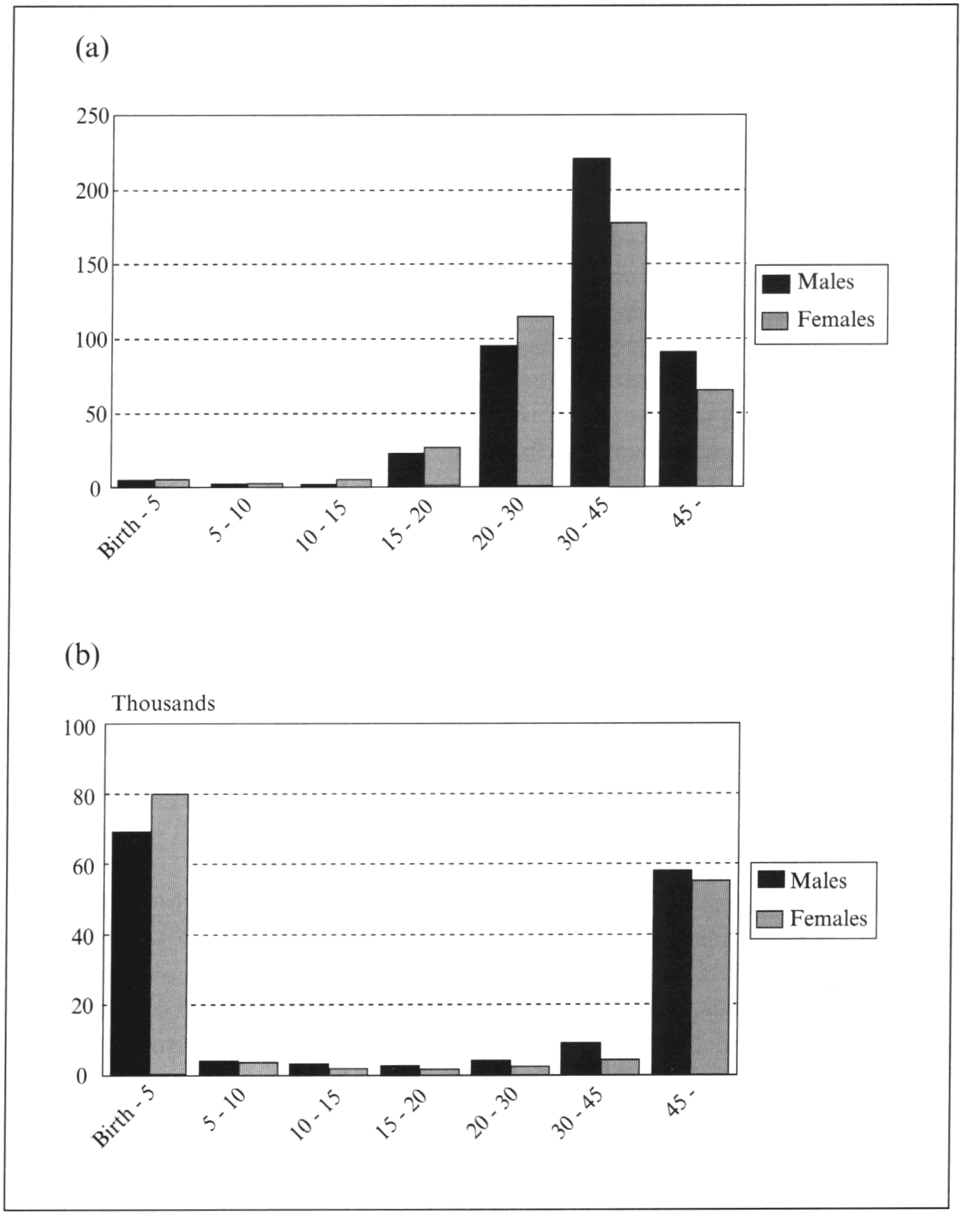

Figure 7.5 (a) Distribution of estimated age at death for thirteen cemeteries from Egypt and Nubia, ranging in context from Predynastic to Roman (data from author's Ph.D. dissertation, University of London). The age categories reflect the variable precision of age estimation methods in archaeology, (b) Data from Figure 7.4 arranged into the same age categories as Figure 7.5(a). Source: S.Hillson.

102:100. Girls and women, therefore, seem overall to have had a slightly increased chance of joining the death assemblage. This difference arises in childhood, when young girls tend to die at a slightly higher rate than young boys (the ratio is 100:108 for the under-twenty-year-olds in the graph). At every other stage, girls and women die at lower rates than men (the ratio is 106:100 for individuals twenty years of age or older). Accepting that children are not well represented in archaeological material and that it is difficult, in any case, to sex young individuals, the sex ratio would be expected to show slightly higher proportions of males. For adults in the graph derived from archaeological material in Figure 7.5, there are 436 males and 356 females, a ratio of 110:100. This is not far from the expected figure and, given the vagaries of archaeological recovery, is a close result. The slightly increased proportion of males could be due to the slightly more robust nature of the male skeleton which could lead to better preservation, and it is also possible that there is a bias towards males in the identification of sex from the skeleton.

HEALTH, NUTRITION AND SOCIAL CONDITIONS

Archaeological remains give a variety of information about health, but the most common features relate to injury, joint disease, dental disease and a limited range of infectious diseases.

Trauma

Injuries are amongst the most common conditions seen in ancient skeletons, although they still affect only a limited proportion of the individuals studied at most cemeteries. Of necessity all are injuries that have involved at least some fracturing or cutting of the bones. When this occurs and the individual survives, the break is first immobilized by a *callus* of rapidly formed bone, which is then gradually replaced by normal bone in the process of consolidation, and finally the bone contour is remodelled back to something approaching its original form. The extent to which the original appearance is restored depends largely upon the amount of displacement that occurred on either side of the break (Fig. 7.6). There are many archaeological examples of extensive and massively displaced fractures which have not only consolidated but also remodelled implying that, in spite of severe injuries, the individual has survived for many years afterwards. Similarly, there are many examples of fractures where no healing has taken place, where death presumably occurred soon after the injury was inflicted and, on occasion, it is possible to postulate the events leading up to death (Manchester 1983; Wells 1964).

Figure 7.6 Healed fracture in the shaft of a tibia; the bone has been displaced to one side but has healed well. Source: S.Hillson.

Some types of fracture are commonly sustained when someone trips and falls. The end of the radius just above the wrist is frequently broken when the hands are stretched out to stop a fall. This is known as a Colles fracture, after a Dublin surgeon named Abraham Colles who reported it in 1814. A similar type of fall, onto the outstretched arm, is often the cause of a fractured collar bone or clavicle. A stumble may also cause injuries to the tibia, and especially the fibula, just above the hinge joint of the ankle. These are usually termed Pott's fractures, after Percival Pott of St Bartholomew's Hospital, London, who described them in 1769, and are related to strong twisting forces on the foot. They are especially common, for some reason, amongst Anglo-Saxon men in British cemeteries (Wells 1964). In recent times, skull fractures have most commonly been to the lower jaw, followed by upper jaw, cheekbone (zygomatic) and then nose, a pattern relating largely to car injuries in which unsecured front seat occupants are thrown forward against the dashboard. Over the past few decades, cheekbone fractures have become more common and lower jaw fractures less common, and this is thought to represent a rise in violence at a time when seatbelts have become more commonly worn world-wide (Banks 1991). It is clear that interesting social interpretations could be made from the pattern of fractures.

Other injuries seem to be more clearly related to violence inflicted by people on one another. A break halfway down the forearm, involving both radius and ulna, is often caused when the arm is raised above the head to parry a blow. Such fractures are common in the skeletons of both men and women in Nubian cemeteries of a variety of dates (Wells 1964). There is evidence that the lower leg was a common site of injury in fighting with the long, broad sword of early medieval Europe, where the weight and length of the sword facilitated a rapid disabling blow to the leg below the shield. This is seen, for example, in the graves of warriors killed in AD 1361 at the battle of Visby on the island of Gotland (Wells 1964).

Skull fractures are common in some archaeological material, although they are most commonly fractures to the cranial vault rather than the face. In most cases these are well healed, but a proportion were either the fatal injury or occurred in association with other fatal injuries. Some must be due to falls directly onto the head, but most probably result from blows with a stick, club, mace, sword, spear and the like, and the varying outline of the lesion presumably reflects the type of weapon and mode of attack. Occasionally there is clear evidence of cuts from swords and axes, with secondary cracking around the main cut (Courville 1965a, 1965b; Manchester 1983). Where a projectile was the cause of the injury, it sometimes remains embedded in the bone as, for example, in a man buried outside the iron age British hill-fort of Maiden Castle with a Roman *ballista* bolt lodged in his spine (Wheeler 1943), or the tip of a flint arrowhead embedded in a sternum from Stonehenge (Manchester 1983).

One special case of skull injury is ‘trephination’, where a hole is deliberately cut in the cranial vault (Brothwell and Sandison 1967). This has been described in ancient skulls throughout the world and may have been carried out with a variety of intentions. In many cases it seems likely that some form of medical treatment was being attempted, but other rituals and beliefs may well be involved. Over one half of known trephinations show full healing of the bone, with a smooth remodelled edge to the hole. There may also be more than one—seven healed trephine holes are present in one South American skull.

At first sight, a study of the distribution of fractures amongst ancient people has great potential for elucidating some fundamental social changes, and there are some fascinating stories that can be developed around individual cases or cemeteries, but there are considerable difficulties at a population level. Although they are common relative to, for example, cases of infectious disease, fractures rarely involve more than a few per cent of individuals and, once a collection of skeletons has been broken down into comparable groupings of different sexes and age categories, there are not many cases left in each group. With all the vagaries of archaeological evidence, it is difficult to draw general conclusions from such data.

Joint disease

Joint disease (Rogers and Waldron 1995) is the most common type of pathology seen in archaeological skeletons—in many collections, almost all adults above middle age are affected. The changes can be grouped under two headings: bone proliferation, and erosion.

Bone often proliferates at the margin of the articular cartilage which forms the bearing surface of synovial joints such as the knee or hip, or where the edges of the intervertebral discs join the bodies of the vertebrae in the spine. In both situations, a frill of bone known as an 'osteophyte' runs around the edge of the joint. Osteophytes are very common in archaeological material and they are often found in association with other signs of joint disease, but they may also occur on their own. They increase generally with old age. Outgrowth of bone may also occur (but much less frequently), actually within the fibrous edge of the vertebral discs, to fuse vertebrae into the characteristic 'bamboo spine' of ankylosing spondylitis (AS for short). Such spines are spectacular, but rare finds. Slightly more common is fusion of vertebrae by ossification of the ligaments which run up and down the front of the spine, to give a 'dripping candlewax' appearance which is characteristic of the unrelated condition diffuse idiopathic skeletal hyperostosis (DISH). In this disease, it is also usual for bone to proliferate in the enthesis (the point at which a tendon joins the bone) of the knee and the Achilles tendon. Such 'enthesophytes' may also be found in skeletons where there is no evidence of DISH, and may be an indicator of injury to tendons due to heavy and repeated use of a particular part of the body, but they are little understood.

The word 'erosion' used in joint pathology implies a loss of the compact cortical bone layer which underlies the surface of synovial joints, to expose the underlying spongy trabecular bone. This is difficult to be sure about in archaeology because the ends of long bones, with their thinner layer of cortex, tend to suffer more postmortem damage than the robust shafts. Erosion (without proliferation) in the hands and feet is typical of the inflammatory condition rheumatoid arthritis (RA), but very few cases have been seen in archaeological material. This may be because bone changes only appear at an advanced stage, or because hands and feet do not survive well archaeologically. Bone is much more commonly lost in a different process which involves the flat plates of bone forming the top and bottom of vertebral bodies, and to which the discs are attached. 'Degeneration of intervertebral discs' is marked by a pitting and roughening of the plates, usually accompanied by proliferation of osteophytes around their edge. This condition is very common in archaeology, especially in the base of the neck and in the lower back. Sometimes, a particular form of indentation in the bone plate, called a Schmorl's node, is caused by the pressure of material bulging out from the disc when it becomes herniated (a similar herniation which causes pain by pressing against a nerve is the injury called 'slipped disc').

The most common joint condition seen in archaeology, however, is the disease of synovial joints known as osteoarthritis (OA), caused by a degradation of the articular cartilage which coats the bony bearing surfaces of the joint. The underlying bone, which is what remains for archaeologists, may show pitting or an abnormality of contour or, when the cartilage has degraded completely, a shiny polished and grooved surface where bone has moved directly on bone. This defect is known as eburnation and is considered to be pathognomonic, or unambiguously diagnostic, of OA (Fig. 7.7). Changes to the joint surface are usually accompanied by osteophytes, but not always. Any of the body's synovial joints may be affected, but OA is particularly common in the hands, the accessory (non-disc) joints of the spine, the joint between clavicle and scapula which forms the point of the shoulder, the base of the big toe, the knee and the hip. The last three are clearly along an axis of heavy, lifelong, mechanical stress, and there is some association of OA in these joints with obesity. In addition, OA becomes progressively more common with increasing age, so it is often regarded as a condition related to progressive wear-and-tear of the joints through life. This has led to the idea that the distribution of OA can be indicative of activity and occupation in ancient people, but there is little clear evidence for a relationship between occupation and OA epidemiology in living populations. Similar claims for the distribution of enthesophytes are also difficult to support. With all the vagaries of derivation of archaeological material, a great deal of caution is needed before interpreting OA data. In addition, although the relationship of OA to age requires the rate of disease to be compared only between equivalent age groups, this relationship is not strong enough for it to be used in age-at-death estimation.

Dental disease

Dental diseases are probably the most common of all in archaeological collections (Hillson 1996). At some sites virtually all adults are to some extent affected, and a proportion of children may be involved as well. The main group of diseases is related to dental plaque, the deposits of bacteria and their products which build up on the surface of teeth. Even with effective brushing, plaque is impossible to remove entirely and, in the absence of any oral hygiene, the deposits grow until checked by abrasion

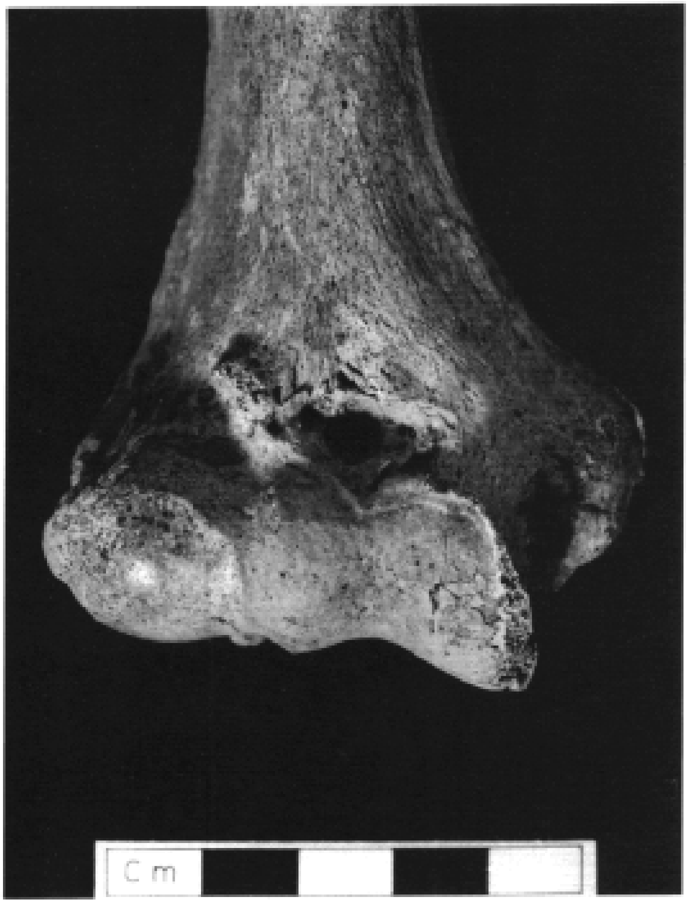

Figure 7.7 Osteoarthritis in an elbow joint; the joint surface to the distal end of the humerus is shown, with a clear area of eburnation and development of osteophytes. Source: S.Hillson.

from lips, cheeks and tongue. Plaque deposits often become mineralized in life, to produce the hard material called dental calculus or tartar. Calculus deposits are extensive in most archaeological collections, suggesting that oral hygiene was of limited efficiency. The cell walls of the bacteria in plaque are mineralized during the formation of calculus so their outlines can be seen clearly in scanning electron microscope pictures of ancient calculus, and in effect they are fossil bacteria.

Another indicator of the presence of dental plaque is the loss of bone due to periodontal disease. The plaque bacteria provoke a reaction from the body's immune system, and long-standing plaque deposits produce periodic bouts of inflammation in the gums, so that even people with regularly brushed teeth have some evidence of low-level inflammation somewhere in their gums. When these bouts of inflammation reach a certain level, the swelling of the gums allows plaque bacteria to enter the small groove in the gums around the base of the tooth crown. Once this has occurred, more severe bouts of inflammation ('periodontitis') may damage the joints that hold the roots of the teeth into their sockets. When this connection has been broken, the supporting bone around the sockets starts to resorb and, with repeated bouts of periodontitis, the whole jaw is remodelled and eventually the teeth are lost. Once this has happened, the bone heals over to produce a smooth, compact surface. Periodontal disease is the most common cause of tooth loss in living populations and seems to have been a major cause in the past as well—many adult archaeological jaw specimens show larger areas of exposed tooth roots than would normally be expected. When first fully erupted, a less than 1 mm wide band of root is exposed around the base of the crown above the bony socket but, with increasing age, this band increases in width ('growing long in the tooth'). Periodontal disease may in part be the cause of such root exposure, but there is another process involved. As the crowns of the teeth wear, constant adjustments need to be made to keep them in occlusion and all teeth continue to erupt slowly throughout life in order to compensate for the loss of crown height with wear. This also leads to root exposure. In jaws where the pattern of periodontal disease has been relatively even throughout, it can be difficult to distinguish between the effects of bone loss and continued eruption. Fortunately, in many jaws, the pattern of periodontal disease is irregular, affecting the molars more severely and earlier than the incisors, and the irregular bone loss that results can be detected with some confidence.

The most consistently recorded dental disease in archaeological material is dental caries, or tooth decay (Fig. 7.8). The bacteria in the dental plaque live by metabolizing organic components of the mouth fluids, but they also make use of the carbohydrates (sugar and starch) in the food which passes through the mouth. Sugars are small molecules and can diffuse immediately into the plaque, whereas starch is composed of long molecules that cannot enter directly, but it is broken down into sugars by amylase, an enzyme present in the saliva. When the plaque bacteria ferment sugars in order to produce the energy which they need for life, they also produce a by-product—lactic acid. A sugary drink causes a marked phase of plaque acidity, within two minutes, which takes half an hour or so to return to neutrality, whilst starches produce a less marked but longer-lasting acid phase. So, throughout the day, the acid levels in different areas of the plaque deposits fluctuate. During the acid phases, the calcium phosphate mineral of the enamel starts to dissolve, and during the neutral phases, mineral is redeposited in the enamel. This cycle of loss and repair can maintain the surface of the enamel in a steady state but, where the acid phases predominate, there is a net loss of mineral. To start off with, this produces only microscopic changes, but eventually a cavity forms. This cavity may grow rapidly, cutting into the enamel, into the dentine and finally

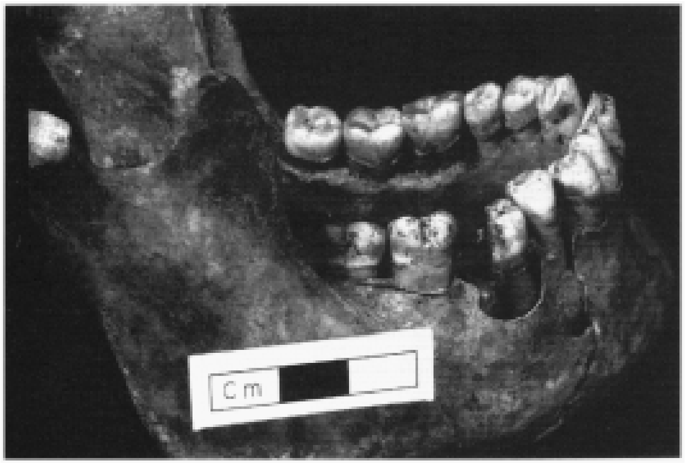

Figure 7.8 Dental caries causing widespread destruction in the first molar of a post-medieval lower jaw from London. Almost half the tooth has been destroyed by the cavity, penetrating to the pulp chamber and causing inflammation of the bone around the apex of the root—this is shown by the loss of bone around the tooth. The teeth also show a line of calculus deposits, following the original position of the gums. It is possible to see a groove-like defect of enamel hypoplasia in the teeth at the front of the jaw. Source: S.Hillson.

exposing the soft tissue of the pulp to infection, but it may also progress very slowly. Indeed, some cavities can be remineralized and stabilized without any surgical intervention.

The distribution of dental caries in a population is related strongly to the pattern of carbohydrate consumption. In most modern populations there is a high incidence of caries, particularly amongst children, which develops mainly within the deep fissures of the molars and in the difficult-to-clean 'contact area' just below the point at which neighbouring teeth meet. A different pattern is found in archaeological remains which date from before the nineteenth century, during which trade in cane sugar developed greatly. The most common form of dental caries in, for example, prehistoric European collections affects particularly the neck of the tooth, where the crown meets the root, and is mainly a disease of adults. This presumably reflects a diet which was high in starch, but low in sugar. Another interesting contrast may be made with adoption or intensification of agriculture—a clear cultural horizon, for example, in North America where the gradual change from fully hunter-gatherer Archaic contexts through to the increasingly maize-cultivating Woodland and Mississippian contexts apparently resulted in greatly increased carbohydrate consumption (see pp. 302–3). This change is marked by a progressive increase in dental caries, and an accompanying change in the pattern of dental attrition (Rose *et al.* 1991).

Inflammation of bone

Bone inflammation, or osteitis, is usually divided into 'periostitis' and 'osteomyelitis' (Ortner and Putschar 1981; Roberts and Manchester 1995). Periostitis involves changes to only the outer, compact, part of a bone, whereas osteomyelitis involves the inner, spongy, part. Both types of inflammation may occur together. Evidence of a generalized, low-level periostitis is very common in some collections of material, with a thin layer of porous new bone on the surface. Its cause is complex and, although some researchers use it as an index of general infectious disease, such bone formation may occur for reasons other than inflammation.

The deeper seated forms of osteomyelitis are more clearly related to infections. Bacteria may enter the bone through a deep wound or a compound fracture (where a bone fragment pierces the skin from inside), or through the pulp chamber in a tooth with a deep carious cavity. In such cases, infection is usually by a broad spectrum of bacteria. In chronic osteomyelitis these are contained by a mass of granulation tissue, around which an area of bone is resorbed. Pus often forms within the mass and, eventually, bone is resorbed around a channel *(cloaca)* through which the pus drains. The area of bone may then heal. One common site of chronic osteomyelitis is in the bone of the jaw, where infection occurs through a pulp chamber exposed by dental caries and 'periapical abscesses' form around the apex of the tooth roots. Another common site is near the cartilage growth plate of bones near the knee in children, where blood-borne pathogens may settle.

Tuberculosis, leprosy and the treponemal diseases such as syphilis and yaws may also cause bone inflammation. Tuberculosis is normally due to infection through inhaled air by the tubercle bacillus *Mycobacterium tuberculosis,* although it may also be caused by eating meat or drinking milk from cattle infected with *Mycobacterium bovis.* The skeleton is only one of a number of parts of the body which may be affected and the osteitis caused progresses slowly, in particular foci. One common focus is the spine, where bone is replaced by fibrous tissue and the vertebrae collapse to produce the well-known hump-backed condition. Other parts of the skeleton may also be affected, such as the ends of long bones and the hip bones. Tuberculosis can be one of the more difficult diseases to diagnose in the skeleton because there are so many alternative possibilities to consider. In addition, spinal tuberculosis is predominantly a disease of children, and children's remains, as has been pointed out, are less well preserved than those of adults. Tuberculosis has been tentatively diagnosed in prehistoric European material and clear evidence of the disease has been found in the soft tissues of Egyptian mummies. It is thought that the Roman Empire was an important factor in the later spread of tuberculosis through the Old World.

Leprosy is caused by an infection of the similar bacterium *M. leprae.* It is primarily an infection of the skin and nervous system, but bones are involved due to paralysis of muscles (which causes bones to remodel in response to new stresses) and blood vessels that supply bones, and because the lack of sensitivity makes the extremities more prone to injury. Not all forms of leprosy produce bony changes. Where they do occur, the earliest involve loss of bone from the hard palate, the upper jaw and floor of the nose. Foot and finger bones may also be deformed, although these are harder to spot in fragmentary archaeological material. It seems likely that leprosy spread widely through Europe during the Roman period.

The treponematoses are a group of diseases due to infection by a genus *(Treponema)* of spirochaete bacteria. Today, the treponematoses include endemic syphilis, venereal syphilis, yaws and pinta. Similar diseases existed in ancient times, but it is not clear that they took exactly the same forms as today. The skeleton is only one part of the body to be involved. Small colonies of bacteria form, causing damage to any tissue with which they are in contact. The skull and the long bones are best for diagnosis and show a range of widespread pitting and cavities. Whilst a diagnosis of treponematosis may be quite clear, the distinction between the different types can be difficult. There are many different opinions upon the origins of the different forms.

By and large, good archaeological evidence of these major infectious diseases is much less common than either diffuse low-level periostitis or diseases of the joints, teeth and fractures. Certain sites may produce a great deal of evidence, such as the famous medieval leper hospital cemetery near Naestved in Denmark (Møller Christensen 1961), but a routine report will only rarely produce specimens of this kind.

THE MICROSCOPE AND HUMAN REMAINS

Bone

In life, bone is as alive as the rest of the body, with living cells, blood vessels and nerves (if a bone breaks, it hurts and bleeds), and as with most of the tissues of the body, bone is involved in a continuous process of tissue turnover. One type of specialist cell constantly cuts tunnels through the bone, whilst another group of cells follows behind and replaces it with new bone. A microscope section of bone shows rounded structures, made up of concentric layers, called osteones (also called osteons or Haversian systems), which represent this turnover process. Bone turnover is involved in growth and is particularly important in the remodelling which takes place in, for example, the development of dimorphic features in the skull, pelvis and long bone shafts with sexual maturity. Bone turnover is also involved in the remodelling which takes place with disease. The pattern of osteones changes gradually with age and there have been several studies which suggest that the process may be used for estimating age at death.

The greatest difficulty for the microscopy of archaeological bone involves the changes that have taken place since death (Bell and Jones 1991). Under the microscope, damage is seen mostly as small zones of altered mineralization called diagenetic foci. Often these are scattered quite widely through a bone section, but they may be packed close together so that the whole section is altered. The foci are sometimes poorly mineralized, but may also be more heavily mineralized than the surrounding bone, and it is not clear what they represent. The surface appearance of archaeological bone varies a good deal from site to site, but is not a good guide to the internal preservation. Experimental evidence suggests that the foci start to form soon after death, and the degree of alteration is not related to the time spent in the ground. The two-thirds or so by weight of fresh bone which is mineral remains predominantly calcium phosphate, but the precise mineral phase may change. Cells and their contents are thought to decompose rapidly, although there is some evidence that fragments of cell wall may survive. Bone also contains a proportion of non-cellular organic material, in particular collagen, which is lost gradually, although the rate of loss is highly variable between sites (see pp. 302–3).

Dental tissues

Like bone, the teeth are made of mineralized tissues (Hillson 1996). They are more heavily mineralized than bone, particularly the dental enamel which coats the surface of tooth crowns and is almost entirely mineral. The main difference, however, is that the dental tissues—enamel, dentine and cement—do not turn over. Once formed, they may remain little changed throughout life. This means that the process of growth is preserved in their structure, giving rise to many different avenues of research.

Dental *enamel* is a dead tissue, even in living people. It has no cells and almost no organic content, and consists of microscopic bundles of tiny crystals, woven together into a strong structure. In life it is immensely resistant to the wear and tear, damp and widely varying acidity of the mouth. After death, it is the most resistant part of the body in all except highly acid conditions of burial and is therefore by far the most studied microscopically. *Dentine,* which makes up the main internal structure of the tooth and its roots, has a somewhat higher mineral content than bone, but similarly has a considerable proportion of collagen and other organic components. The cells of dentine do not, in fact, reside within the tissue, but line the pulp chamber and send long processes down microscopic tubules which run through almost to the boundary with the enamel or cement. *Cement,* which is much more similar to bone in composition, also has cells incorporated into its structure. The cement coats the surface of the roots and functions as an anchor for the collagen fibres of the ligament that binds the tooth into its socket. Collagen therefore dominates the structure of cement, which is built up from mats of fine fibres and includes large fibres from the ligament. Both dentine and cement are modified, after death, in a similar way to bone (Bell *et al.* 1991). They can show similarly large disruption, but the cap of enamel over the crown has a protective effect and the dentine underneath is often relatively well preserved even if the roots and bones are heavily damaged.

Dental enamel growth and enamel hypoplasia

A section through a tooth crown (Fig. 7.9) shows clearly the strongly layered structure of the enamel (Hillson 1996). The lines of the layering are regularly spaced and represent rhythms (twenty-four hourly and roughly weekly) in enamel deposition, so a count from the first layers under the cusp, down to the last layers at the base of the crown, gives an estimate of the time taken for the crown to form. The pattern of layers (which vary in prominence) can also be matched in all teeth which were being formed at the same time—somewhat like dendrochronology— and can be used to identify teeth belonging to one individual. It may even be possible to identify the point of birth as a particularly prominent layer under the first molar cusps and, when a child died before its crowns were complete, it is possible to produce a high precision age estimate by counting to the point at which formation was interrupted. Some anthropologists have defined a particularly prominent category of layers known as Wilson bands, which are believed to be caused by disturbances to growth such as disease or dietary deficiency.

It is possible to study part of the enamel layering without sectioning, because some of the internal growth layers outcrop on the crown surface to create a pattern of grooves (Fig. 7.10). These so-called 'perikyma grooves' can be seen clearly under low magnification (some even with the naked eye) in obliquely angled light. Wear destroys them, so specimens are best selected from young individuals, although the deeper grooves can be seen in protected areas of the crowns of quite worn teeth. Counts of perikyma grooves can be used for estimating age in children, in the same way as internal enamel layering can, as discussed previously. Disturbance to growth causes variation in groove spacing which can be seen clearly under low magnification. Larger variations of this kind produce a defect visible to the naked eye which is routinely diagnosed in archaeological dentitions as 'enamel hypoplasia'. Both clinical and experimental studies have linked hypoplasia to childhood fevers and dietary deficiencies and the distribution of hypoplasia in the teeth of different archaeological sites is used as an indicator of general health. It is suggested, for

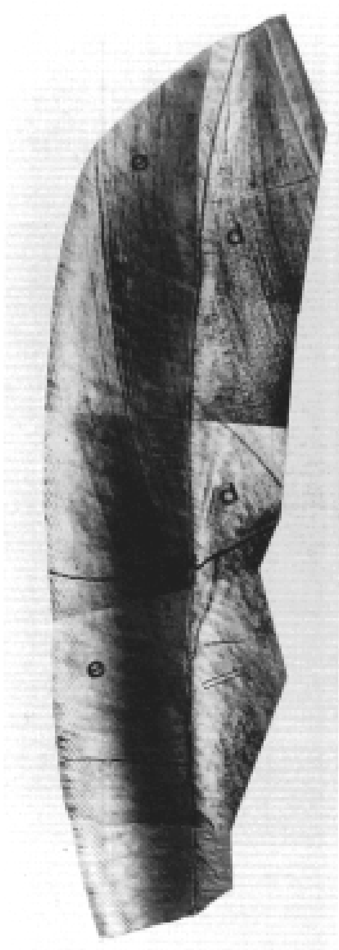

Figure 7.9 Section of part of a canine tooth crown from the site of Kerma, Nubia, built up from a mosaic of photomicrographs, taken in a polarizing microscope. The worn occlusal surface of the tooth is to the top, exposing some of the dentine (labelled 'd') which forms most of the right of the picture. The enamel (labelled 'e') coating the crown surface is on the left, with growth layers angling up towards the surface. Source: S.Hillson.

example, that the increasing rate of hypoplasia from Archaic to Woodland and Mississippian cultural contexts in North America represents the effect of larger settled communities (enhancing the spread of infectious disease) and the risk of reliance on one single agricultural food source (Goodman and Armelagos 1985; Goodman *et al.* 1984).

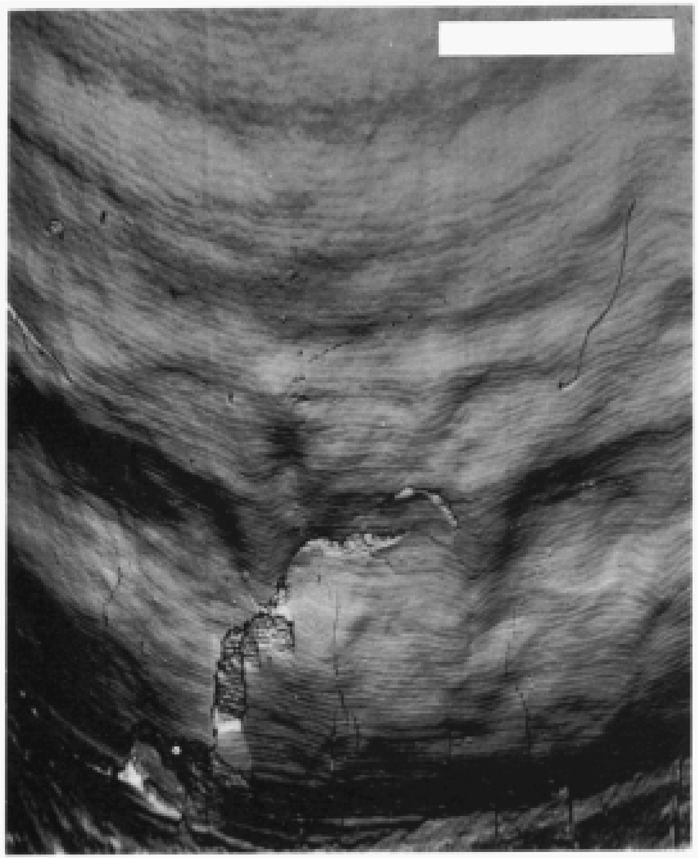

Figure 7.10 Enamel hypoplasia of the furrow type in a molar from Kerma (scanning electron micrograph of an epoxy resin replica of the crown surface). The fine grooves are the normal growth layering of the crown, but superimposed over it are large furrow-like defects formed by a combination of the finer grooves. The scale bar is 1 mm. Source: S.Hillson.

Histological age estimation in adults

Since the 1950s several age-at-death estimation techniques have been developed for forensic purposes, based on a number of age-related changes seen in tooth sections (Hillson 1996):

1 Secondary dentine deposition. After the root has been completed, dentine continues to be deposited at a slow rate to line the pulp chamber. In addition, patches of secondary dentine are laid down to seal the inner ends of dentinal

tubules whose outer ends have been exposed by attrition and caries. Both processes lead to a gradual infilling of the pulp chamber with increasing age.

2 Root dentine sclerosis. The dentinal tubules are progressively filled in, starting at the apex of the root, by heavily mineralized material. The area of infilled tubules appears transparent in a section of fresh dentine, and the size of this transparent area is correlated with the age of a patient when a tooth was extracted.

3 Cement deposition. As cement is deposited regularly throughout life, the thickness of the layer over the root becomes progressively greater. A number of studies have suggested that annual layers can be recognized in sections of human enamel, and that layer counts correspond closely to age at death. Other studies have yielded less encouraging results and a great deal must depend on the methodology used, because the cement layering in human teeth is very fine indeed.

It must be stressed that, although these changes do show correlations with age, the correlations are not very strong and vary from tooth to tooth and from study to study. They have, however, been developed into age estimation methods which do not perform much less well than the more traditional macroscopic techniques described earlier. These methods have been used widely for forensic purposes but, apart from a few experiments, have not been widely applied in archaeology because of the need for sectioning and, in particular, the highly variable preservation of dentine and cement.

‘ANCIENT BIOMOLECULES’

Biological polymers

A polymer is a large molecule built up from sequences of small structural units joined together. Proteins are polymers whose structural units are the amino acids (over a hundred amino acids are known, but only twenty or so occur in mammal proteins). The most common protein in bone, at about 20 per cent by weight, is collagen. The nucleic acids (including DNA) are polymers with helical backbones to which are attached units called bases. DNA is responsible for defining the arrangement of amino acids in the proteins which are produced by living cells. Bases are arranged into sequences which encode the genes, each defining a particular protein.

Since 1980, DNA has become the centre of a great deal of attention (Brown and Brown 1994). DNA molecules are large polymers which reside in the nucleus and mitochondria of living cells (Strachan and Read 1996). Each strand of DNA has a ‘backbone’ to which is attached a sequence of ‘bases’. These sequences are built up from an alphabet of different bases (adenine, guanine, cytosine and thymine), whose order defines the proteins for which different genes in each DNA molecule are responsible. In living cells, DNA is usually found as a 'duplex' in which two complementary strands are twisted together, with each adenine on one strand matched by a thymine on the other and each cytosine similarly matched by a guanine. If the sequence of one strand in the duplex is known, then the sequence of the other strand can always be inferred. The length of DNA molecules is usually expressed as a count of base pairs in their sequence ('bp', not to be confused with years before present).

Each nucleus of a human cell contains forty-six very large DNA duplex molecules, made visible in stained preparations under the microscope as the twenty-three pairs of chromosomes (Strachan and Read 1996). These molecules vary from 55 million up to 250 million bp in length. In each one, it is thought that only around 30 per cent of the sequence defines genes, of which there may be 3,000 per chromosome—only a small fraction of genes have yet been mapped out (mostly those associated with inherited diseases), although the Human Genome Project aims eventually to produce a complete map. The length of the base sequence which codes for a particular gene is highly variable, but may be 10,000 to 15,000 bp and, in each, only about 10 per cent of this sequence actually codes a protein. Overall, the whole collection of genes, the nuclear genome, contains only one copy, or just a few copies, of each gene.

A living cell also contains many mitochondria, each of which also contains its own entirely separate DNA. Molecules of mitochondrial DNA are circular, with 16,569 bp sequences, known in their entirety and coding for thirty-seven genes (with only a very small proportion of non-coding sequence). Unlike the nuclear genome, there are thousands of copies per cell of these mitochondrial DNA molecules, although they make up only a tiny fraction of the total DNA in the cell as a whole because they are so much smaller. Another difference is that, whilst the nuclear genome is inherited from both mother and father, mitochondrial DNA is only inherited down the maternal line.

Research on DNA has developed on two fronts which are of relevance to human remains in archaeology. One is the invention of DNA-based methods for identifying, sexing and estimating relationships between people, as evidence in forensic cases (Strachan and Read 1996). These are routinely applied to DNA extracted from blood stains, soft tissues and so on. Sex is determined by demonstrating the presence of base sequences in genes specific to the X and Y chromosomes which determine sex, whereas relationships are usually determined by studying parts of the extragenic DNA (the part outside the genes) which have highly repetitive and highly variable sequences. The other major development is the demonstration of DNA survival in forensic bone specimens tens of years old, and in archaeological bones up to 10,000 years old (Hagelberg and Clegg 1991; Hagelberg *et al.* 1989, 1991). Currently, 2 g archaeological bone might yield 1–10 μg (0.000001–0.00001 g) DNA, of which only a few per cent is human and the bulk is bacterial. Most is in fragments of strands less than 300 bp long, and its duplex structure is likely to be much broken-down.

The study of DNA in archaeology has become possible through the invention, in 1986, of the Polymerase Chain Reaction (PCR) technique, which generates many copies of a defined part of the base sequence preserved in a tiny number of surviving DNA fragments. This allows routine laboratory methods to be used for sexing, establishing relationships and so on and, in theory, the technique will work even if only one fragment of a DNA strand containing the target sequence remains in the archaeological specimen. Most work in archaeology has however been carried out on mitochondrial DNA rather than nuclear, because the much greater number of copies makes it more likely that a particular target sequence has been preserved. There have been many problems in developing these methods for archaeology, including difficulties with extraction, with the presence of factors which inhibit PCR reactions and, particularly, with contamination by modern human DNA which is carried on the skin flakes, sweat, and droplets in exhaled air of excavators and laboratory technicians. It is, however, now established that 100 to 400 bp sequences of ancient human DNA can be amplified from bones up to 10,000 years old. This is not possible with all specimens and may even vary between neighbouring skeletons within one site, but generally there is a better chance of extracting DNA from well-preserved bone, rather than poorly preserved (Hagelberg *et al.* 1991). Paradoxically, bone and dentine seem to be better substrates than mummified soft tissues, which are readily contaminated by micro-organisms.

Since the first demonstration of DNA preservation in archaeological bone, it now seems possible to determine sex by distinguishing X and Y chromosomes in ancient DNA extracted from bones and teeth (Stone *et al.* 1996). DNA profiling techniques have been used to identify conclusively the bones of the last Tsar and his family, found in Ekaterinberg in 1991 (Gill *et al.* 1994). Still other work has involved a study of ancient migrations by examining mitochondrial DNA from archaeological bone specimens in North America (Merriwether *et al.* 1992; Stone and Stoneking 1993) and the Pacific (Hagelberg and Clegg 1993).

In addition to this work with human DNA, it now seems possible to extract and amplify the DNA of bacteria which is also preserved in ancient bones. Positive identifications of *M. tuberculosis* and *M. leprae* have been made for DNA extracted from bones showing the pathological changes (see pp. 293–4) expected for tuberculosis and leprosy respectively (Hummel and Herrmann 1995; Taylor *et al.* 1996; Waldron 1996). It is possible that viral DNA may eventually be detected in a similar way. These developments offer an important range of methods for confirming diagnosis in palaeopathology, or for diagnosing those conditions which leave no visible pathological sign in the bone.

Stable isotopes

The calcium phosphate mineral component of bone and dental tissues contains quantities of the element carbon, whilst the proteins present in bone, cement and dentine contain both carbon and nitrogen. The atoms of both elements can exist in a number of states (isotopes), the most famous of which is the radioactive form of carbon, ^{14}C. 'Normal' carbon (98.9 per cent of carbon) is the stable isotope ^{12}C, but there is also another stable isotope ^{13}C which is less abundant (1.1 per cent). For nitrogen, the 'normal' stable isotope is ^{15}N (99.6 per cent of nitrogen) and the other consistently occurring, but less common, stable isotope is ^{14}N (0.4 per cent). The abundance of the stable isotopes of carbon and nitrogen can be measured in collagen extracted from samples of archaeological bone using the technique of mass spectrometry (Ambrose 1993; De Niro 1987; Schwarcz and Schoeninger 1991), to produce the ^{13}C:^{12}C ratio (?^{13}C) and the ^{15}N:^{14}N ratio (?^{15}N).

Why would this be useful? The ratios of these isotopes in the bones of a particular animal are controlled by their position in the food chain. For example, ?^{15}N is affected partly by the proportion of nitrogen-fixing plants in the food chain. This could be related to the proportion of legumes in the diet, or the reliance upon marine resources which come from a food chain with blue-green algae at its base. It is also greatly affected by the proportion of protein in the diet—most of which comes from meat consumption. The values for ?^{15}N are therefore highest in the bones of people (and other animals) relying on marine resources and lower in those who rely mostly on terrestrial resources, and higher in both cases for carnivores than herbivores. In theory, the introduction of legumes into the diet should lower ?^{15}N values, but it has proved difficult to demonstrate this.

The carbon in collagen also comes mostly from the protein in the diet. ?^{13}C values are again slightly higher in people whose food is derived mostly from marine sources, but it is also affected by climate (it increases with higher average temperature and sunshine, and decreases with higher rainfall). The largest contrasts are between food chains based upon C4 plants as opposed to C3 plants. C3 plants include all trees and woody shrubs, the grasses from temperate environments and from shaded, woodland habitats; wheat, barley and rice are temperate grasses and so fit into the C3 group. C4 plants comprise the subtropical and tropical grasses, with the exception of those from shaded woodlands; the tropical/subtropical cereals maize, sorghum and millet are of C4 type.

One of the clearest contrasts which such methods can be used to investigate is the gradual adoption and intensification of agriculture in North America (Schwarcz and Schoeninger 1991). It is possible to monitor the greatly increased dependence on maize (a C4 plant) *c.* AD 900–1000 as opposed to the indigenous gathered food plants (C3), through a clear change in ?^{13}C values of collagen extracted from human bones. This is paralleled by a simultaneous increase in dental caries and a change in attrition pattern (Rose *et al.* 1991). The advent of beans into the diet at a similar date should have left its trace in the ?^{15}N values too, but this cannot be detected and it is not yet clear why not. Similar evidence for the adoption of maize has been found in Central and South America, and there is also evidence for the origins of millet cultivation in northern China at around 7000 BP. C4 plants did not form part of early agriculture in Europe and the pattern of carbon and nitrogen isotope values is instead interpreted in terms of the relative balance of marine and terrestrial resources, climate and, in particular, the reliance on meat. Some values for ?^{15}N in prehistoric European human remains are very high, perhaps indicating a much greater degree of carnivory and lesser reliance on cultivated plant foods than has hitherto been assumed.

It is also possible to determine ?^{13}C values for the carbon preserved in the mineral of dental enamel. The main difficulty with this is that there may be contamination by secondary carbonate deposition from groundwater, but the better preservation of enamel makes it possible to apply the technique to a wide range of material, for example early hominids from Africa (van der Merwe 1992). Further possibilities lie in comparisons between teeth (representing childhood) and skeleton (representing the condition at the time of death) which may show differences in stable isotope ratios implying a change in diet or movements of people (Sealy *et al.* 1995). Another possibility may be to monitor the effect of weaning, by detecting a decrease in ?^{15}N from the parts of teeth which were formed whilst a child was breast-feeding, to those parts formed after weaning.

CONCLUSION

Human remains are the closest approach that can be made to people from the past, and it could be argued that they lie at the centre of archaeology. Whenever a large cemetery is excavated, study of the human remains collection (which is, after all, the reason why the cemetery is there) should be fully integrated into the excavation, post-excavation work and report. The biological phenomena described in this chapter need to be interpreted in the light of other archaeological evidence relating to the way of life of the people buried in the cemetery. They also need to be compared between sites before they can tell a story: a few isolated bodies only rarely yield interesting interpretations on their own, so that the collection in any one cemetery must be put into context and the assembly of comparative data is an essential part of any project.

Today, most excavations of human remains take place under rescue conditions, where graves are to be destroyed by building or engineering works, but ideally, plans need to be made in advance for the study and subsequent disposition of the remains, including extensive consultation with concerned religious and cultural groups. Most countries in the world have legal requirements with which the excavators must comply but, in many cases, little distinction is made between the human remains themselves and other grave contents—they are all 'relics'. Many archaeologists feel that the ultimate aim should be to rebury human remains (or place them in a suitable ossuary) after they have been carefully studied, to a schedule agreed between all interested parties. It may sometimes be possible to agree a form of disposition which provides an appropriate resting place, whilst allowing occasional visits for further study in the future. One of the archaeologist's chief aims is to establish as closely as possible the cultural identity and affinities of the people buried at the site, and this may not be easy to accomplish, so that archaeological evidence becomes important when several modern cultural groups lay claim to a collection of material.

These ethical issues of reburial are discussed in Chapter 10 within the wider context of questions regarding the ownership of the past. Here it is sufficient to note how the issue of reburial places rigorous constraints on research. If there is only one chance to study the material before it is reburied, then the records must be right first time, standards (not only of recording, but of handling the material) must be as high as possible, the observations must also be as complete as they can be, and they must be compatible with the records of other researchers, working on other collections. There have been several attempts to define minimum standards for recording but the most widely used are the so-called Chicago Standards (Buikstra and Ubelaker 1994).

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The main topics introduced in this chapter are expanded in the textbooks of Brothwell (1981), Bass (1995) and Hillson (1996), which also give access to the literature. The classic skeletal anatomy text is Frazer's (Breathnach 1965), and key differences between human and other mammal bones and teeth are described in Hillson (1992). Kelley and Larsen (1991) include a wide range of edited papers on dental matters. Methods for age estimation are surveyed in Angel *et al.* (1986), an imporant assessment of dental ageing methods is given by Smith (1991), and Sjøvold (1988) provides a comprehensive treatment of sex determination methods. Buikstra and Ubelaker (1994) define a wide range of techniques for studying human remains. Waldron (1994) provides a sharply focused discussion of the broader inferences that can be made from collections of archaeological human remains. Ortner and Putschar (1981) provide the standard textbook of bone palaeopathology, whilst Manchester (1983) gives a good introduction and Rogers and Waldron (1995) is a key source for joint disease. Brothwell and Sandison (1967) is now a rare book, but is one of the palaeopathology classics. Key reviews of enamel hypoplasia are given by Goodman and Rose (1990) and Skinner and Goodman (1992). The most comprehensive general text on molecular genetics is Strachan and Read (1996), whilst Brown and Brown (1994) provides a readily accessible introduction to ancient DNA. Stable isotope studies are surveyed by Ambrose (1993) and Schwarcz and Schoeninger (1991).

8

STUDYING STRUCTURES

Matthew Johnson

INTRODUCTION

When a foraging band of the !Kung San of the Kalahari Desert halt for an overnight stop, one of their number plants two sticks in the ground. These two sticks stand for the door-posts of the more substantial structures the !Kung build in other contexts. The planting of the sticks allows the !Kung to orient themselves in a ring around the central hearth, the men on one side, the women on the other. Outside the ring, as the sky darkens and the fire brightens, is a wilderness the !Kung consider as hostile, full of dangers and evil spirits. Thus, the placing of two sticks constitutes not just the dwelling, but the whole !Kung universe: it divides up the women and men, the families in the band, and the social and natural world beyond (Whitelaw 1994:224). This story is one taken from the gallery of ethnographic examples habitually used by archaeologists to help interpret their findings. It illustrates in microcosm some of the common problems and possibilities raised by the archaeological study of structures.

These common themes are in part straightforward. First, all human groups need some physical form of shelter; all build in some form or another, however ephemeral that form might be. Lewis Binford and others have written of the emergence of 'home-base' behaviour as one of the criteria of the emergence of *Homo sapiens sapiens* (Binford 1983); and once such a home base is created, it naturally takes on a physical, archaeologically visible, form. Away from the Equator, shelter from the elements is as necessary as clothing and food to the physical basis of human existence.

Second, the shelter that is needed is symbolic as well as material in nature: that is, it is about cultural as well as physical needs. The size and shape of dwellings and other buildings are about family form and social sentiment, what a dwelling 'ought' to look like, as well as about environment. It follows that the form of structure used may tell archaeologists something about the social organization and cultural values of that group: the !Kung dwelling reflects !Kung values, how they see the world. Thus the size and organization of structures investigated archaeologically will reflect their former occupants' values and perceptions, though they may not do so in a direct or simple manner.

Third, however, the physical traces of that structure may be ephemeral and fragmentary in the extreme. This is particularly true when structures are not only ephemeral in form in the first place, but are subjected to the attrition and erosion of succeeding millennia. Wood rots; stone is systematically 'robbed' and reused by later builders; shallow foundations are truncated or removed completely by later ploughing. The practical and interpretive skills of the archaeologist may be stretched to the limit when dealing with patchy, imperfectly preserved, fragments of structures, just as those skills will be stretched to the limit with their interpretation. The pair of !Kung sticks may be impossible to find archaeologically after a few days, let alone centuries.

This complex set of problems, limitations, and opportunities is common to the archaeology of structures of all cultures and periods. Within this common set of problems and opportunities, however, lies a huge amount of variation in the type of structures built by ancient peoples, from the simple windbreaks and tents of nomads and hunter-gatherers to the huge monumental constructions of complex societies: the pyramids and ziggurats of the ancient civilizations, or the cathedrals, palaces, factories and tower-blocks of our own world. Each type of structure has particular potential and poses particular problems for the archaeologist, and there is corresponding variation in the ways in which different archaeologists choose to interpret excavated and standing remains. To illustrate these points, there follows a series of examples of structures from different contexts in space and time. In the following section I have selected four case studies to illustrate the huge differences in building traditions which archaeologists study, and I then turn to the technical and material basis for the building of structures, before examining the way these may be excavated, reconstructed and interpreted by the archaeologist.

STRUCTURES AROUND THE WORLD

The study of structures in pre-modern societies is not the preserve of archaeology alone: as the !Kung example makes clear, it impinges on the territory of the ethnographer and social and cultural anthropologist. Similarly, the study of structures built by more complex societies shares the academic territory of the architectural historian, whose aims and methods are somewhat different from the archaeologist's. Within literate societies, the archaeologist will also have to intrude on the ground of the historian and historic conservationist, as I shall discuss later.

Hunter-gatherers at Molodova

The upper palaeolithic site at Molodova, in the Ukraine, was occupied by a small band of mobile peoples over thirty thousand years ago (Wymer 1982:159). These people hunted mammoth, woolly rhinoceros, ox or bison, elk or moose, reindeer, and bear, in addition to foraging for plant foods. Molodova was an open site; that is, natural features such as caves or rock shelters were not used. There was also a lack of other forms of building material, given the harsh conditions of what was then the tundra. The people of Molodova chose to employ a highly unusual building material: mammoth bones. The bones were arranged in a rough circle about ten metres in diameter; within the circle archaeologists found a series of hearths, not all probably used at the same time. The bones were probably used to weigh down mammoth skin hides, as indicated in the reconstruction shown as Figure 8.1; the hides would be laid over a framework of branches (Wymer 1982).

Anasazi pueblos

The Anasazi culture of what is now the south-western United States flourished from the early tenth century AD onwards. The Anasazi lived in a distinctive form of structure, the 'pueblo' (Hill 1970). The pueblo form is still used by the Native American group most closely linked culturally to the prehistoric Anasazi, the Hopi, and insights into Anasazi architecture have been gained through the use of Hopi structures as analogies. The pueblo consisted of an agglomeration of sub-rectangular rooms, often arranged around one, two, three or four sides of a courtyard (Wetherill 1966; Fig. 8.2). The cells of this agglomeration could be added one to another to create a range of final forms. The overall shape of the whole pueblo could be sub-rectangular, circular or semi-circular, or end up simply as a row of rooms. The size of the pueblo could vary from the tiny to the monumental. External doors were rare or non-existent. Within these agglomerations, individual family units had a series of rooms, often reached from the roof above by a small step-ladder rather than through external doors. In the courtyard, or in other locations, circular structures called 'kivas' were partly sunk into the ground. The modern Hopi tribe use these kivas for ceremonial activities: their sunken position between the earth and the sky has symbolic resonance, as does the circular shape, which is seen as a microcosm of the world. It is reasonable to suppose that the Anasazi structures embodied a related set of beliefs.

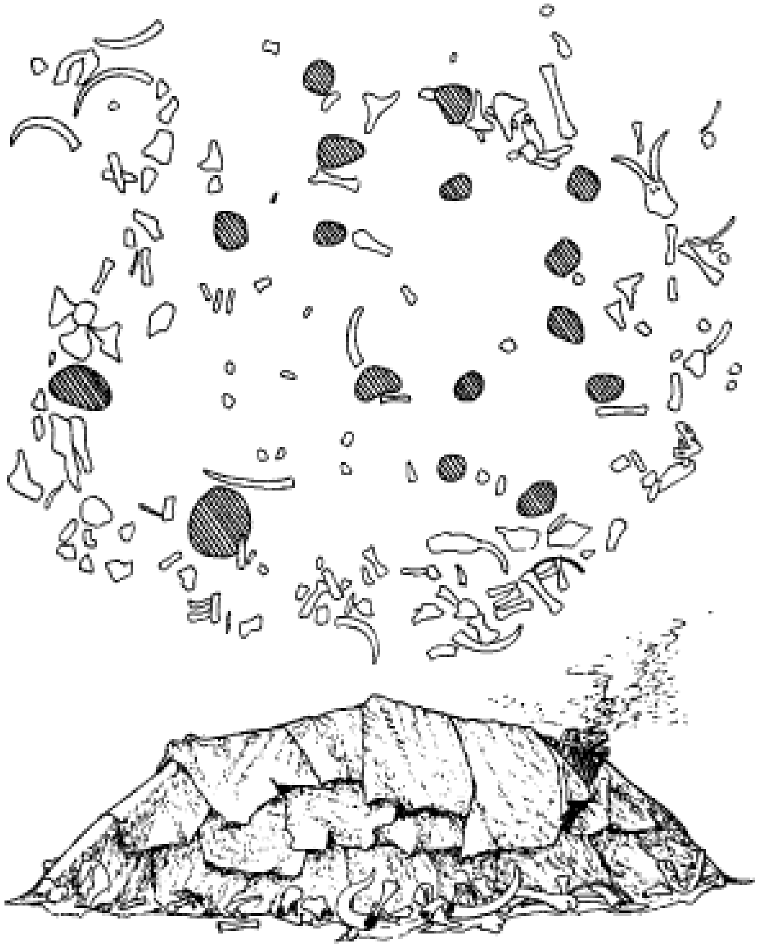

Figure 8.1 Plan and reconstruction of palaeolithic dwelling at Molodova. Source: Wymer 1982.

Many such structures were in spectacular positions, perched on cliff edges or, as at Mesa Verde in Colorado, below massive natural arches in the cliff walls. The usual method of building was through the use of sun-dried brick or clay walls. As the Anasazi culture reached its peak, however, around the time of the great Romanesque and Gothic cathedrals of Europe, many such pueblos became ever larger and were rebuilt in stone (Wetherill 1966). Such stone walls used a variety of techniques, but were of 'dry' construction: that is, they did not use mortar or other bonding between the stones. The outside walls could reach to a monumental height of over ten metres.

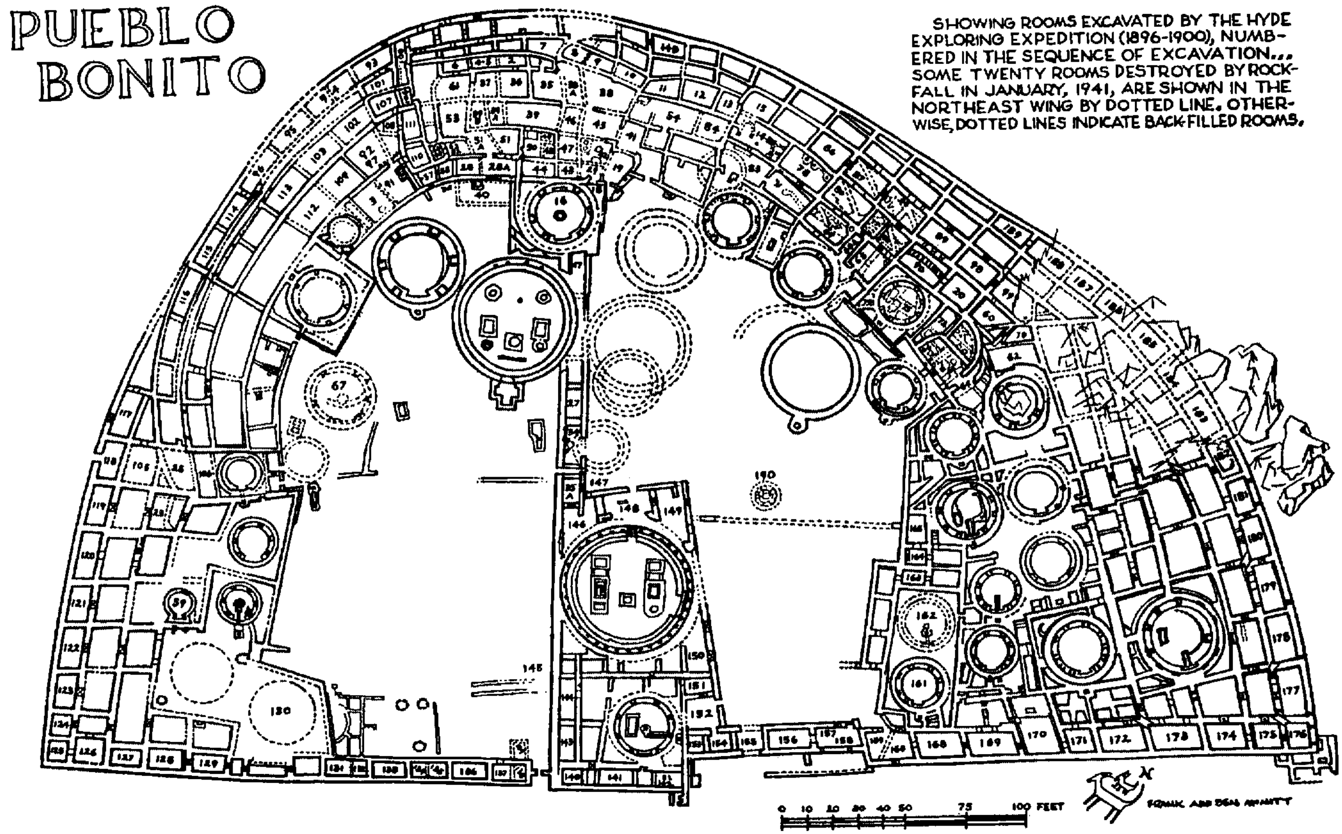

Figure 8.2 Plan of Pueblo Bonito, one of the greatest Anasazi pueblos at Chaco Canyon, New Mexico. Here, a cellular form of architecture usually executed in dried mud or adobe is recreated in stone. The circular areas are partly sunken structures called 'kivas', which have ritual function. Reproduced from R.Wetherill: *Anasazi* by Frank McNitt. © University of New Mexico Press.

The reasons for the abandonment of these structures remains a mystery, though increasing aridity of the climate is the preferred explanation of many archaeologists, as well as transformation of the environment brought about by stripping the landscape for timber (Betancourt and van Deveder 1981). The aridity of the region has in fact assisted in the interpretation of the pueblos: many timber floors have been preserved, with the result that dendrochronology (tree-ring dating) has been used to date many of the pueblos with great accuracy. The varying styles of stone walling have also been put into stratigraphic order, enabling very close dating of many structures by a combination of relative and absolute means (Wetherill 1966).

Great Zimbabwe

Great Zimbabwe is the only archaeological site in the world to give its name to a nation. It is in fact one of over 150 sites in modern Zimbabwe to exhibit signs of having broken from the African tradition of building in clay: these enclosures or *zimbabwes,* which date from the fourteenth to the eighteenth centuries AD, have monumental stone walls of varying heights. These walls appear to have surrounded clusters of clay-built dwellings, now vanished (Hall 1987, 103–16; Fig. 8.3). Great Zimbabwe itself is the largest of these sites, and was occupied from the tenth and eleventh centuries onwards, before it was transformed in the thirteenth and fourteenth centuries into a major regional centre for thousands of people (Huffman 1996). The site reached its height in the fifteenth century. The walls enclose the city as well as ritual areas; they were built with the simple technique of dry stone with few doorways or other features.

Who built these structures? They appear to be the products of cattle-raising chiefdoms who built their power on trade, particularly of gold (Huffman 1996: 176–8). Trade objects from as far away as China and the Islamic world have been found, indicating a complex social network indigenous to black Africa. Interpretations of the structures at Great Zimbabwe have varied, but in recent years it has been suggested that they must be interpreted in terms of ritual, with male/female oppositions repeated across the Great Enclosure (Huffman 1996; Fig. 8.3). In this interpretation, the enclosure may have acted as an initiation centre for girls.

Gothic cathedrals

The towns of medieval Europe often chose to express their wealth and confidence in the provision of ever larger and more elaborate structures for public worship, dominated by the great cathedrals. Such structures were distinctive in form, craftsmanship, and the sheer scale of their construction, dwarfing the wooden houses around them (Fone 1984). The building material was stone, though the

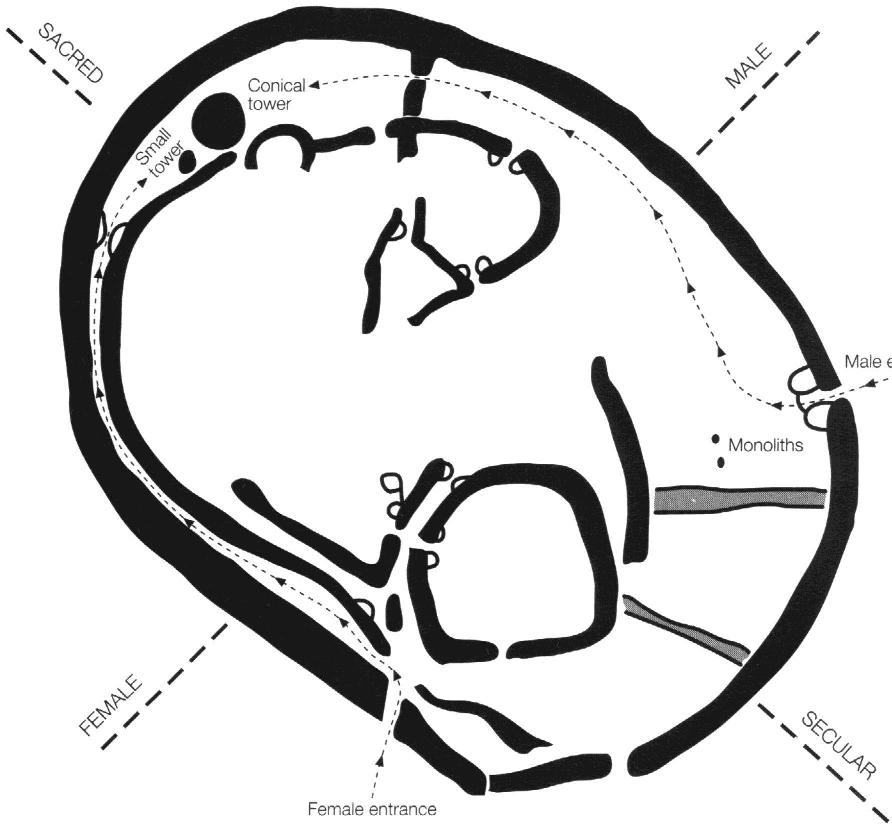

Figure 8.3 The Great Enclosure at Great Zimbabwe, showing Huffman's interpretation of the space in terms of sacred/secular and male/female space. Reproduced from M.Hall, *Farmers, Kings and Traders: The People of Southern Africa, 200–1860* with permission David Philip Publishers (Pty) Ltd, South Africa.

roof was of timber. Pointed stone arches were used, for structural as well as aesthetic reasons (Fig. 8.4): the keystone of the arch (the stone at the arch's summit) was more easily held in place, and the lateral stress of the arch was reduced in comparison with a round arch. Equally, however, the aesthetics became dynamic rather than static, the whole sequence of arches thrusting upwards towards the sky and to God.

Gothic cathedrals were built according to a fairly rigid set of rules. Arches set around a rectangle formed a bay, which could be vaulted over and supported on pillars; the form of the church was thus a series of stone bays. The whole structure being a skeletal one rather than based on thick stone walls, the space between the pillars could then be filled with coloured glass. The church as a whole thus became

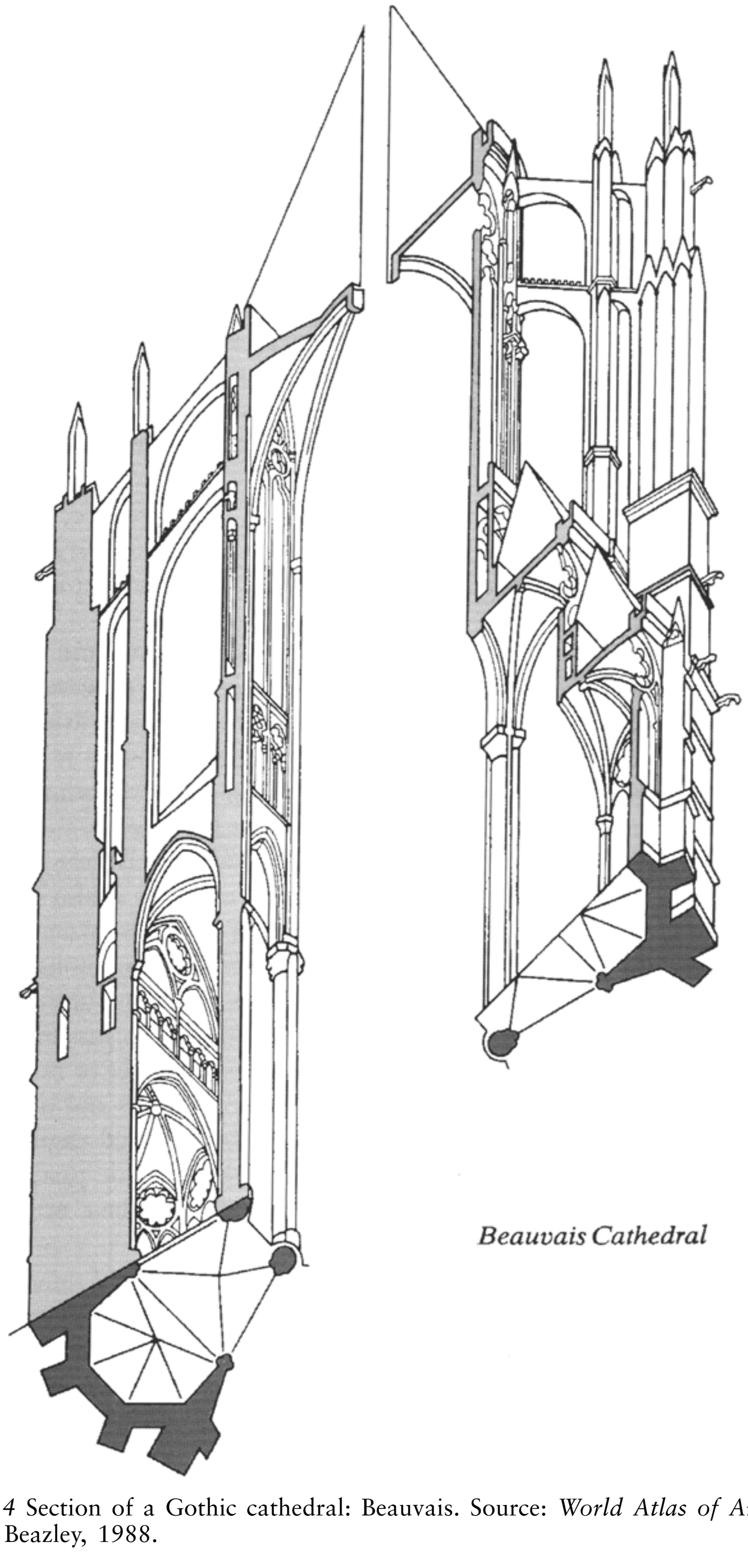

Figure 8.4 Section of a Gothic cathedral: Beauvais. Source: *World Atlas of Archaeology,* Mitchell Beazley, 1988.

a forest of pillars, all thrusting upwards towards a stone vault, the whole being painted and filled with coloured light (Fletcher 1938:326–29). As different and new as these aesthetics were, the form of Gothic cathedrals, with aisles or lower vaults running along either side of the main body of the church, reflected the Roman plan of early Christian basilicas a thousand years earlier (Fletcher 1938:214–22). Moreover, however competitive and acquisitive were the communities who built them, these structures also reflected the values of medieval Catholicism. Thus the Gothic church reflected a complex series of structural, aesthetic, and symbolic requirements, as well as being reflective of the self-image and aspirations of the communities that built them. It has indeed been argued that their architectural complexity reflected the complexities of scholastic discourse of the age (Panofsky 1957).

TECHNICAL SYSTEMS

All human groups in the past were constrained by the materials to hand and the environment within which those materials occur—remains of prehistoric igloos have not been excavated in Egypt or India, nor have remains of sun-dried brick houses been found in the Arctic tundra! Prehistoric populations learnt to use the materials they found around them in ways that showed a deep understanding of the potentials and limitations of the natural environment, as we have seen in the Molodova example illustrated earlier. On the other hand, building materials can be used creatively in a variety of ways, and can be used to deceive or create a false impression. Such creative uses may offer the archaeologist a clue to the social status and function of a structure, and even its symbolic meaning. Thus Roman monumental structures were often built with a combination of brick and concrete, utilizing the potential of these materials to create arched, vaulted, and domed forms (Fig. 8.5). Nevertheless, they chose to mask these forms with façades of plaster or marble in order to create a more traditional Graeco-Roman exterior of pillars and lintels in the Classical Orders. This combination reflected both the Romans' engineering skills and their desire to retain the mental structures of the Hellenic past, rather as the architectural form of several Anasazi pueblos reflected their origins in clay-walled construction, although being built in stone.

This section will look at the properties, potential, and weaknesses of some of the more common building materials. It will stress through examples the very diverse ways in which materials were used by cultures before the great transformations of the Industrial Revolution. Such structural materials include timber, stone, and mud-brick or brick.

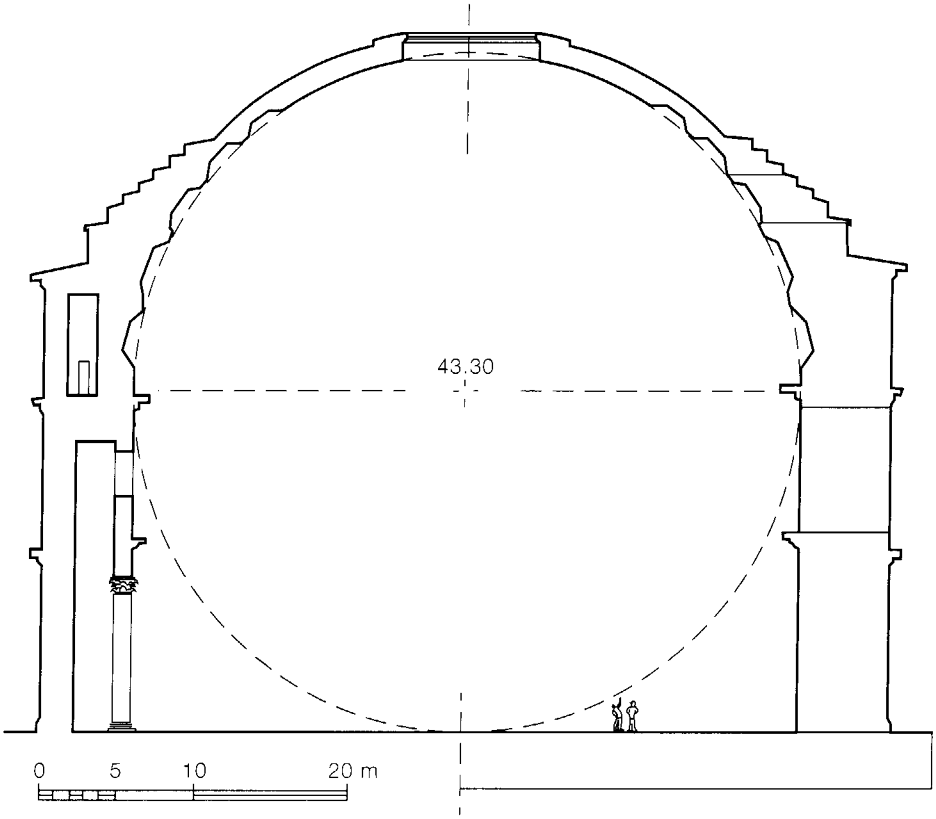

Figure 8.5 The construction of the dome of the Pantheon, Rome. The upper 'layers' of the dome were constructed using successively lighter building materials. The exterior, however, retained the traditional Hellenistic façade. Reproduced with permission of B.T.Batsford Ltd.

Timber

In many ways timber is the most versatile of all building materials. When used along the 'grain', or when trunks or branches of trees are used whole, timber has immense tensile strength, and may be used to create a skeletal framework supporting the walls and roof of a structure. Planks and bark may be used to create the walls and roof themselves, or smaller branches and twigs used to create wattle walls and partitions. The timber posts supporting this skeletal structure may be buried in the ground at their base, or beams may be laid along the ground or in a trench as a foundation (known as sills or sill-beams).

So-called 'Celtic' huts in the Europe of the first millennium BC often consisted of a circular ring of posts, apparently linked together at their apex by a series of plates or interlocking horizontal beams (Reynolds 1979). These supported a conical roof made by taking lighter poles, placing their bases on the tops of the walls, and lashing these together at the summit of the cone. Thatching, a thick covering of reeds lashed on to these poles, completed the roof. The walls would then be panelled with wattle lining, and this lining would be covered with dried mud or 'daub'. The 'wattle and daub' walls would be protected from the rain by having the thatched roof overhang the sides heavily. Such a circular building could only have a limited span governed by the height and weight of the roof. Sometimes larger structures could be created by widening the floor space inside and supporting the roof by an internal circle of posts. Similar structures have been recorded from some traditional African communities, and can be seen reconstructed in various open-air museums across Europe (Reynolds 1979) —as well as more famously if less accurately in Asterix cartoons!

The major problem with timber structures of any type that have earth-fast posts is that, when the posts are set in the ground, they rot relatively quickly; experimental reconstructions of post-built structures suggest this may happen in twenty to thirty years, or in other words a generation or so. Consequently, such structures must often have had a very limited life. That life may have been extended: for example, the bottoms of the posts were sometimes deliberately charred before burial in the ground, charring apparently inhibiting the decay of the post; in other contexts, as indicated for example by documentary records for medieval England, the rotten bases of timbers may have been cut off and the bases of the posts placed instead on stone 'pads' for support.

A more complex but durable method of timber framing can be seen in late and post-medieval northern Europe, and in areas of imperial European settlement around the world, in which 'sill-beams' or horizontal timbers at the foot of the structure are raised above the ground by being carried on small stone or brick walls. Posts are then linked by means of carpentered joints into the sill-beams, beams into the posts, and so on, creating a complex skeleton tied together by accurately carpentered joints and wooden pegs, rather like a structure made from 'Meccano' (Harris 1978; Johnson 1993; Fig. 8.6). In such a structure, the timber frame is rendered less susceptible to damp—many houses and farm buildings of this type have survived for over five or six hundred years.

The strengths of this particularly complex form of timber-framing are various. The structure may be prefabricated in its various parts before being assembled on site—there is archaeological evidence for this in the presence of Roman numerals scratched into the various beams, giving a guide to on-site assembly (Harris 1978). It is also stronger, and may even be taken apart, moved, and reassembled elsewhere, as can be seen at exhibits like Singleton in Sussex, England, and St Fagan's near Cardiff in Wales, where such structures have been reassembled as part of open-air museums (Moir 1997). However, this type of structure does require much better quality timber, and skilled carpentry. As massive and durable as many prehistoric

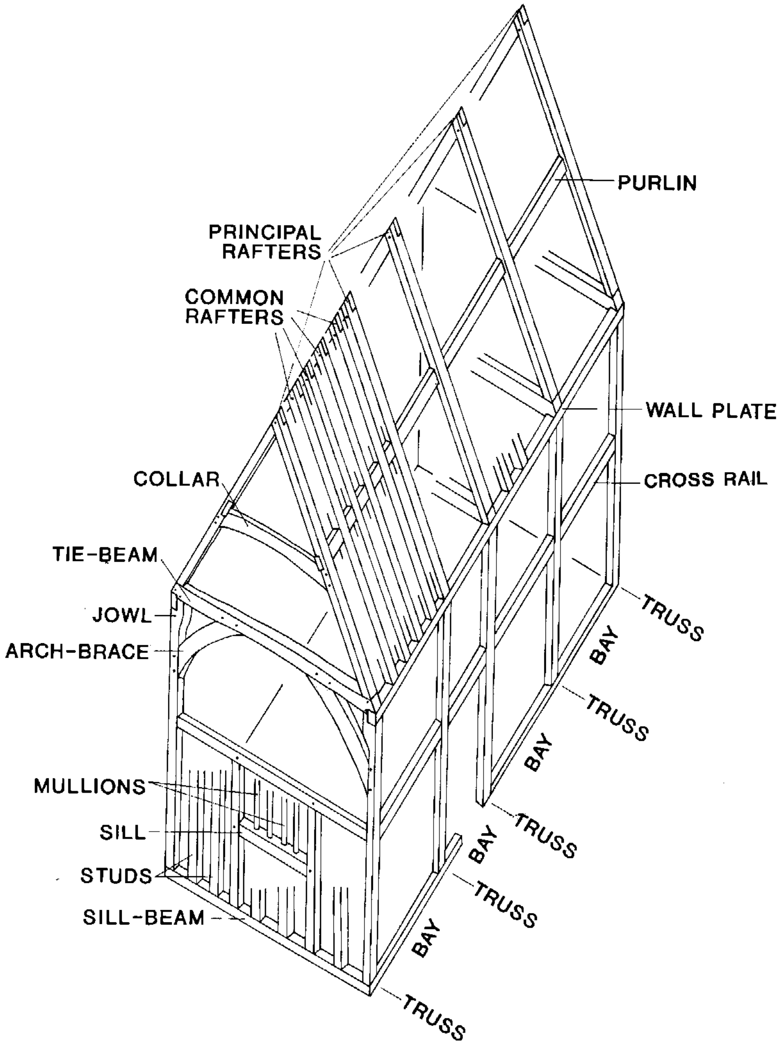

Figure 8.6 The timber 'skeleton' of a seventeenth-century East Anglian house. Source: Johnson 1993, fig. 3.1.

houses may have been, the techniques for their construction were not as specialized; houses such as the 'Celtic' huts described may well have needed little specialist knowledge. Skilled carpenters with a knowledge of geometry, a deep understanding of the properties of timber, and an ability to prefabricate the timber skeleton in the builder's yard, are needed to build a timber-framed house.

The use of timber in such a way also requires quite complex systems of woodland management (Rackham 1986). To create this second kind of framing is not simply a matter of going out into woodland and cutting a tree down: timber for use as part of a structural frame has to be carefully grown, often over several generations; carpenters often show great skill in using timber that is curved or 'waney', masking or even making an advantage of its second-rate nature. Because of these requirements, substantial timber-framed buildings are thus symptomatic of quite complex, state-level, societies. Given the need for such management, such timber was often scarce, and poorer dwellings were either constructed in a cruder manner from sub-standard timber or from other materials.

Where wood was plentiful it was used to create solid walls, in the manner seen today in Canadian, Swiss or Scandinavian pine-built log cabins. Straight pines would be piled one on top of another with rough-hewn interlocking joints at the corners, with little or no foundation, the sheer weight of the walls giving stability. Native groups in what is now the north-west coast of North America used this technique (Oliver 1995).

Different kinds of wood have different tensile strengths and qualities. In the deciduous forests oak is the most popular wood for use as a building material; other kinds of timber have particular qualities, but oak has all-round strength. Nevertheless, elm and other woods are known.

Being perishable in the long run, wooden structures often have to be inferred indirectly by the archaeologist, as discussed in Chapter 4.

Stone

Like timber, there was a plentiful supply of raw stone in the landscape for prehistoric peoples to exploit; but again, like timber, the extraction and preparation of good quality stone for major building projects are lengthy and arduous processes.

The earliest stone structures known to archaeologists are the 'manuports' used to construct windbreaks in the Lower Palaeolithic of Africa (Binford 1983). These stones appear to have been carried a little distance and arranged to form some kind of shelter; as such, they form one of the first pieces of evidence for 'home-base' behaviour amongst the early hominids. Loose boulders or rubble of various kinds have been used in a variety of structures. Dry-stone walls have been created by many societies in many periods of the past in many different parts of the world, by the piling and simple coursing of such material. Again, stones can be piled up as 'rafts' to provide foundations for timber-framed or clay-walled structures. Piles of rubble of this kind can be used to provide a platform for the sorts of timber structures mentioned above. For a properly stone-walled structure, however, it is necessary to finish the stone to some degree, whether by facing it or extracting good quality stone from quarries if none is available on the surface.

It is not necessary to use mortar to build a stone structure. The Anasazi pueblos discussed earlier used high walls in 'dry' stone walling, as did the Incas (Fone 1984). Inca palaces often had walls of great height constructed with huge stones, each many hundreds of tons in weight; despite their size, these were crafted to fit tightly together. The great palaces of Mycenae and Tiryns in bronze age Greece were also constructed in this manner, with 'Cyclopean' walls (Fone 1984). Nevertheless, most stone walls of any size or pretension use some form of mortar for bonding. Roman and medieval walls had a distinctive method of construction, in which a wall was built by first raising the two faces a few courses in finished stone, filling the gap between with rubble, pouring mortar over that rubble, and continuing upwards in similar fashion when the first part of the structure had set (Adam 1994). As a result, the core of such walls was often quite weak.

Many stone buildings employ techniques apparently unsuited to their material. This is the case with Greek and Egyptian temples—monumental structures with tall pillars closely set and surmounted by stone lintels, even though post-and-lintel construction is a technique more suited to timber. Egyptian temples are clearly derived from wooden models (their capitals from acanthus leaves, for example) (Fletcher 1938:41). Greek temples were often initially built in wood and replaced piecemeal in stone, and their design reflects these origins. The pillars stand for tree-trunks as posts, the lintel for the wall-plate, and so on (Fone 1984). A more primitive example of the same use of wooden techniques in stone is that of Stonehenge: the great lintels of the famous stone trilithons at Stonehenge have mortise-and-tenon joints, clearly derived from carpentry joints.

Different stones have different structural and aesthetic properties, and past cultures often employed a combination of stones within the same building. Sedimentary rocks such as limestone and sandstone tend to be workable, but are often soft and susceptible to erosion. Granite, conversely, is a hard rock that is durable but only worked with difficulty. Chalk is generally too soft to be used, though a hard variety known as 'clunch' is sometimes used, as at Ely Cathedral in England.

The use of flint in areas such as East Anglia in England is an interesting study in the way an intractable building material can be manipulated. Flint nodules can be laid in courses to form an undistinguished rubble-like wall. However, they are impossible to use for cornering, so poorer churches in East Anglia had circular bell-towers to avoid the need for corners, whereas richer communities used worked limestone (ashlar) or bricks for cornering. Two techniques could be used to create flint-walled structures in more ambitious ways. Large nodules could be 'faced' by chipping, and the chips then impressed into the mortar in the interstices, a technique known as 'galletting'; or the nodules could be squared into brick-like forms. All these methods can be seen on medieval and later buildings.

Stone walls vary greatly in their manner of construction. Random rubble walling is common, and need not be an indication of poverty—the 'Cyclopean' walls of Mycenae in Greece and of the Inca civilizations of Peru mentioned above are examples of this technique, where tightly jointed dry-stone walls of huge proportion represent immense effort. Walling is more commonly coursed or laid in rows, however, whether the blocks are shaped and finished or merely selected according to size. High walls would be built up in sections in the pre-modern period, each stage supporting the scaffold in its turn. Small holes for scaffolding can often be seen, and provide a clue to building technique: thus, the presence of holes in a 'spiral' pattern on circular towers and turrets of the Welsh castles of Edward I, indicating use of the French inclined scaffold rather than the horizontal English manner, suggests the presence of French masons during their construction.

Whatever the type of stone used, its use and quality will depend on local availability and the use of quarrying. Areas rich in stone may nevertheless be poor in terms of good-quality building material, either because the local stone is friable or otherwise unsuitable or because surface material has been shattered. High-quality stone therefore tends to come from quarries. These survive themselves as archaeological sites of importance, such as the Pentelic marble quarries from which the Parthenon and many other great Greek temples were constructed, the Egyptian granite quarries at Aswan, or the 'humps and bumps' that remain of stone quarries at Barnack in England (Alexander 1995). Quarries can be sourced, as can reused stone.

When a major stone building fell out of use, its materials were soon removed and reused in other, often more humble, buildings. Great medieval monasteries, the majority of Hadrian's Wall, and many other monuments, have all been completely or partly destroyed in this way, though sharp observation will usually reveal the reused stone in buildings in the vicinity. In other cases the outer 'skin' of finer faced stone has been removed, as most famously in the case of the Great Pyramids of Egypt.

Finally, one major advantage of stone structures for the archaeologist is their preservation though time. A stone wall can survive indefinitely, and far more damage has been done to ancient stone structures from deliberate destruction and removal of building materials than from natural erosion. Often good building stone will be taken away from a disused building for reuse elsewhere; archaeologists term this removal 'robbing'. In the case of limestone, modern farmers will destroy ancient building and process the stone in order to lime their fields. Apart from earthquake damage, the main natural threat to a stone wall is generally from frost cracking: if water can penetrate into a wall and then freeze, its expansion will crack the wall open. Fire can have an analogous effect—the Romans and later generations used knowledge of this to help in quarrying raw stone (Adam 1994). As a consequence of this relative durability, much of our knowledge of structures of all types comes from stone structures. One example already mentioned is that of Stonehenge, where we may suppose that the stone trilithons are based on analogous wooden structures (Richards 1991). Another is the site of Skara Brae in the Orkney Islands of Scotland, where a series of neolithic houses in stone was excavated by Gordon Childe (Parker-Pearson and Richards 1994a:42–45; Fig. 8.7). Such was the apparent scarcity of other materials at Skara Brae that even items of furniture such as beds and cupboards were constructed using flat slabs of limestone, giving us important clues as the appearance and internal organization of neolithic houses in adjacent regions which survive simply as collections of post-holes.

Brick

Mud or earth has been used since at least the neolithic period in some form or another. In hotter climates, walls of sun-dried mud were built, protected from rain by some form of thatched roof. The great civilizations of Egypt and the Middle East built great structures through the use of sun-dried bricks.

Figure 8.7 Skara Brae, Orkney: a neolithic stone-built settlement. © Historic Scotland.

Earth mixed with water and straw would be cast in a mould and left to dry in the sun. The 'tells', or hill-like build-up of such ancient sites, are principally made up of many millions of such bricks, each phase of the site being built on top of the collapsed mud-brick ruins of the previous one (Redman 1978).

In more temperate areas bricks needed to be fired in a kiln. This was a technique spread by the Romans in temperate Europe (Adam 1994): behind the stone or plaster façade of many Roman buildings is a core of brick and mortar. Early bricks tended to come out of the kiln in a variety of colours, and builders in medieval and later Europe exploited this to create patterns in brick walls. Bricks could be moulded in certain patterns, or carved or 'rubbed' more easily than stone to create mouldings and decorative features. Like stone, brick could be reused: the reuse of Roman brick in medieval or later structures is common across the former Roman empire (Wright 1972).

Concrete

Concrete was again a Roman innovation. Created from a mixture of stone and lime, liquid concrete will set into a solid, sturdy mass capable of withstanding great stresses and strains. The Romans used concrete to create a variety of architectural forms such as the great dome of the Pantheon (Adam 1994:185; Fig. 8.5) that were not equalled in Europe until after the Middle Ages.

INVESTIGATING BELOW-GROUND STRUCTURES

So far, building materials have been discussed in terms of the uses to which they can be put and the limitations and possibilities which they offer. I now want to turn to the task that faces the archaeologist: that of working out the form and function of a structure in all its details from the often partial and fragmentary remains he or she may excavate or observe in other ways. How do we recreate the whole building from elusive and ephemeral remains in the ground?

Excavation

Of course, archaeology is more than excavation and we have already encountered archaeological examples of structures that are still standing, such as the major monuments of the ancient civilizations. Nevertheless most structures from the human past have left little or no trace above ground, and may have been built of inherently perishable materials such as wood. This is particularly true of dwellings of the mass of the population, as opposed to the palaces, mansions and ritual structures of the élite, though the latter have suffered disproportionately through their role as political symbols, most famously in the case of the Bastille.

A building that has been destroyed, or which has decayed, will leave traces in the ground of various kinds (see Chapter 5). More substantial structures need foundations of some kind dug into the subsoil and these are frequently preserved in the archaeological record. Sometimes, in addition, occupation debris or layers of material from destruction or decay will have built up around the lower part of a building, covering the lower walls, and this will mean that the lower parts of a structure remain preserved intact. On certain occasions more substantial remains even than this will have been preserved: for example, at least two Romano-British villas had gable walls that collapsed outwards in one piece, leaving the 'prone' wall and gable preserved in a horizontal position (King and Potter 1996; Fig. 8.8). Occasions such as this are very rare, however. More frequently, most of the former fabric of a building will have been 'robbed' or removed for other uses, or will have decayed leaving no trace. The excavator is therefore usually in the invidious position of having to reconstruct a building from what remains of the foundations alone. The difficulties of such an exercise are obvious, particularly since many plausible 'common-sense' rules of interpretation have to be questioned.

It would appear to be plausible, for example, that the grander or more 'permanent' a building in its lifetime, the more visible its remains will be to the excavator. This is not, however, necessarily the case. The size, pretensions and investment of labour in a building may have only an indirect relationship to its archaeological visibility. If we take the hypothetical example of a wooden structure with posts set in deep and substantial post-holes, such a structure will be highly visible archaeologically. It would nevertheless be vulnerable to relatively quick decay, as we have seen. If, on the other hand, the posts rested on stone pads rather than being set in the ground, or were tied together by a shallow sill-beam, the building might be much more permanent, but much more ephemeral in terms of its archaeological survival. Remains of such pads or sill-beams might easily be removed by ploughing, or be missed within the confines of a narrow trench.

In many cases quite substantial buildings have largely vanished and are revealed only by very slight traces of wear patterns on rubble or earth surfaces. The range of fifth-century AD buildings at Wroxeter are a classic example of this (Barker 1981). It is probable that similar structures have been missed on other sites of all areas and periods not dug with the appropriate techniques. In other cases, all physical traces of an earlier building will have been removed by builders of later periods taking the foundation stones for other purposes. Such later workers dug 'robber trenches' to remove the foundations; archaeologists can often use these trenches to their advantage, tracing their form to reveal the line of the original foundations (Barker 1986). In other cases floor levels inside a structure may also have been removed by ploughing or other surface disturbance, the excavator being left with the task of joining up post-holes like a row of dots to form a building. Sometimes the numbers of post- or stake-holes clearly form a line; in others, lines may remain unconvincing, particularly where several phases of building may be represented by a jumble of holes that are not clearly related one to another stratigraphically.

In an attempt to deal with these problems, archaeologists have refined their techniques of excavation and primary interpretation considerably over the last few years (Barker 1986). In terms of excavation, archaeologists are firstly much more sensitive to the information contained in the ground. Post-holes, in which a pit is dug, the post inserted, and the pit then backfilled, are differentiated from stake-holes, in which stakes are merely driven into the ground. Different types of post-hole may be seen: those in which the post is left to rot in its place, others where the post has been removed. Careful excavation will also reveal whether the post was a vertical one or set at an angle; this was done, for example, at Cowdery's Down, England (Millett 1983). This last detail may be important in ascertaining the form of the superstructure. Large-scale, open-area excavation is often crucial to the understanding of buildings that are not major monumental structures (Barker 1986). The often confused patterns of post-holes mentioned above are impossible to understand in a narrow trench or when covered with a grid of baulks. Similarly, differential wear on surfaces of rubble indicating the pressure of sill-beams can be missed outside a large open area or destroyed without being understood within a narrow trench. An important non-destructive source of information on vanished structures is that of geophysical prospection: as the technology behind geophysics has advanced, so the buried traces of structures can be revealed with more clarity (see Chapter 5).

Experiment and ethnography

In addition to refining their excavation techniques, archaeologists have sought to explore in more detail how structures in the past may have been built, used and decayed by constructing experimental structures in the present. Such experiments have been immensely valuable for the very simple reason that a clear knowledge of how a building 'stands up' in practice is needed in order to create a three-dimensional reconstruction from a two-dimensional plan. Such experimental reconstructions, based on the undeniable premiss that physical conditions were the same in the past as they were in the present, have been useful in filling the interpretive gap between the archaeological pattern and the appearance of the past structure as a whole (West 1985). This is particularly true of post-hole patterns, since the carpentry of timber buildings can be complex, as we have seen. Experimental, as well as paper, reconstructions of buildings are useful in this regard for isolating practical problems of construction. Ethnographic parallels are also useful here in providing a link between pattern on the ground and the standing structure(s).

Another problem is that, however unmistakeable the archaeological trace, the structure above may be open to a variety of interpretations. Many sites in firstmillennium BC Europe have 'four-poster' structures, seen as four post-holes (Cunliffe 1991). What these structures looked like above ground, however, is a matter for speculation, as is their function. Paradoxically, structures with far less trace in the archaeological record may be reconstructed with far more confidence.

A good example of all these problems is the history of archaeological interpretation of Anglo-Saxon buildings. At first, early Anglo-Saxons were thought to live in small, partly subterranean structures called *Grubenhauser* after their German counterparts or sunken-floored buildings (SFBs) (Fig. 4.18). SFBs were characterized by a large, shallow pit dug into the ground, with post-holes and other features around the pit suggesting a timber superstructure; they were first noticed in section, in the sides of gravel pits in eastern and central England. However, it was subsequently shown by large-scale open-area excavations that SFBs were only one type of structure in Anglo-Saxon settlements; that they accompanied, and were probably ancillary to, larger rectangular halls, the latter being structures which, having no pit, would not be apparent in the sections of the gravel pits (Marshall and Marshall 1991). At the same time, the superstructure of the SFB was called into question: experimental reconstruction suggested that, if the pit really was used as a living-space, its sides would soon have been subjected to erosion in the absence of revetting. It seemed more plausible that the pit served a different function underneath a planked floor, and subsequent experimental reconstructions have suggested a loftier dwelling of less humble pretensions. The Anglo-Saxon 'sunken-floored building' has become, more cautiously, the 'sunken-featured building', and a combination of evidence from open-area excavation and experimental archaeology has led us to revise our view of its appearance and function.

INVESTIGATING AND INTERPRETING STANDING STRUCTURES

So far I have considered how archaeologists excavate and reconstruct past structures, but archaeology is as much concerned with standing as excavated structures, and the section below discusses the differences in method required to analyse such evidence. The greater knowledge of the upper parts of the building given by having a building more or less complete brings advantages but also complexities. Many more structural phases may be evident and these need to be recorded and interpreted. While rules of stratigraphy are still largely valid, structures may be propped up, undercut, or have fresh infilling. Ironically, a standing building may not be fully understood without careful piece-by-piece demolition, which is rarely possible given the conservation value of most such structures. Standing buildings are often still functioning structures, such as religious buildings, houses, and even industrial hardware, or high-status pieces of national or world heritage that cannot be dissected at will by the archaeologists.

In many ways, the division between buried and standing structures is an arbitrary one: the wider questions archaeologists want to ask will affect the way they dig up and record structures. A good example is the early history of excavation of medieval peasant houses. At Wharram Percy in England, peasant houses survived as upstanding earthworks (Fig. 26.3), and at first the archaeologists left baulks standing over the earthworks: this stress on vertical control was in concordance with the aim of establishing the date of desertion of the site. As excavation progressed, however, it became clear that the structures were much more ephemeral than first thought and that the baulks would have to be removed in order to understand the structures fully. Thus a change in excavation technique went hand in hand with a widening of the aims of the excavation, away from questions of dating towards those of the social and economic position of the peasant houses (Beresford and Hurst 1990).

Another example of the interaction between research themes and excavation techniques is the Romano-British town of Wroxeter (Barker 1986). For much of the last century, the major questions asked concerning this site were 'what was the chronology of the site and the appearance of the major public buildings?' More recently, large-scale open-area excavation has revealed a series of substantial buildings overlying the main early Roman structures, buildings that nevertheless left ephemeral traces. Again, this shift in technique has gone hand in hand with a shift in the focus of the questions asked, away from the identification of particular buildings towards the asking of wider social questions about the end of Roman Britain.

Hence excavation, primary interpretation, and wider research themes should not be unduly separated. A distinction should also not be overdrawn between archaeological forms of interpretation and those of other disciplines, most notably architectural history but also folk-life studies, anthropology, economic and cultural history, and conservation studies. Thus, many of the observations given above on structures and their interpretation derive strictly not from archaeology in its narrow sense but from other disciplines. Equally, however, in so far as such disciplines deal with physical remains of the past and their interpretation, they may be considered to overlap with archaeology. The greatest overlap is with architectural history. In many cases, the overlap is to the point where archaeology and architectural history are one and the same thing, as for example with the great palaces and temples of many of the ancient civilizations. The temples of the Maya civilization of Central America survive as great upstanding ruins, but knowledge of these structures was first gained by early archaeologists (Sabloff 1989). Again, archaeological excavation at the great temples of classical Greece was motivated in part by a desire to fill in the missing pieces of their architectural history (Ridley 1992).

Traditionally, architectural historians have tried to understand the aesthetic and engineering aspects of structures, and have tended to neglect the questions of social context and economic function that occupy the interest of the archaeologist. Questions such as 'when was it built?', 'who built it?' and 'what were the main stylistic influences of the structure?' have tended to delimit the scope and range of traditional architectural history (Porphyrios 1981). Many of the assumptions of this type of approach are also found in the techniques of typology in archaeology (see Chapter 5). More recently, however, architectural historians have broadened their approach, being more concerned with the social and economic functions of buildings. Mark Girouard, for example, has looked at the changing role of the English country house, tracing how great houses acted as symbols of power and as social centres for the local élite (Girouard 1978). He reviewed the different architectural developments of the sixteenth to nineteenth centuries so beloved of traditional historians—the introduction of the Classical Orders, Baroque, Palladianism, and so on—not just as a succession of styles, but in terms of what they can tell us about the social life of the owners and users of these houses.

Architectural historians have also expanded their field by looking beyond the great house: over the last forty years the study of traditional or vernacular buildings has been expanded into a major theme. Traditional or vernacular structures are those that are 'common, ordinary, regional and small' (Mercer 1975:1). Their study has involved scholars in looking at the structures that housed the mass of the population rather than simply those of the élite, and at everyday life as well as the exceptional—concerns close to the heart of most archaeologists.

Parallel developments have led other disciplines also to develop a range of interests pertinent to the study of structures. Folk-life studies, developed from the late nineteenth century onwards, have always included an interest in traditional architecture (Ewart Evans 1966). Anthropologists have similarly become more sensitive to the material culture and technical systems of the peoples they have studied, while the so-called 'New Social History' and 'New Cultural History' have paid more attention to the evidence of the everyday structures of life such as dwellings and other buildings (Isaac 1983). When looking for models to interpret his or her evidence, therefore, the archaeologist is not short of complementary disciplines to turn to.

At the same time, archaeology has widened its interests beyond traditional questions of chronology and distribution. Archaeologists are now more willing to turn to contemporary ethnographic examples for models to interpret their evidence, and are more prepared to examine the social and symbolic aspects of structures. Archaeologists have therefore moved closer to the concerns of other disciplines also.

This interaction between different disciplines concerned with the study of structures can also be seen if we look at the early history of archaeological approaches to buildings. Early evolutionary approaches combined thinking on architecture and social evolution. Scholars such as Innocent (1916) and S.O.Addy (1898) asserted that there was a link between the house type characteristic of a human group and the position of that group on the evolutionary scale, between simple and complex. In particular, it was suggested by some nineteenth-century writers such as Addy that circular houses were symptomatic of matrilineal societies, whereas rectangular dwellings characterized patrilineal groups. Since in many areas of the globe rectangular houses appeared to succeed circular structures at some point in prehistory, this was interpreted as evidence for the end of matrilineal groups and their replacement by patrilineal cultures. Thus, the evolutionary schema fitted house type in with the evolutionary schemes of human society proposed by Morgan, Marx, Engels and others, of the kind discussed in Chapter 11. Such global evolutionary models were regarded with more and more scepticism as the nineteenth century progressed: scholars pointed out the difficulty of generalizing from present cultural groups to past ones and stressed the uniqueness of cultures (McNairn 1980). In terms of structures, then, archaeologists found evolutionary schema less appealing: rather, if each culture had its own form of dwelling, structures could be used as diagnostic of particular, unique cultural groups. Gordon Childe, for example, listed house form as one of the criteria for defining an archaeological culture (McNairn 1980).

The form of structures was thus used by the culture-historical school of archaeologists as one trait among others in the definition of archaeological cultures, though they accepted that it was less satisfactory than other stylistic traits such as ornamentation or burial practice, since house forms were far more obviously influenced by environment as well as cultural preference. The decoration of a pot is largely a matter of cultural choice. Not so, however, with the selection of materials and building techniques—an igloo would not be an appropriate cultural choice of dwelling in the Amazonian rain forest. However, distinctive forms of structure could be seen to ‘get up and move’ in Childe’s terms (McNairn 1980), indicating the possibility either of the diffusion of cultural traits or of the migration of peoples.

A typical example of this type of approach to the significance of structures was the mapping of *Grubenhauser,* the sunken-featured buildings discussed earlier, typical structures in north-western Europe after the fall of the Roman Empire. These distinctive structures appear to be culturally diagnostic of ‘Germanic’ groups: they may be found in various contexts in the ‘North Sea culture area’ of early medieval Europe (West 1985). Again, distinctively long rectangular house forms moved with the *Linearbandkeramik* early neolithic culture across the loess soils of Europe in the fifth millennium BC (Hodder 1990). In both these cases, it is unclear whether the movement of forms of structure was a result of diffusion or migration; in other words, whether a set of ideas including those on house forms was being transmitted between peoples, or whether peoples were moving across Europe taking their forms of dwelling with them.

In a more recent context of study, much interesting research has been done by post-medieval archaeologists and architectural historians on the movement of house forms from the Old World to the New (Fig. 8.9). Robert Blair St George has traced the movement of particular types of house plan from Puritan East Anglia in England to the seventeenth-century colonies of New England, whilst forms of house present in seventeenth-century western England have been excavated in Virginia (Blair St George 1987). These houses were built using very different techniques in the New World. Timber was more plentiful in the vast forests of Virginia and New England than in the old, deforested countryside of the mother country; and because Virginian planters did not intend to stay for more than a few years, posts were set in post-holes in Virginia long after the practice was abandoned in England. Despite these wide structural differences, the plans of dwellings in the two areas were strikingly similar. Virginia and New England shared the same similarities and differences in terms of plan that the West Country and East Anglia shared at 'home'.

West African forms of structure have also been shown to migrate in this way: forms derived from the Yoruba houses of West Africa appear to have been built by newly transported slaves in the West Indian plantations. Thereafter, through a process of 'Creolization' (the emergence of forms that were hybrid between the different ethnic groups in the Caribbean and North America), houses showing distinct West African influence were built on slave plantations in the Carolinas and other areas of the American colonies (Upton and Vlach 1987).

The New Archaeology of the 1960s and early 1970s (see Chapter 2) introduced a wide range of new techniques in the interpretation of structures. The origins of many of the scientific techniques mentioned above lie during this period. Perhaps more important, however, was the processual contribution to the interpretation of structures. The primary sentiment of the New Archaeology was one of optimism. In line with the general premisses of processualism, it was argued that structures were not just unique creations of ancient peoples, opaque in their particularity: archaeologists were not just confined to talking about the technical aspects of dwellings—structures could tell us about the social dimensions of the past too. In particular, given the new stress on the ideas of adaptation and systems theory, structures were seen as settings for particular activities that were related one to another in a functional way. Lewis Binford himself concentrated on the more ephemeral evidence of hunter-gatherer sites, looking at the ways that stone tools and bones were distributed around different types of site. He argued that we could infer the size and composition of groups from aspects of their sites, and that ethnoarchaeology and archaeology of structures could be related. Thus, for example, he mapped the slight windbreaks and scatters of hunting debris associated with Nunamiut Eskimo hunting stands, which he felt offered a way to understand hunter-gatherer sites in the past (Binford 1983).

Work by processual archaeologists on more substantial structures included functional examination of palaces and other major structures in early state societies (Sabloff 1989). Palaces and temples were not simply regarded as élite buildings symptomatic of 'high culture' or 'civilization': their social role was also investigated. For example, it was argued that many of the great stone temples of the Maya civilization acted not simply as sites for the worship of the gods, but as centres for the redistribution of prestige items. Thus, the priesthood of the temples had economic and political power as well as religious significance. Archaeologists explained the rise of the Maya civilization in terms of the aggregation of this economic and political power. Thus, Maya temples were seen as more than just the mysterious relics of a lost and forgotten civilization: they were used to suggest why that civilization had developed and how it had functioned as a social network. Other élite structures were understood in similar ways. The great Minoan palaces such as Knossos and Phaistos were also seen as centres of redistribution, structures at the very top of an increasingly complex and stratified network of sites (Cherry 1986). So New Archaeology pushed the pendulum back from regarding structures as unique and particular towards looking at general stages in human evolution and the way in which types of structure reflected those stages.

New Archaeology also stressed the role that ethnographic analogy had to play in understanding structures. As we have seen, this stress on looking at non-western cultures in the present was not new, but the New Archaeologists were concerned to find out in more detail how contemporary structures were built, what their social and economic context was, and how they decayed and left archaeological traces. They then used this evidence as an aid to the understanding of prehistoric structures. New Archaeology also stressed the possibility of looking at the social nature of structures through the study of built space. One famous study was that of Hill (1970), who examined the pueblo architecture in the American Southwest and looked at the pottery found within these structures; using ethnographic analogy, Hill argued that pottery painting styles were passed down from mother to daughter. If this was the case, indication of localized pottery styles within different areas of the pueblo would point to a matrilocal society (one in which husbands moved to wives' residences rather than vice versa). Hill found that such concentrations existed; although the study was challenged, it remained an exciting example of the sort of social inferences that one could draw from the archaeology of structures.

One method of looking at the social role of rooms within a building is through the 'penetration analysis' of complex structures, a technique developed outside archaeology by Hillier and Hanson (1985). Hillier and Hanson's interest was in both modern and ancient architecture. Their method was to treat rooms as units, and map the links between rooms rather than their spatial proximity. This was important because, as with a maze, rooms can be physically close to one another but far apart in terms of access. This kind of topological analysis has led to a re-examination of the social roles of different rooms within, for example, medieval castles, Minoan palaces, Roman villas and many other such large structures (Locock 1994). Thus it has been shown how the layout of medieval nunneries differed from that of monasteries in very insignificant ways in superficial terms, but profoundly in terms of the arrangement of rooms (Gilchrist 1993).

More recently, archaeologists have expanded their scope of enquiry still more widely: they have looked beyond the social and economic functions of structures, and have turned to examine the symbolic meanings that structures might embody. Archaeologists have recognized that not only churches and temples carry symbolic meanings, but that everyday life and the space within which that life takes place is also meaningfully constructed. In other words, ordinary life is also organized around ideas: ideas of how to think and behave in a family, ideas about solidarity of community, ideas about time and work discipline. All these ideas will influence the way people choose to organize and arrange space within structures, however humble or ordinary the dwelling may have been.

In looking at the symbolic structures that lie behind physical ones, archaeologists have been encouraged by the work of anthropologists such as Pierre Bourdieu, who have shown how patterns of space within ordinary dwellings in non-western societies may represent very elaborate systems of symbolic meanings. Bourdieu showed for example how Berber houses in North Africa were split into men's and women's spaces, and how different activities such as cooking and sleeping were seen as 'male' and 'female' (Bourdieu 1973). This split was not one indicated by walls, but rather by the positioning of the hearth, the eating area, the bed, and so on, within the one large space of the house. At the same time the house as a whole was seen as a female domain, contrasted to the 'male' world outside. Bourdieu thus demonstrated that the Berber house is much more than just a machine for living in: it encodes and expresses different ideas about the sort of people Kabyle men and women are, and the way they should think and behave.

When archaeologists look at ancient and prehistoric structures it is more difficult to perform this kind of complex symbolic analysis since the inhabitants of ancient houses are long dead. They are therefore no longer available for the sort of observation and intensive questioning that Bourdieu and other anthropologists could indulge in. Nevertheless, the materials for such a kind of symbolic analysis are available if the archaeologist is sensitive enough to the evidence. He or she may look at the nature of physical boundaries between different areas of a dwelling, and interpret these as symbolic boundaries also. The relationship between the inside, social, world of the house and the outside, natural, world may also be examined in terms of the boundaries placed between the two areas. Inside the house, different areas of cooking, eating and sleeping may be discerned, and interpreted as activities taking place in different parts of the household. The provision of privacy, or the lack of it, may indicate the relative weight of community versus individual in that household and culture. Finally, the deposition of rubbish may be examined: as Lord Raglan pointed out, the house is kept clean not only for the sake of tidiness, but because it is sacred.

Ian Hodder has explored how the houses of early neolithic societies in the Near East and the Balkans expressed a series of ideas about nature and culture as well as about household relations. Hodder saw neolithic houses as expressive of an idea he calls the 'domus'. Through structural evidence Hodder sees the idea of the domus unfolding as neolithic culture spread across Europe; changes in house form playing a key role in this (Hodder 1990).

Work in pre- and protohistoric periods has linked changing architectural forms to changing perceptions of gender, status and ethnicity. Many of the iron age structures above have been seen in structuralist terms, linking left/right, front/ back oppositions and orientation to cosmological and social ordering (Parker-Pearson and Richards 1994b). Studies of Roman villas have been the subject of much traditional work on art and architectural styles, and have been seen as fairly straightforward indices of 'Romanization'. Recent work has challenged such simplistic interpretations, and seen villa architecture in contexts across the Roman Empire as a far more complex expression of identity (Scott 1990; Scott 1994; Wallace-Hadrill 1988).

My own work on traditional architecture in Suffolk, England, has looked at how houses related to society in the late medieval and early modern periods (Johnson 1993; Fig. 8.10). The medieval house was dominated by a large central hall that was open to the roof. The hall was a symbolic expression of the relations between different parts of the household. Though it was not divided physically, the hall was divided into upper and lower ends, a divide that corresponded to master and servant. This divide was marked by architectural features such as the placing of windows and doors, and in some cases the raising of one end onto a 'dais' or low stage. Thus, the hall could symbolize community by being open to all while still demarcating wide difference in status within that community.

Changes in symbolic values can also be seen underlying the changes in houses at the end of the Middle Ages. The open hall was reduced in size and given a ceiling and chimney-stack. This reduced its importance as an expression of the household and its visual impact. At the same time other, more private, parts of the houses gained in importance. Increasing segregation between different parts of the house, a greater degree of privacy, and rising material comfort all added up to a 'process of closure'. This process went hand-in-hand with changes in the way houses were built, away from traditional systems of timber-framing towards more 'rational' and cost-effective methods, reflecting the rise of market capitalism. Closure and technical

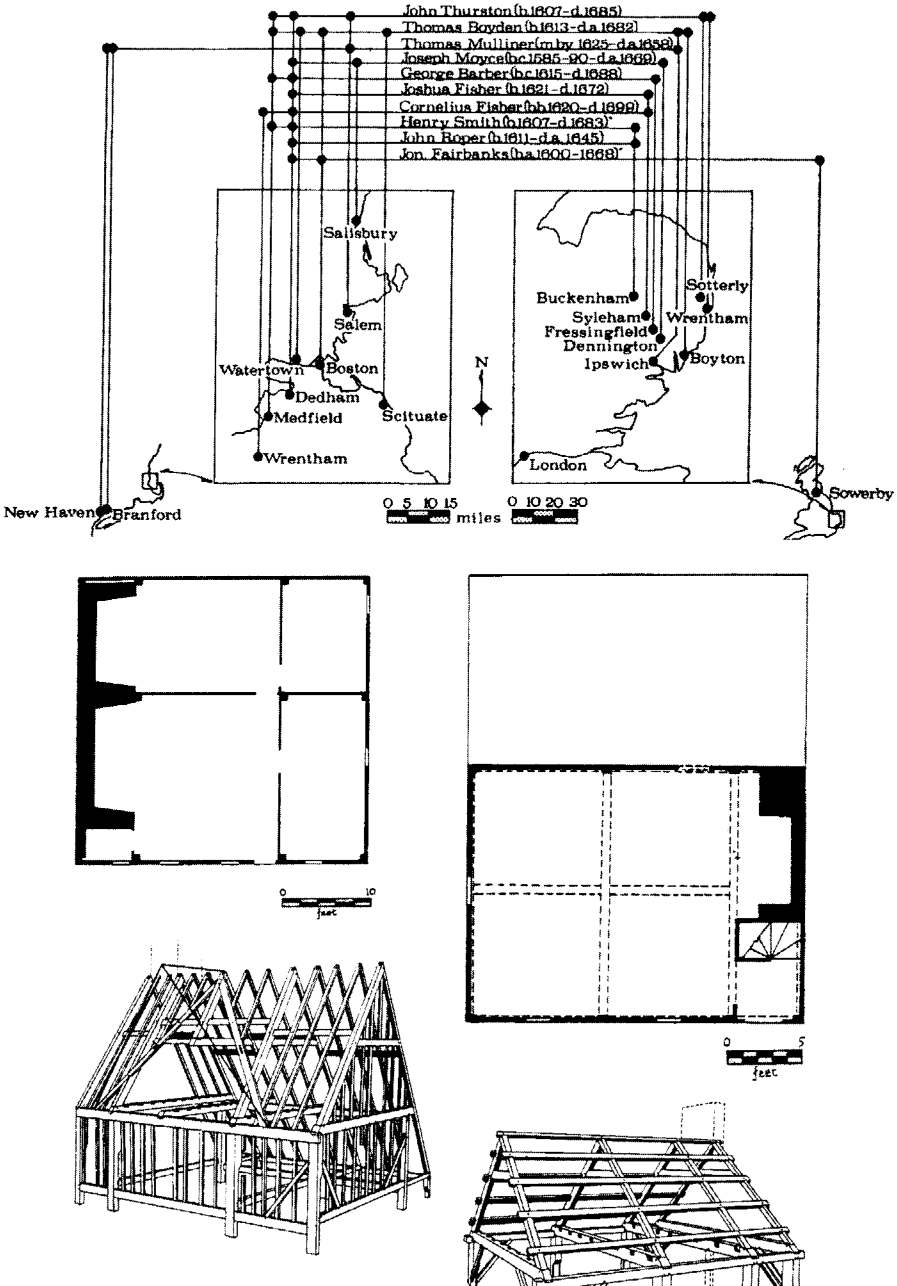

Figure 8.8 Links in house plans between East Anglia and New England. The map above indicates the East Anglian origins of carpenters in seventeenth-century New England; below are the plan and roof frames of two seventeenth-century New England houses. Source: Museum of Fine Arts. Boston.

Figue 8.9 The collapsed gable wall of a Roman villa at Meonstoke, Britain: this wall collapsed forward at the end of the villa's life, leaving it substantially intact and prone on the ground. By kind permission of the Trustees of the British Museum. Drawn by S.Crummy.

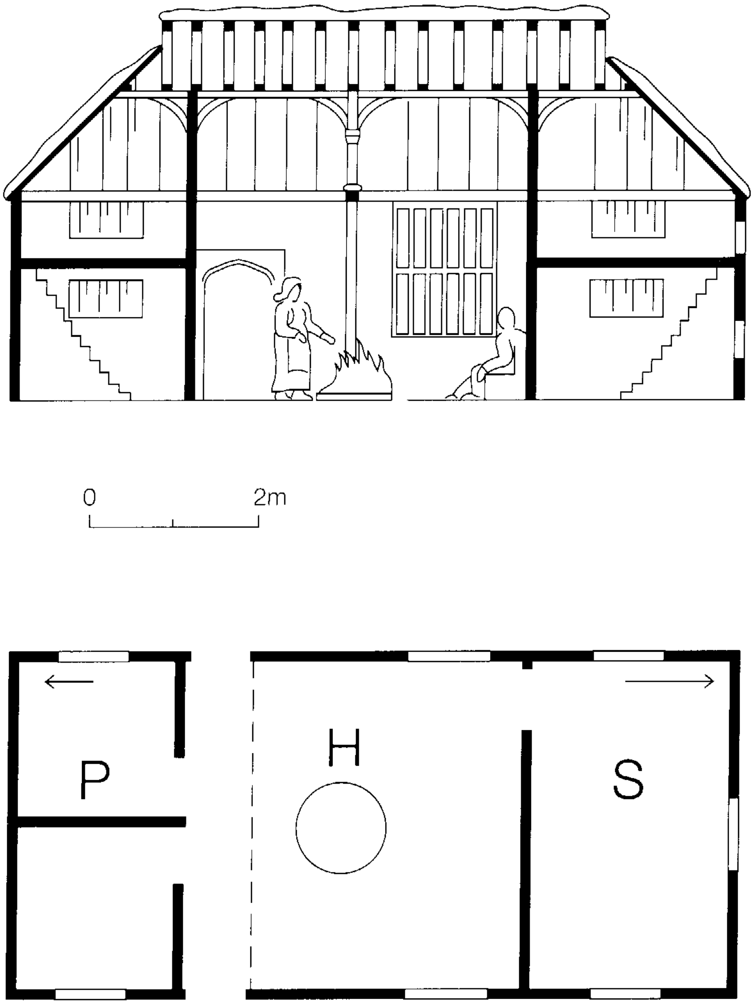

Figure 8.10 Traditional architecture in Suffolk, England: changes in symbolic values. Source: Johnson 1993.

changes reflected social changes, away from medieval towards modern patterns of family and household life.

There has been much work on similar lines in 'colonial archaeology', where scholars have looked at different architectural forms in terms of the archaeology of modernity. Much of this work has been done on the east coast of the USA (see Chapter 28), though other colonial contexts such as southern Africa have also produced exciting studies of both traditional and 'polite' architecture (Hall 1987).

CONCLUSION

All the examples of interpretation of structures given in the last section have their problems: all leave important factors out of their analyses, whether these are symbolic, cultural, economic, or environmental in nature. No single method of looking at structures has yet been seen as fully satisfactory. However, this is inevitable given the nature of archaeology: enquiry never stops, and our ideas and models are constantly being confronted with contrary evidence and being found wanting from the perspective of competing approaches. Nevertheless, this chapter must end with a paradox. We have seen that archaeologists are very good at recovering the fragmentary traces of structures through techniques that are constantly being refined, whether these are of remote sensing or of new excavation methods. Archaeologists have also spent much time learning to interpret better the traces which they find, having learnt the lessons of experimental archaeology and ethnoarchaeology. We have yet to develop the full potential of the archaeology of structures, however, in the field of our broader understanding of how past cultures used and thought about built space. We are very good at recording and interpreting the traces of structures at a primary level, but less good at understanding what they mean. We need more imagination and understanding of different cultural systems to make good this difference in the future.

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For archaeological methods generally, see Chapter 4, but Alcock *et al.* (1996) is an excellent practical guide to techniques of recording; other handbooks in the same series are useful for standing buildings. Harris (1978) is a clear, accessible and fascinating introduction to the complexities of timber framing. Shackel (1996) is an excellent study of industrial architecture in its context. In my own books (1993, 1996) I examine architecture—both traditional and polite—from a contextual perspective and try to relate it to wider cultural and social forces. Moore (1986) is a definitive ethnoarchaeological study. Kent (1989), Locock (1994), Samson (1990) and Parker-Pearson and Richards (1994a) provide collections of case studies from a variety of theoretical perspectives, and Graves (1989) and Gilchrist (1993) are useful interpretations of religious structures. For structural studies in other disciplines, see Porphyrios (1981) for a collection of readings that give a flavour of the methodology of architectural history, and Girouard (1978) and Howard (1987) for studies of the relationship between élite buildings and politics by architectural historians, whilst Bourdieu (1973) remains a classic study. Glassie (1975) is a classic structuralist text. Lefebvre (1991) and Roberts (1996) are examples of approaches derived from historical geography. The reader edited by Upton and Vlach (1987) gives a flavour of American architectural studies.

9

STUDYING ARTEFACTS

Elizabeth Slater

INTRODUCTION

For a discipline concerned with the study of human actions and human development through time, the central place accorded in archaeology to artefacts—objects made and used by people—is not hard to understand. They are the direct products of human intelligence and, however incomplete the archaeological record and however selectively objects entered that record, they are actual items that were deliberately made and utilized. The questions may be 'who?', 'where?', 'why?' or 'what?', and the artefacts may not be able the answer these directly, but they are one of the most easily accessible and recognizable forms of evidence. Also it is the collections of objects in museums, plus the standing monuments, that form much of the public face of archaeology. Archaeologists may be ultimately concerned with the broad issues of social, political and economic systems, and the individual objects standing in serried ranks in museums may seem far removed from these, but it is the objects that are a source of fundamental data: 'the things humankind makes and uses at any particular time and place are probably the truest representation we have of values and meaning within a society' (Kingery 1996:ix). How far, if at all, we can approach any 'true' understanding or interpretation of the material record, or whether any such record is even seen to exist, is a matter of much debate (Barrett 1994; Hodder 1991), but artefacts must still be worthy of study as one of the few things to come to us directly from the past.

Each object currently known has its own history and participated in the sequence: creation-use-deposition-recovery. It is these histories, often only revealed through the study of the artefact itself, that form a major component of the base data of archaeology. The problem is how to reach these because, when we are confronted with an archaeological object, very little of its history is readily visible. Only two things are immediately apparent: the shape of the object, and the general type of material involved. With these two aspects readily accessible, and with (until the last few decades at least) a paucity of techniques available to extract more information, it is not surprising that the study of artefacts within archaeology has been dominated by consideration of form and material, augmented when possible with information on final context and association.

However, it was not just that form, material and context were visible, there was also an assumption that these aspects were normally sufficient to reveal the whole history of an object. As far as manufacture was concerned, identification of the material was thought to give information on how the object was made because only a few standard processes were postulated for the production of objects. Similarly, use could be determined via shape and context: shape because it was assumed that most objects had a utilitarian function and therefore the form of the object could say something about that use; context as a means of confirming final use. The main exceptions to this utilitarian approach were objects found in graves or other special deposits, and here context dominated, as they were ascribed a ritual or ceremonial function. As for the date of the object, for objects from historical periods this could come from historical dating and for those from prehistoric periods the shape and decoration of certain objects could be considered against chronological frameworks devised by various means in which objects had been placed by their form (their typology) into sequences of relative date. If scientific methods were employed at all, it was mainly to provide more detailed information on the material, such as whether an object of copper-coloured metal was made of pure copper or a mixture of copper and another metal, or whether objects were of a generally similar material and could therefore be classified into a group on the basis of a presumed common origin.

From this basis, the 1970s can be seen as a watershed in the study of artefacts because they heralded an expansion in the range of scientific techniques available and also reappraisal of the fundamental rationale of archaeology, its nature and theoretical frameworks. In this latter context there has been a continuous questioning of many of the basic assumptions of archaeological methodology, producing profound changes throughout archaeology not least on the study of artefacts; much of this volume is concerned with the resulting reinterpretations of artefactual material as, for example, elements of material culture (Chapter 11), a component of production and exchange (Chapters 15 and 16), and as social indicators (Chapters 12 and 22). Although this section is concerned with the narrower field of artefacts as material entities and, in particular, the insights to be gained from the scientific study of the physical and chemical aspects of artefactual materials, the impact has been no less profound. This is because approaches to the study of artefactual material—the areas deemed worthy of investigation as much as the interpretation of the artefacts themselves—have always been controlled by the prevailing orthodoxies on the nature of the past and the issues deemed significant at the specific time, as well as by the techniques available. What makes the last two decades appear, at present, to be a very significant period is that a re-evaluation of the questions to be asked of artefactual material came at the same time as the development of new techniques of examination, allowing new areas of research to be opened up. Thus, a pottery vessel might previously have been assessed solely in terms of its visual characteristics—its form, its colour, any decoration, type of clay used and where it was found—whereas it is now possible to try to investigate, via study of the artefact alone, the actual raw materials involved, their potential sources, place of manufacture, temperature and conditions of firing, date of firing, nature of any surface treatment, absorption of contents into the vessel walls, form of pigments or glaze, physical and chemical properties of the fabric and their possible influence on use. Therefore, many new opportunities have been opened up and many new questions can be addressed, just at the time when archaeology itself has been looking at the questions it should pose. However, whatever the last few years may have brought, archaeology as a discipline has a long history and many of the questions currently being asked are still rooted in past frameworks; thus it is not possible to approach the current study of artefacts without some appreciation of the historical picture.

HISTORICAL PERSPECTIVES

One of the most profound influences on the development of archaeology, and therefore on the study of artefacts, was the establishment of the Three Age System by C.J.Thomsen in the mid-nineteenth century (Chapter 1). In his observations of form within specific classes, Thomsen was seeing changes in shape as improvements through time. The overall tripartite sequence of worked stone followed by the products of technological processes, the metals of bronze and iron, was all well in keeping with the western European view of the primacy of technological development, an idea fostered by experience of the Industrial Revolution. These concepts of progress and progression were recurring elements in much archaeological work in the nineteenth century. Thus, in the 1870s General Pitt-Rivers used both archaeological and ethnographic material to argue that the forms of individual classes of object with a similar function must necessarily change and improve through time (Lane-Fox 1875), whilst Flinders Petrie, addressing the problem of the dating of prehistoric graves in Egypt, postulated that certain types of object or forms of decoration would appear, grow in importance and then decline, their relative abundance within grave assemblages thus being a guide to their position in a chronological sequence (Petrie 1899; see Chapter 5).

Whether considering the form, decoration or material of artefacts, these ideas of change and progress formed only a part of the overall evolutionist approach that dominated much of archaeological theory in Europe during the later nineteenth century. A further central tenet of this approach was the assumption that all human societies developed along a straight evolutionary line from 'barbarism' to 'civilization' (with occasional backsliding allowed), and that the artefacts produced by a society could serve as markers to identify the level reached by that society. The reliance on artefacts to provide the link through which other aspects of society could be established stemmed, in part, from the sheer quantities of material available compared with other archaeological evidence, but a further major impetus was increased European exploration and observation of the artefacts produced by contemporary non-western societies. Thus, the supposed early use of bronze and iron in Europe when compared with the scarcity of metal use by peoples of Australasia, North America and sub-Saharan Africa—areas deemed to have remained rooted in stone age technology—served only to reinforce the supposed primacy of artefacts as a guide to all aspects of society and the idea, in particular, that the production of metal artefacts was a mark of progress.

By the end of the nineteenth century, artefacts were still the main component of the archaeological record considered worthy of detailed study, with objects of stone and metal given particular significance. A broad chronological picture had been developed into which these objects could be placed. One major component was a long 'Age of Stone' that was thought still visible in many parts of the world. In favoured areas such as the Near East and the eastern Mediterranean, out of this barbaric Stone Age had come the early civilizations of Mesopotamia, Egypt and the Aegean. The great classical civilizations of Greece and Rome were viewed as the logical outcome of these moves towards civilization. Similarly, the appearance of new types of artefact and the use of new materials were seen as a part, almost an essential part, of the development of civilization. Ceramic and metal artefacts were necessarily attributed to more advanced societies, because pottery and metals had to be formed or manufactured via technical processes and were not as immediately available as stone, bone, wood and many other organic materials.

No real explanation for the appearance of ceramics and metals was thought necessary; all could be explained by the concepts of progress and evolution—after a certain amount of experience and experimentation, new materials would be introduced as society developed. Given the western European view of the primacy of technology, there was some interest in the actual processes involved, but it was generally assumed that the methods used, say, to fire pottery or to smelt ores to yield metal operated under basic scientific principles and thus would have been very similar to systems still operating in the nineteenth century AD (for example Gowland 1899). However, while there might still be no need to explain their appearance, that appearance was seen as important because the introduction and use of ceramics and metals were taken to mark or form the route to civilization (Rodden 1981). Therefore, with the beginnings of the latter part of the Stone Age (the Neolithic) and the Bronze Age then considered coincident, respectively, with the introduction of ceramics and non-ferrous metals, these transition points within the chronological framework came to be seen almost as important as the framework itself and as major milestones in human development.

By the early twentieth century, many aspects of the evolutionist approach had become untenable, not least because of the increasing recognition that societies with the same level of technology can have very different types of artefact, settlements, economies, social systems and so on. The idea of a single route from so-called barbarism to civilization dominated by theories of progress was not totally abandoned, but was allied to the concept of 'culture' (Chapter 11). There was much emphasis on the typology of small groups of objects deemed to be particularly diagnostic and which, in combination with common settlement types and burial rites, were held to represent particular groups: a prime example was the notion of a 'Bell Beaker culture group' within early bronze age Europe identified by the presence of a distinctive form of pottery and still considered in terms of this traditional terminology (for example Champion *et al.* 1984:168). In essence, this culture-historical approach (typified by the writings of Gordon Childe) reinforced the importance attached to the shape of objects, to their typology. Collections of objects found on sites were considered in terms of their similarities or differences, and more detailed chronological frameworks based on very complex typological schemes were developed. This reflected the general concern at this time, described by Willey and Sabloff (1980) as the 'classificatory-historical' period in archaeology, to establish regional chronological systems that might eventually be tied into some historical structure. One of the key elements within the European system was comparison of artefact collections from different sites to try to determine the geographical distribution of certain 'culture traits'. This, in turn, introduced a spatial aspect into the study of artefacts. Objects found on sites spread over a large geographical area were being recognized as alike in form or carrying similar patterns of decoration and were being classified into cultural groups on the basis of appearance.

This inevitably prompted questions about how the objects reached the sites, and an interest in production and exchange on a regional basis. A necessary adjunct to this speculation was research into where a specific set of objects had been made: where had they come from? Was it feasible to assume, for example, that ceramics showing the same type of decoration were all made in the same place? Were particular raw materials or production centres under specific 'cultural' control? Indeed, for raw materials such as high quality cherts or metal ores that have specific geological associations and are not uniformly distributed, could the search for appropriate raw materials or the control of them have been a driving force that could explain patterns of settlement and economic trends? These questions, combined with improvements in analytical facilities, led to increased interest in the possibility of using chemical composition of artefacts as a further line of investigation (Peacock 1970). Thus began the systematic development of two aspects of the study of artefacts that remain paramount today: the use of a physical or chemical characteristic (be it colour, petrology, chemical composition, or isotopic composition) to classify objects into groups; and the use of that characteristic to try to link artefacts to the source of raw materials or to place of manufacture.

As early as 1796 Klaproth had analysed Roman glass and Greek and Roman coins, and by the mid-nineteenth century Wocel was already suggesting that chemical composition could be a guide to the source of archaeological materials (Pollard and Heron 1996). Others followed his lead, but the wet chemical techniques then available required large samples and analysis was mainly confined to determination of the type of material via the major elements, such as whether a metal coin was pure silver or a silver alloy; or a copper-based ear-ring of tin-bronze or brass (Davies 1934/35). From the 1940s, the development of more sensitive methods of chemical analysis, such as emission spectroscopy, that could operate with smaller samples at higher precision, meant that more elements could be analysed and that more objects were available for analysis. Analysis was still mainly for the major elements, thus little more than a further adjunct to description, but as more data were produced there was increased interest in the possible value of the minor and trace element content as a means of classifying or grouping objects (Caley 1964).

In the particular context of European prehistory, the main emphasis was on neolithic ceramics and copper-based artefacts of the Bronze Age (for example Brown and Blin-Stoyle 1959). In the culture-historical approach it was these types of object that had already been classified in terms of their typology and formed the basis of the typological and chronological frameworks. Thus chemical analysis was undertaken to test their validity and determine whether objects viewed as similar on typological, cultural or chronological grounds also showed similarities in composition that might suggest a common origin or tradition. However, as larger scale analytical programmes developed, there was a tendency to see the analytical data as more objective than qualities like decoration and style, and classification increasingly based on chemical composition alone, without the validity of the analytical groupings that emerged necessarily examined with sufficient rigour (Butler and van der Waals 1966; Junghans *et al.* 1968). If an object showed more or less than a specific concentration of an element, it went into one group or another and justification of the choice of the particular element or the concentration at which division was made was often lacking. In part through the emergence of multivariate computer systems that allow examination of the structure and stability of groupings, but mainly through an appreciation of the factors that can affect chemical composition from raw material to surviving object, the emphasis in chemical analysis has now moved towards a very rigorous appraisal of the interpretation of analytical data: objects may be apparently similar or different in chemical composition but what does this mean?; how valid are the groupings?; do they really reflect differences in raw materials and/or processes? Given analytical errors, how 'similar' is 'similar'? How much difference in composition can be allowed and the objects still put into the same group?

Amongst scientific techniques, new analytical and computer systems can therefore be seen to have had a very profound effect on the study of artefacts. The same can also be said of the increased use of scientific dating methods, because techniques such as radio-carbon and uranium-series have not only allowed direct dating of an individual object's creation or deposition but have also allowed the production of chronologies independent of historical and typological frameworks (Chapter 5). This has had three main effects on the study of artefacts: first, it allows assessment of whether objects really did change in form through time and thus whether date had any influence on artefact shape—the validity of complex typological dating sequences can be examined independently; second, where these sequences do collapse and date does not appear to be a controlling influence on artefact shape, consideration has to be given of other reasons for changes in form; and third, it releases objects from their role as chronological markers and promotes consideration of some of their other aspects.

The introduction of independent dating methods also allowed broader issues and assumptions about the material record to be examined including, as far as the Neolithic and Bronze Age of Europe are concerned, key questions relating to technical innovation and stagnation. In the early stages of the application of radiocarbon dating, for example, a major inference drawn from the dating of material from a few pertinent sites was the proposition that copper production began in south-east Europe without any external technical influences from Anatolia or western Asia (Renfrew 1969). Thus radio-carbon dating was suggesting that the production of metal from its ores, one of the key developments highlighted within the Three Age System, could have started independently in both western Asia and eastern Europe and, because of the apparently later appearance of metalworking in the intervening areas of Anatolia and the Levant, that the appearance of metalworking in Europe could no longer be explained by the simple diffusion of ideas from the Mesopotamia.

This particular example of the impact of the application of scientific dating methods has been taken not only because of its immediate significance but because the ideas were being presented in the late 1960s and early 1970s, a pivotal period for the study of artefacts and when new insights were still being grafted onto the existing concepts. Therefore, while the idea of independent development of metalworking questioned one of the major elements of the diffusionist approach it did not impact *per se* on the study of artefacts, because it was conducted within the pre-existing framework of artefact studies. The postulated early appearance of metal use in south-east Europe was still seen to require explanation and there was a lingering attachment to a concept that could be seen as 'technological determinism';

that is, that accumulated experience of one pyrotechnological process like pottery-firing could, with access to appropriate raw materials, lead to experimentation and the introduction of another pyrotechnological process such as metal ore smelting. In support of Renfrew's research a sherd of contemporary graphite ware was examined to determine its conditions of firing; the latter were initially assessed as firing at around 1050°C in a reducing atmosphere and, with the melting point of pure copper at 1083°C and the smelting of oxidized ores to yield metal requiring a reducing atmosphere, Renfrew concluded 'that refractory technology in the southeast European Chalcolithic had evolved sufficiently, in the firing of pottery, to provide the conditions required for the smelting and casting of copper' (Renfrew 1969:38). Although more than one centre of innovation in metal use and production was being proposed, the casting of metals or the smelting of metal ores to yield metals were still seen as inherently 'difficult procedures', their first appearance as of great cultural significance for the area, and their roots lying within technological experience. Thus the application of radio-carbon dating in this area, and indeed scientific dating techniques in general, did not at that stage have any real effect on the way that the individual artefacts were actually considered.

What the results from scientific dating did do was contribute to the increasing dissatisfaction with the adequacies of the level of description sought within archaeology and growing recognition that a full re-assessment of the nature of the archaeological record was required (Chapter 2). Initially expressed via the Anglo-American perspective of the so-called New Archaeology (Binford 1972), these continuing debates on archaeological practice, principles, theory and philosophy have had a profound influence on the way that artefacts are viewed. Some of these major debates concerning artefacts have centred on the level of inference and the whole nature of the role of artefacts, much illuminated by insights from anthropology and ethnography (Hodder 1982). Various perspectives have emerged which see objects not as isolated items but as expressions of the whole society in which they were made and used. Why was an object produced? Why was it found in this particular context? What was its role? In place of descriptions of shape and material have come new questions: what does the form of an object indicate?; was shape dictated by use, material, period, culture, method of manufacture or combinations of these?; what is known of the function of an object?; can this be adequately assessed by consideration of context or is any direct method of examination possible?; what does the chemical analysis of a sample taken from an object actually mean? —is it a true reflection of the original composition of the object, and if so, can it be used to indicate the raw materials used to make it?; if objects have a similar composition, does this necessarily mean they were made in the same place?

How far these questions can be answered depends on the information that can be extracted. For an artefact considered as a material entity this can include its material, the types of raw materials and processes used to make it, the actual raw materials, their source, the general location of production or actual manufacturing centre, why the object was made, its possible function, the detailed shape of the object and the degree to which its shape was dictated by its material or by function. However, before looking at some current examples of artefactual studies, it must be stressed that artefacts should not be looked at in isolation and one always has to bear in mind how they were produced and what effects that might have had on the final product. A piece of glass might be analysed to see if its composition can say anything about its place of manufacture, but how can that composition be considered unless something is known about the raw materials used? A chert object may show signs of deliberate heat treatment, but why might that have been done— was it to make the object easier to manufacture? Is the absence of a particular size of object of great significance or was it just impossible to produce objects of that size from the materials available? The person making the object may have been operating within a particular political, economic and social framework that dictated what was made, but at the point of production the direct involvement was with the object and the process. If it is considered in those terms, the analysis of an artefact should start with consideration of factors such as what raw materials were available, whether any differences in their composition could have been appreciated, and whether any choices could have been made, before we select out those analytical results that we think are significant. Similarly, if a piece of chert is showing some evidence of heat treatment but not enough to alter the properties sufficiently to have been appreciated by the person working the chert, is it reasonable to suggest that the heat treatment was deliberate? It is an obvious point, but one that becomes more pertinent as more levels of description are possible, that if we want to perceive artefacts as they were perceived in the past—if they are to be used as anything near 'a representation…of values and meaning within a society' (Kingery 1996:ix) — then we have to start by looking at them as they would have been seen in the past, while still asking the four basic questions of artefacts: what were they made of?; where were they made?; how were they made?; and why were they made?

WHAT IS THE OBJECT MADE OF? WHERE WAS IT MADE?

The level of description required rests, to some extent, on the reason why the question is being asked; but the nature of the material also has an influence. Thus for wood, bone, hides, leather and ivory, one can normally only reach the species of tree, the type of bone, the form of textile and the species or genera of the plant or animal from which the material derives. For pigments, dyes, resins, glues, many gemstones, ceramics, rocks and minerals, the question is still that of basic identification but at a more detailed level. Is it a piece of granite or limestone? Is it a garnet or ruby? Is this green pigment malachite or verdigris? Was the clay used for this particular pottery vessel an earthenware or China clay? These questions are often answered via structural or physical analysis. For glasses, metals and ceramics, the questions may be more complicated: is this copper alloy a tin-bronze or a brass?; is this a lead glass?; what makes this glass blue? Such questions can only really be approached by chemical analysis. Overall, knowledge of what the object is made of usually comes by visual examination, microscopy, structural or chemical analysis.

Visual examination

Regardless of the current role of scientific techniques and the limitations of basic description, the most important technique in the study of artefacts is, and will remain, visual examination. Just by looking at the object (and this is probably all the study that 99 per cent of archaeological objects will ever receive), its form and shape can be seen, surface wear noted, evidence of manufacture and in most cases at least the basic material identified, although this is normally limited to the type of material—wood, leather, metal, bone, glass, and so on. Colour is another obvious, observable aspect, long used for identification, as noted in Agricola's *De Natura Fossilium* of 1546: 'colour, taste, odour and qualities of minerals that can be perceived by touch are the most widely known because they are more easily recognized by the physical senses than the qualities such as strength or weakness'. However, colour is not an infallible guide to identification even of minerals, although in archaeology it has often been thought that substances with strong colouration, such as pigments and gemstones, can be analysed solely by colour—not on the basis of any objective system, but just on the assumption that only a narrow range of materials would be involved. Thus, red transparent stones would be described as rubies (merely because red and transparent), and a yellow pigment as yellow ochre. As early as the 1930s, Lucas (1934:339) was warning that many green stones within Egyptian archaeological collections had been wrongly described as emeralds and beryls, but once a positive identification enters the literature it is very hard to dislodge. The situation is not helped by the translations of early texts: for example, in Pliny the Elder's *Natural History* of the first century AD, the term 'adamas' is invariably translated as 'diamond' in English translations—leading to much discussion on the contemporary importance of these gems—even when there is nothing in the context to suggest that the term should be taken as anything more than 'colourless material'.

Colour, though, can be used for analysis in one area—that of precious metal alloys—because mixtures of gold and silver are likely to show different shades of colour depending on the proportions of the separate ingredients. Thus, from the prehistoric periods through to the present day, the colour of the streak left by a piece of gold drawn across a touchstone has been used to assess the purity of the gold, and this can be extended into quantitative assay if the mark is compared with those made by alloys of known composition. Comparisons with standards is necessary because colour assessment is very subjective, and there are many sets of universal standards that are used for descriptive purposes in other fields of materials analysis (Hunt 1989). The one most commonly used in archaeology is part of the Munsell system, primarily to give an objective record of the colours of soil and pottery.

The difficulties of using colour for identification have been noted but, given Agricola's comments on assessment based on colour, it may be tempting to classify artefacts in terms of colouration on the basis that this might have been significant originally. However, two points have to be borne in mind: the surface colour might have changed through time via processes such as weathering and corrosion and, particularly for manufactured materials, colour may not have been easy to control. The colouration of man-made glass is a very good example of this because strong and variable effects can be generated by low levels of elements, and it is often difficult to ascertain whether they entered the glass as deliberate additions or as impurities in the raw materials. To make a glass object the raw materials have to be melted together, the molten glass is worked to shape and then the solid object has to be reheated (annealed) to remove the stresses produced during working and make it less liable to break. Given the number of stages involved, and all the variations in melting and working conditions, it is very difficult to decide to what extent the final colour of many glass objects was actually under the control of the producers. Sellner and Camara (1979), for instance, found that differently coloured medieval glasses had ostensibly the same chemical composition, and that the final colour for glass containing 0.7 per cent iron and 1.7 per cent manganese could be anywhere within a range of bright blue through to amber and brownish purple, depending on the specific furnace conditions when it was melted. The basic conclusion must be that archaeological objects may often be divided into groups on the basis of their colour, on the grounds that colour is in some way significant, but if the assumption is that objects of similar appearance were made from the same raw materials or produced in the same place, then the degree of control over colour during production needs to be considered, as do the effects of burial and decay on surface appearance.

Microscopy

Despite the problems, visual examination by the naked eye or with a microscope remains the main method of identifying some of the natural materials. Standard optical microscopes can give a magnification range of ×10 to ×300, and can be used in reflection (where the light is reflected back from the surface of the material), or for transmission (where the light passes through the sample). There are numerous

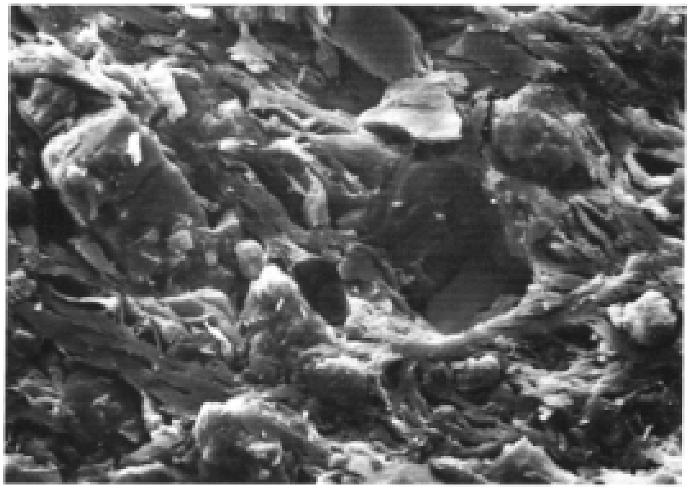

Figure 9.1 SEM image showing the interior structure of a piece of bronze age pottery. Source: Maniatis and Tite 1981.

examples of the application of optical microscopy for the identification of natural materials, including the examination of the grain pattern on a piece of leather to determine the animal from which it was obtained (Haines 1981), the analysis of cell patterns in wood to establish the species, and observation of cross-sections of textile fibres not only to determine whether they are of wool, cotton, linen or silk but, in the case of animal fibres, even the breed of animal (Ryder 1983).

The level of identification has been much improved with the development of scanning electron microscopes, which use beams of electrons rather than light to give an image of the sample, offering both an increased range of magnification and, more importantly for identification, a greater depth of focus which allows a clear view of surface topography. The emergence of the SEM into a routine analysis technique in the 1970s is perhaps one of the most significant technical developments so far in the study of the material aspects of archaeological objects, not least because it can be used in different ways. In one mode, the image of the surface generated by the secondary electrons emerging from the sample gives both high magnification and good depth of focus, so that all the area of an uneven or rounded surface can be kept in focus at the same time (Fig. 9.1). This is used not only in the identification of seeds, textile fibres, woods, charcoal, pollen, and so on via their surface characteristics, but also to examine patterns of wear on objects, as in use-wear analysis of lithic objects (discussed on pp. 379–81). If the form or constituents of the object, rather than the surface, are of interest, the SEM can be used in another mode utilizing the image produced by back scattered electrons. In this case looking at, say, a section taken from the wall of a glazed ceramic, the image will show a 'picture' of the section with the clay body and glaze as distinct layers, because the brightness of various parts of the image are influenced by the chemical composition of the areas being scanned (Fig. 9.2). Chemical composition can be further investigated by utilizing a third component of the radiation emerging from the sample following interaction with the electron beam: X-rays. The energies of these X-rays are characteristic of the elements within the sample and, with an X-ray detector attached, these elements can be identified.

The ability to focus the electron beam down to about one micron and also to move it over the sample means that various forms of chemical analysis can be undertaken: the electron beam can be moved over the sample to give a point-to-point analysis for a particular element (useful to chart changes in composition from the surface to interior of an object); an area scan can yield the overall composition of the area scanned (useful for bulk analysis); or the distribution of a specific element within the area scanned can be displayed (useful to see if the composition shows any variation, or 'inhomogeneity', within the sample). A discussion of a broader range of applications of scanning electron microscopy in the study of artefacts is provided in Olsen (1988) and further examples are given below.

The visual examination by SEM or light microscope of many organic materials such as wood, leather and textiles can give useful information because the diagnostic characteristics are little changed from raw material to object. Another major group of materials used in their natural state are lithics, and for purposes of identification it is often useful to divide them into two large groupings: minerals and rocks. Minerals have a structure based essentially on a single component which comprises

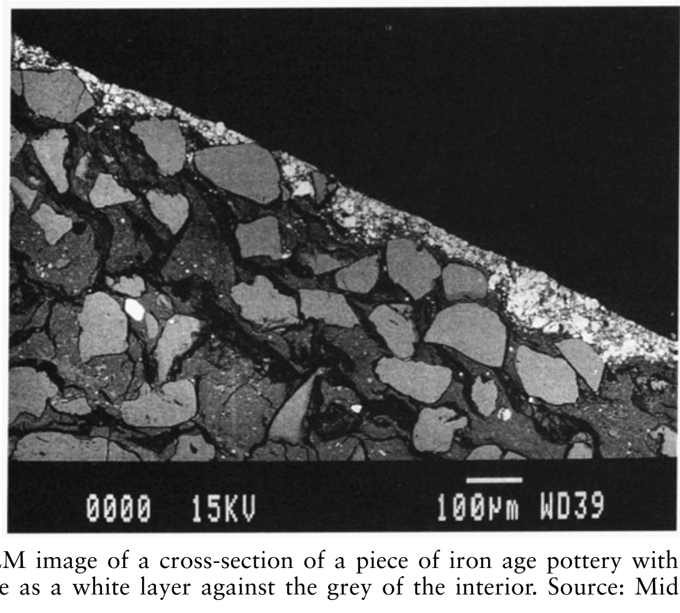

Figure 9.2 SEM image of a cross-section of a piece of iron age pottery with an iron-rich coating visible as a white layer against the grey of the interior. Source: Middleton 1987.

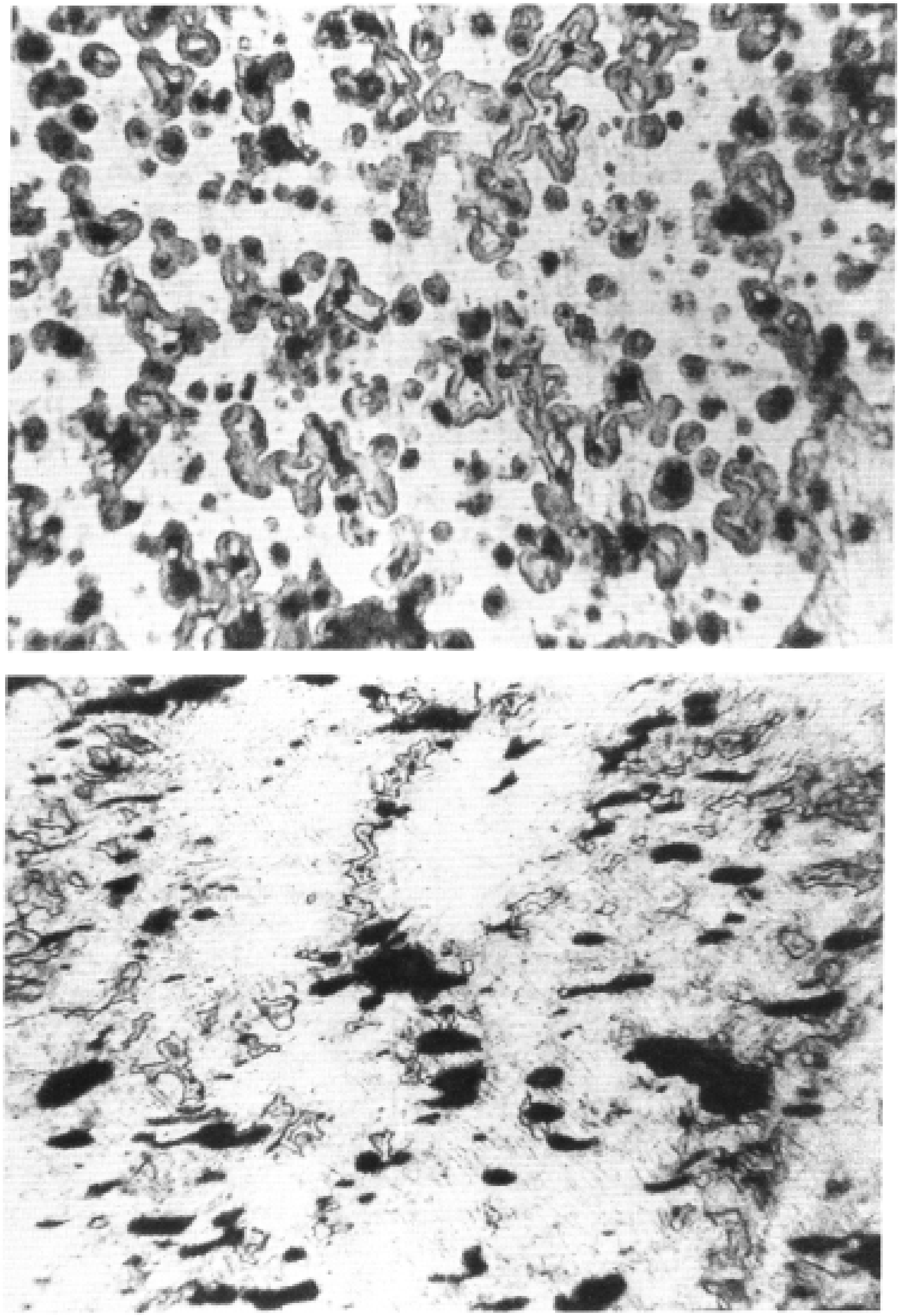

Figure 9.3 Sections of a copper—tin—lead alloy showing (a) the metallographic structure when cast, and (b) the structure after cold hammering; magnification ×400. © The British Museum.

around 80–100 per cent of the weight of the material, with the rest made up of minor and trace components, but rocks are aggregates of separate minerals. Since a particular sample of rock may contain a very high proportion of one mineral, there is inevitably some shading between rocks and impure minerals, but this is a workable distinction that sees, say, a piece of the mineral ruby composed solely of grains of crystalline aluminium oxide (Al_2O_3) at one end of the spectrum and a granite rock made up of separate grains of quartz, albite feldspar, orthoclase, zircon, hornblende and biotite minerals at the other. The reason it is a useful distinction in this context is because different techniques need to be used to identify rocks and minerals.

Aside from the rare precious gems, amongst the most important minerals in archaeological terms are the natural glasses, usually seen archaeologically in the form of obsidian, and the cherts. Chemical analysis has shown that obsidians and cherts have very similar compositions, the major component in all cases being silicon dioxide (silica, SiO_2), and the main difference between them is their structure. Obsidians are glasses and have a typical, non-crystalline random structure, akin to man-made glasses, and it is this structure that gives them their vitreous characteristics. The cherts, in contrast, have a crystalline structure that consists of a very fine network of silica crystals, termed crypto-crystalline because the individual particles are so small. If they were made of pure silica, obsidians and cherts would be colourless. However, they often contain small quantities of impurities and the cherts, in particular, come in a vast range of colours because of differences in impurities. Long before their chemical and structural similarities were appreciated, these different forms acquired separate names—flint, jasper, carnelian, sard, onyx, bloodstone, basanite and so on—but they all have similar chemical and physical properties.

The uniformity in properties within the chert minerals, arising because of their uniformity in composition and structure, is in sharp contrast to the rocks which show major differences in properties both between rock types and within samples of rock classified as the same type. In geological terminology, it is mode of formation that is used in initial classification, into igneous, metamorphic or sedimentary, and thereafter the dominant minerals species that determine whether a rock is described as a granite, a marble, a calcareous sandstone and so on. Thus the several thousand varieties of rock have acquired their geological names, associated with particular physical and chemical properties, because of their specific genesis, geological associations, proportions and type of constituent minerals. Given that it is predominately the nature, quantity and the arrangement of the individual mineral grains within the rock (its petrology) that are used to classify and name rocks, it is hardly surprising that it is these characteristics that are used to identify samples of rock. The main technique employed for this is thin-section analysis using a microscope.

Thin-section microscopy is a very well-established technique in geology, being first developed around 130 years ago, and it has been used for the examination of archaeological material for almost as long (Shotton and Hendry 1979). It is a destructive technique: a thin sliver is taken from the object, mounted, polished down to a thickness of around thirty microns and examined under transmitted light. This light can be either normal white light or, more commonly, polarized light. The technique is used mainly on rocks and a petrologist uses a combination of the shape, colour, number and distribution of the individual grains within the lithic, plus their optical characteristics under polarized light, to determine the particular minerals present and, thereby, the type of rock or mineral. Thin-section analysis has been applied to many thousands of archaeological objects to establish the artefactual material or, in the case of ceramics, the type of rock or mineral particles in the fabric. Detailed descriptions of the method and its archaeological applications are available in many texts, such as Kempe and Harvey (1983) on petrological analysis of rocks and mineral artefacts and Middleton and Freestone (1991) on the petrology of the rock or mineral fraction within ceramics.

While thin-section analysis is essentially a descriptive technique, indicating whether the rock is a gabbro, limestone, feldspar or whatever, the main aim with archaeological artefacts is usually to move beyond this and try, for instance, to classify objects into groups that seem to have been made from the same rock or to try to determine the actual geographical source of the raw materials by comparing the petrology of the artefacts with that of samples taken from various possible sources. Whether any discrimination is possible depends very much on the type of rock or mineral and the variations shown between and within different deposits, and thin-section analysis of the major components often has to be supplemented with chemical analysis of the trace and minor components to provide full characterization. With rocks and minerals, these petrological and chemical characteristics are carried through unchanged from the raw materials to the object, and when there are sufficient diagnostic features to distinguish between potential sources, this petrological-chemical approach can be a very effective technique. It was used, for example, to link Egyptian limestone objects back to their source quarry (Harrell 1992), and to examine sea-borne trade in millstones within the eastern Mediterranean (Williams-Thorpe and Thorpe 1993).

Although pottery artefacts are composed mainly of clay, they often contain rock or mineral fragments embedded in the clay. These fragments can be visible to the naked eye and can also be seen if a small sample is taken from the object and examined under a microscope; in Figure 9.2, for example, the rock and mineral inclusions are clearly visible as white particles against the black background of the clay fabric. Not only can these lithic fragments be seen under the microscope, but if a thin-section is taken they can also be examined and identified via petrological analysis using the same procedures as for solid lithic artefacts. The classification of pottery into coarse or fine wares, or into groups on the basis of inclusions visible within the clay, has long been standard practice in archaeology (Darvill and Timby 1982), and thin-section analysis of ceramics containing rock or mineral particles is becoming increasingly common because it gives a further refinement in this classificatory system. In addition, as with lithic objects, thin-section analysis also offers the possibility of defining the area or region in which the pottery was made, although the interpretation of thin-sections from ceramics can be more complex than for those from lithic artefacts. This is because the mineral or rock inclusions in a ceramic fabric can derive from the clay or may have been deliberately added, wholly or in part, as temper (Rice 1987). However, in the context of classification and sourcing, this is a somewhat superfluous distinction because, regardless of whether the rock or mineral fraction came into the ceramic via the clay or the temper, it is still likely to reflect the local geology of the area where the object was made, and there are certainly many examples where petrological analysis has allowed the specific location or general area of production to be identified (see, for example, Middleton and Freestone 1991; Williams 1983).

As with all classification and provenancing work, there are some limitations to the technique. In particular, the mineral fraction in many ceramics is crystalline quartz, which is very common and undiagnostic as to origin, so any classification has to be based on the size and distribution of the quartz grains. There is also the possibility of transport in raw materials, well attested in the ethnographic record, but, as Williams *et al.* (1974) showed in the context of Roman coarseware, petrological analysis itself can sometimes be used to indicate long-distance transport of raw clay.

Structural analysis

Since, by definition, minerals are essentially composed of a single type of mineral, thin-section petrological analysis is not particularly helpful for their identification because it will simply show the presence of that mineral. Also, as indicated above, colour cannot be considered diagnostic. The other main general method of identification, chemical analysis, is of little value here either because it is not the elements present that are required but the actual chemical compounds: thus a chemical analysis of the copper ore malachite would just indicate that it contained copper, carbon and oxygen atoms and its identification as malachite would need to be confirmed by showing that those were combined into the particular variety of copper carbonate (chemical formula $CuCO_3.Cu(OH)_2$) that is termed malachite.

What is required is a determination of the actual compounds present, and the main technique historically used in archaeology for this is X-ray diffraction (XFD). This has proved extremely useful in certain circumstances but does have the limitation that it can only be used for the identification of crystalline solids and not for organic substances or non-crystalline materials such as glasses. As with many techniques for identification, it can be difficult to interpret the results if the substance is a very complex mixture of compounds. However, where fairly simple inorganic compounds are involved, as in the identification of metallic ores, the corrosion products on metals, decay products on lithic artefacts, or components of plasters, XRD proves extremely useful. It is also ideal for the analysis of most inorganic pigments: XRD studies of pigment samples from wall paintings (Filippakis *et al.* 1976) and ceramics (Noll and Hangst 1975) have shown what a wide range of substances was used as pigments; far more than when identification was by visual examination alone against an assumed, and limited, palette.

For the analysis of organic pigments, organic gemstones such as amber, resins, glues, gums, and organic dyes, the main methods employed are infra-red analysis, chromatography and mass spectrometry. Organic molecules are very complex, and organic substances even more so because they can contain a whole range of different forms of molecule, and identification is seldom based on a determination of the actual molecules present but rather the data from examination of the sample compared with those for known substances. Thus, Beck *et al.* (1971) showed that amber artefacts from Greece are likely to be of Baltic amber by conducting infra-red analyses on samples from the objects and comparing them with the results from a series of natural ambers of various origins. Similarly Wright and Wheals (1987) were able to identify some samples of glues, gums and waxes taken from Egyptian mummy cases via mass-spectrometry on these samples and comparison with the data from seventy reference substances. The development of microanalytical techniques such as gas chromatography allied to mass spectrometry has opened up many new possibilities in the analysis of organic substances, just as new biochemical methods in the study of ancient biomolecules offer some of the most exciting opportunities in other areas of archaeology. However, the detailed investigation of organic substances to a level where the data would have a major impact on the interpretation of artefactual material remains a very problematic area, not least because of the changes produced in organic molecules by processes of decay and attrition that cannot be reproduced in modern reference materials. Analytical data need to be approached with caution, half the samples examined by Wright and Wheals for instance had to remain unidentified, and many working in this area stress the need for more fundamental research into the organic chemistry of archaeological materials (Mills and White 1987).

Chemical and isotopic analysis

Microscopy may suffice for the classification of rock artefacts and the characterization of some ceramic fabrics, but for other major artefactual materials, particularly metals and glass, visual examination just shows them to be metal or glass and to go beyond that into the type of metal or glass requires chemical analysis. There often seems to be a bewildering array of methods of chemical analysis, but most are based on very similar principles and the different techniques have mainly been developed to deal with particular materials, to allow the use of smaller samples, to improve handling procedures, or because they offer improvements in sensitivity or precision.

Some methods appear very complex because of the instrumentation involved. Others, including those based on specific gravity, look straightforward but are difficult in practice. The principle of specific gravity for identification or analysis is that all pure elements or compounds have their own characteristic specific gravity, akin to density and similarly calculated from measures of weight and volume, and that reference books provide tables of specific gravities of pure substances. Therefore, measurement of the specific gravity of an object thought to be made of a pure substance can, in theory, allow the identification of that substance. Obvious examples would be mineral gemstones, and specific gravity could also be used to distinguish between, for example, diamond, rock crystal and colourless glass. The only requirement is that the substance is known to be pure and, if used to distinguish between various possibilities, that the specific gravities are sufficiently different to make identification possible. As specific gravity of a mixture is the sum of those of the individual components, this method can also be used to look at the proportions of the constituents in simple mixtures if the types of material involved are known. This is all very simple, and would appear to offer an ideal method of analysing objects like coins where the basic constituents are presumed known and it would be too damaging to take samples for other forms of analysis. There are, however, problems with the technique, particularly in obtaining sufficiently accurate values for the volume and weight of the object, the two measures used to calculate specific gravity. The problems, but also the use of the method in the analysis of gold alloys where no other method is feasible, are discussed by Oddy and Blackshaw (1974).

Most of the other common techniques of chemical analysis involve some form of energy, normally described as a beam of radiation or a stream of particles, being directed onto the sample to be analysed. The changes produced by or to that beam or stream via interaction with the sample are then used to determine some of the elements present. This gives a qualitative analysis; for a full quantitative analysis of the actual concentrations the results for the sample normally have to be compared to those for a range of standards of known composition. All laboratories prepare their own standards but there are universal sets, such as those developed by the US National Bureau of Standards, used to check 'in-house' material and for interlaboratory comparisons. Laboratories analysing archaeological material often arrange inter-laboratory checks on their results, and as techniques have improved and there is better understanding of the nature of materials, few report anywhere near the degree of discrepancy seen in Chase's oft-cited (1974) project when two bronze samples were sent to twenty-one laboratories and standard deviations of up to 200 per cent were observed for some elements! It is, though, still the case that analytical precision differs between techniques and it should never be assumed that data obtained using different methods on the same sample would be identical. This sometimes causes concern within archaeology, but any analytical limitations are normally far outweighed by the problems relating to the quality of samples and the interpretation of the analytical results. As Pollard and Heron (1996:12) state in their excellent review of analysis techniques within archaeology, 'typically samples are far from ideal from the analytical point of view…archaeological chemistry [is] a challenging field and not one which can be regarded as just another routine application of analytical chemistry'.

The main methods used, so far, for the chemical analysis of archaeological artefacts are optical emission spectroscopy (OES), inductively coupled plasma emission spectroscopy (ICPS), X-ray fluorescence (XRF), atomic absorption spectrophotometry (AAS), neutron activation analysis (NAA), instrumental neutron activation analysis (INAA), proton-induced X-ray emission (PIXE) and proton-induced gamma-ray emission (PIGME). Several methods are employed because all have their own limitations and special requirements, and detailed descriptions can be found in several texts, such as Parkes (1986) and Pollard and Heron (1996).

One major factor governing their use in archaeology is the degree of damage they might cause the object. For analysis by OES, AAS and ICPS, a sample, albeit small, is required, which will be destroyed in the analysis. In NAA the material to be analysed is put into a nuclear reactor and bombarded with a stream of neutrons so that it becomes radioactive and, while a sample is not needed and the whole object could be irradiated, it is normally more practical to use small samples. With XRF and PIXE, a beam of X-rays or protons are directed at the surface of material to be analysed, and as the analysis is done directly on the surface, and this can be the surface of the object rather than a sample from it, these techniques are often described as non-destructive. Indeed, in the 1970s a form of X-ray fluorescence was termed the 'curator's dream instrument' because it was suggested that an X-ray source and detector could be wheeled into a museum and used to examine paint layers and artefact surfaces directly. However, whether useful results can be obtained in this way depends very much on the type of object and the reasons for the analysis. The incident beam penetrates to a depth of only 20–200 microns, and records the composition of this surface layer, and so is only useful if the composition of the surface layers is of particular interest or, if bulk analysis is needed, the composition of the surface can be assumed fully representative of the interior. This latter requirement is particularly problematic for archaeological material because there is the possibility not only of deliberate modification of the surface via processes such as gilding, but also of changes to the surface composition arising through burial, decay, corrosion and so on. Also, while it may be possible to obtain a form of qualitative analysis directly on the object, high-precision quantitative results require the surface analysed to be flat; sensitivity is much reduced if the incident and emitted radiation have to pass through air rather than a lighter gas or vacuum, and the size of the vacuum or gas chamber will therefore dictate whether the object can be examined without sampling.

It is not only the problems of sampling that restrict the use of analytical techniques in archaeology. Darkening produced by radiation, for instance, has to be considered for some types of transparent mineral gemstone and man-made glasses. However, the main constraints are often even more practical ones. Their influence on the choice of technique is well illustrated in the case of the analysis of the garnets in part of the seventh-century AD Sutton Hoo treasure (Bimson *et al.* 1982). The aim was to determine the types of garnet represented. The simplest way to do this would have been by specific gravity or optical properties, but the gems could not be removed from their mounts. X-ray diffraction would have been most appropriate to determine the actual mineral species, but the stones could not be sampled. XRF was finally chosen, but the objects were too large to fit into a vacuum system and the metal backings would have distorted under vacuum, so an in-air system was used with some of the important lighter elements having to go undetected. Some analytical data were obtained and possible sources for the stones given, but the research strategy was essentially a compromise between retaining the integrity of the artefacts and producing some useful information.

Regardless of the problems of selecting a suitable analytical method, many hundreds of thousands of archaeological objects, mainly metals, glass, lithics and ceramics, have been analysed over the last 150 years. It would therefore be impossible to consider all the applications of chemical analysis in the study of artefacts, but the interpretation of analytical data, and indeed the role of chemical analysis, is one of the areas that has seen the greatest changes and these can be illustrated in general terms by considering approaches to metals and glasses. These two materials cause particular difficulties in the interpretation of data because, unlike lithics and most objects of organic materials, there is a whole series of chemical processes—and thereby potential for alteration of the chemical composition—between extraction of the raw materials and the final sample taken from the finished object.

Metals

There are two main types of raw material for metal objects—metal ores and native metal. Native metals are found as metals and are immediately available for converting into an object. Native gold, either mined or collected from secondary deposits, has always been the main source of gold, and native coppers were exploited extensively by indigenous populations in North America and intermittently, often in the first stages of metal use, in many other parts of the world. There are also a few examples of the use of meteoric iron (iron deposited from the break up of meteors). However, despite the importance of native metal in certain contexts, all the evidence suggests that the majority of metal used throughout history has been derived from metal ores.

In the first half of the twentieth century, many hundreds of copper-based objects, mainly from the Bronze Age of Europe and the Near East, were analysed to determine the type of metal employed, to try to chart the sequence of metal use and the introduction of mixtures of metals in the form of alloys. General sequences were established which saw the earliest objects of pure copper, assumed to be native metal, followed by various impure coppers thought to represent smelted metal, then deliberate alloys of copper and tin (tin-bronzes), copper—tin—lead mixtures and then copper—zinc alloys (brasses). There was much discussion and interpretation of these sequences, with the use of impure copper and various forms of copper alloys attributed to improvements in the hardness or ease of working of these materials compared with pure copper (Wertime 1964). The chronological pattern of use of particular alloys also required explanation and has often been presented as the result of experimentation in mixing metals together or the availability of different ores allowing observation of the different metals that they would yield (Tylecote 1962).

With tin-bronzes typically containing 8–15 per cent tin and brasses with zinc to 20 per cent and more, charting composition in terms of the alloys only required analysis of the major components. However, the improvements in analytical methods by the 1960s started both to allow the determination of the minor and trace constituents and to suggest that these might have some potential value. The result was an expansion of analytical investigations of metals, well exemplified by the Stuttgart programmes that involved the analysis of over ten thousand gold and copper-based objects from the European Bronze Age (Junghans *et al.* 1968). With variations appearing in the composition of the objects, the final outcome of these programmes was the grouping of artefacts on the basis of similarities and differences in their minor constituents. This raised the questions of what the chemical analysis of archaeological artefacts was designed to achieve and whether, for example, the final chemical compositions of objects spanning thousands of years in time and drawn from locations thousands of kilometres apart could be discussed or explained against any single model, let alone whether the distribution or grouping of any type of object can be considered in terms of compositional data alone and without reference to the overall archaeological background and any social, cultural or economic influences. The other limitation was that, while there was some recog nition that the processes of production of metal objects had an effect on their final composition, and therefore should be considered if objects were to be grouped on the basis of composition, this particular factor was not much considered.

This is no longer considered acceptable, and since the 1960s there has been much research on how the chemical composition of a sample drawn from a metal object should be interpreted (for example, Craddock 1980). The situation is complex because, for a metal derived from an ore, the ore has to be heated to a particular temperature in a specific atmosphere (that is, smelted) so that various chemical reactions can occur and metal produced. It is now appreciated that the minor and trace elements used in classification are not transferred unchanged ore to metal, and research is continuing into the compositional variability within ore bodies, the effect of smelting, any changes produced during melting and casting and so on. Most of this research has involved experimental smelting, comparing composition of the initial ore with the final metal (Tylecote *et al.* 1977), but for the Bronze Age in particular it has been hampered by the paucity of direct evidence of mines, smelting furnaces and working areas. However, the situation at least for Europe is now changing, with ore extraction dated to the Bronze Age recorded for mines in Italy, Austria, Ireland, Spain, England, Wales, Bulgaria and Rumania (Craddock 1995). Unfortunately, few of these sites show evidence of associated ore processing, smelting or direct metalworking and, as far as the elucidation of processes is concerned, what are needed are more complexes like those at Timna in the Sinai (Rothenberg 1990) where the original ore, furnaces, metal product, slag and other working debris could all be examined. This would both help understanding of compositional changes from ore to metal and provide more basic information on processes to aid identification. For example, from an analysis of crucibles, slags and other residues, Yener and Vandiver (1993) postulated the so-far rarely seen occurrence of tin ore smelting at a third-millennium BC site in Anatolia, but Muhly (1993) has argued that the mere presence of tin on the interior of the crucibles does not necessarily mean that they were used to smelt tin ores. Much of Muhly's argument rests on the highly contentious textual evidence for trade in tin and the archaeological feasibility of tin smelting in the Taurus at that date, but he also questions assumptions on the processes used to smelt tin oxide ores.

The difficulties of interpretation do not mean that chemical analysis of non-ferrous metal objects has been abandoned, rather that this is now done in full appreciation of limitations of this approach. For instance, analytical data continue to have a very useful role in the study of coinage (Bowman *et al.* 1989), in tracing the introduction of different forms of alloy like brass (Craddock 1978), in looking at the selection of particular metals for specific types of object (Northover and Gerloff 1988), and in the analysis of gold objects where, because of the use of native metal, some, but by no means all, of many of the problems introduced by intra-source variability and metal processing do not apply (Elùere 1987).

However, given the problems posed by chemical analysis, the introduction in the 1960s of the necessary instrumentation—high-precision heavy element mass spectrometers—prompted consideration of whether stable isotope analysis of lead could be an alternative means of establishing a basic 'fingerprint' that might be different between ore sources and also carry through into the metal product. In a simple exposition of a very complex phenomenon, the rationale behind this approach is that when the earth originally formed, deposits of lead/thorium and lead/uranium were laid down and as the radioactive ^{238}U, ^{235}U and ^{232}Th decayed through time to yield the lead isotopes ^{206}Pb, ^{207}Pb and ^{208}Pb respectively, the proportions, and therefore the ratios, of these isotopes became different between deposits. With the subsequent mineralization of this lead into lead ores, particularly galena (PbS), it separated from the uranium and thorium and the isotopic ratios were no longer subject to change but became fixed, and remained as a characteristic of the ore to be carried through into metal produced from it. Although based on lead, this form of characterization by stable isotope ratios is not restricted to objects of metallic lead: not only was lead a major component of leaded-glass and added to copper as an alloying agent, but most silver was derived from lead ores and contains a proportion of lead from those ores, and many copper ores are intimately associated with lead minerals and some of that lead can come though into the final copper. It is therefore a very versatile technique and since the 1960s many metallic ores and archaeological metal artefacts have been investigated using lead isotope analysis, most notably by teams at Oxford (Gale and Stos-Gale 1992) and Heidelberg (Wagner *et al.* 1989). However, as with many techniques, as the data accumulate problems emerge and the underlying tenets tend to be questioned, and there has been considerable debate on the basic significance of similarities and differences in lead isotope ratios and the validity of using them as a classificatory device (Budd *et al.* 1993), and these discussions may well continue.

Glass

Glass is another material where the current chemical, and for lead-based glasses isotopic, composition of the object comes at the end of a long series of processes, with the raw materials, processes of manufacture, weathering and decay all having an influence on final composition. However, when it comes to the interpretation of analysis, the difficulties come as much from the nature of the material itself as from the effects of processes. Three main uses of man-made glass can be seen amongst archaeological objects: free-standing glass in the form of glass objects; layers of glass (glazes) on ceramics and lithics; and vitreous coatings (enamels) applied to metals. Only a very few compounds can adopt the non-crystalline structure that both defines a glass and gives glass its particular properties, and most man-made glasses are based on silicon dioxide, silica. A glass can be produced just by heating pure silica until it fuses, but this fusion only occurs at a temperature of around 1700°C and until this century glasses could only be produced by mixing the silica with another compound (a flux) to lower the fusion point, allowing the flux and silica to melt together at around 900–1200°C to form a glass. Various elements can act as fluxes and one of the initial aims behind the chemical analysis of glass was to establish the form of flux used. From analysis, three basic types of glass are now recognized amongst archaeological material: soda glass with a high level of sodium from the use of a compound rich in sodium as a flux; potash glasses with a high level of potassium from potassium-rich compounds; and lead glass from lead fluxes. This correlates with the textual evidence: glass-making recipes, from the seventh-century BC tablets from the library at Nineveh (Oppenheim *et al.* 1988) through to medieval treatises, describe the main ingredients of glass as various mixtures of crushed quartz, rock, and sand (sources of silica), natron, other natural salts, plant ashes (sources of sodium and potassium) and lead compounds (Frank 1982; Henderson 1989).

However, there are limitations in the inferences that can be drawn from the chemical analysis of glass. Glasses differ from crystalline materials in that they contain no actual compounds but are just agglomerations of particles derived from the raw materials. Therefore analysis may show that a glass is high in sodium, and a sodium-rich flux was used, but it cannot readily indicate the form of that flux (Sanderson and Hunter 1980). Nor can it indicate what impurities might have entered the glass with the basic raw materials. Nowhere is this better illustrated than with the calcium and magnesium content of glasses. Most glass analyses reveal appreciable levels of these elements (*c.* 2–7 per cent) —their presence is very beneficial in soda and potash glasses because the fluxing elements make the glass susceptible to decay, which calcium and magnesium to some extent counteract. For a long time it was assumed that these elements had been added deliberately, using limestone, shells, dolomite rock and so on, but none of the texts mentions more than two ingredients and it is now considered that they entered glass as impurities in the silica or flux. Indeed, it may be that glasses made with purer ingredients without these stabilizing elements have simply not survived to be analysed. As the sixteenth-century English glass-maker Merrett said, ‘in the finest glasses, wherein the salt is most purified, and in a greater proportion of salt to the sand, you shall find that such glasses standing long in subterraneous and moist places will fall to pieces, the union of the salt and sand decaying’ (Frank 1982:78), which suggests that Merrett was used to just the two ingredients, sand and salt, and did not recognize that purifying the raw materials had removed important constituents from the glass. The interpretation of chemical data on glass is therefore very challenging, but there is considerable interest in using chemical analysis to determine the development of techniques for producing different kinds of glass (Bimson 1987; Henderson 1989; Kaczmarczyk and Hedges 1983).

HOW WAS IT MADE?

Information on processes can be obtained from documentary and pictorial sources, structures and residual debris at manufacturing and/or production centres, scientific data on the processes that must have been carried out, the artefacts themselves, and ethnographic and modern practices. Many of the descriptions of manufacturing processes used in archaeology come from these last two sources: practices such as the hand-moulding or wheel-throwing of ceramics, the spinning and weaving of fibres for textiles, and the cleaning, dressing and tanning of hides are universal. The main interest in these particular processes concerns the diversity in the methods and tools used.

The documentary record tends to be biased towards descriptions of production processes. Amongst the most interesting texts, if not always reliable or easy to translate, surviving from the classical Greek, Roman and medieval periods of Europe are Theophrastus' *De Lapidibus* (fourth-third centuries BC), Vitruvius' *De Architectura* (first century BC), Pliny the Elder's *Natural History* (first century AD), the *Stockholm and Leyden X* papyri (third century AD), the ninth-century AD *Mappae Clavicula,* Eraclius' *De coloribus et artibus Romanorum* (tenth century AD), Theophilus' *De Diversis Artibus* (twelfth century AD), Cennino Cennini's Il *Libro Coll'Arte* of the 1390s, the *Pirotechnicia* of Biringuccio of 1540 and Agricola's *De Re Metallica* of 1558. The direct information they provide on processes is very variable, as not only are many of these texts fragmentary, or copies of early texts and very difficult to translate, but they were seldom written as manuals on processes and the writers had very different levels of direct experience of the phenomena they seem to be describing. Thus sections of Pliny's *Natural History* are continually being re-translated in the light of current knowledge on first-century AD processes, and it is archaeological information that is being used to illuminate the text rather than the other way round. There is, though, potential in certain types of contemporary pictorial and textual information: nowhere to date is this better demonstrated than in the systematic research of Needham and colleagues into the documentary and archaeological data on science and civilization in China (Needham 1958).

Interest in the translation and interpretation of texts can itself prompt research in the study of artefacts. For instance, much of the interest in opaque glass, extensively researched by Bimson (1987) and others, stems from the so-called 'glass texts' amongst the seventh-century BC cuneiform tablets from the Nineveh library in Mesopotamia. These were long known to contain information on the production of coloured glasses, but this could only be fully elucidated through the study of contemporary artefactual material (Oppenheim *et al.* 1988), with more data on these opaque glasses appearing year by year. With opaque glasses it is not just a question of the form of object, where and when the glass was made, the colours produced and so on, but rather how the opacity was generated because, while opaque glazes appear very early in the history of glaze and glass production, opacity is technically difficult to generate, as glass only appears opaque because of the presence of small crystals within the glass matrix, and these crystals have to develop a crystalline structure while the basic glass remains non-crystalline. In a good example of research developing with the availability of techniques, it is only in recent years that the magnification offered by the scanning electron microscope has allowed the crystals causing opacity to be seen (Freestone 1987). With an X-ray analysis system attached to the SEM, or with the related instrument the electron microprobe, it is also possible both to view a high-magnification image of the sample and to obtain a chemical analysis of that area of the sample on a point by point basis and thereby determine the opacifier involved.

The new opportunities offered by the high magnification capabilities of electron microscopes are particularly well illustrated by Barber and Freestone's (1990) examination of the Lycurgus cup, a glass vessel of the Roman period in Europe dating to the fourth or fifth century AD. It is dichroic, that is it appears green if viewed in reflected light and purple if seen in transmitted light. Knowledge of how this effect was produced in modern glass led to the idea that the glass probably contained a very fine distribution of metallic particles, but also confirmed that it is extremely difficult to generate dichroism because the particles must fall within a very limited size range so that they both scatter and absorb light to give the two-colour effect. Chemical analysis of the cup in the 1960s showed that it was a soda-silica glass containing trace quantities of gold and silver, and it was assumed that the dichroic effect was produced by a dispersion of gold and silver particles, but it took until the 1980s before Barber and Freestone, using transmission electron microscopy, were able to see the minute particles and analyse them to confirm that they were of a gold/silver/copper alloy. With a particle size range of 50–100 nanometres (nanometre=10^{-9} metre), they were working at the limits of the technique. This is an extreme example of the investigation of a very specialized manufacturing process (only around ten pieces of Roman glass showing dichroism still survive), but scanning electron microscopy and electron microprobe analysis have proved very potent techniques in the examination of a whole range of different types of artefact. They are particularly useful in the examination of artefacts composed of different layers (Fig. 9.2), where a chemical analysis of a sample would give the overall composition but not the composition of the individual components, nor information on how these related. Therefore the techniques have been used extensively in the study of glazes on ceramics (Middleton 1987; Maniatis *et al.* 1993), on lithics, including the particular lithic body termed faience (Tite and Bimson 1986) and for the characterization of vitreous and glassy material in general (Tite 1987).

Electron microprobe analysis is also much used in the study of layers on metal objects, to examine techniques of gilding and plating for example (Scott 1986), and to look more generally at how metal objects were made, their composition and how inhomogeneous that composition is. Establishing the degree of inhomogeneity is important if a sample is to be taken for chemical analysis, or if a surface analytical technique is to be used, because it is necessary to know how representative that sample or surface is of bulk composition. Inhomogeneity and methods of manufacture of metal objects can also be revealed using the technique of metallography under an optical microscope, the method most commonly used in the routine examination of metal objects. Metallography is very similar to other forms of microscopy, including thin-section analysis of lithics, in that it involves visual examination of the structure of a metal sample under a microscope. However, to appreciate fully its potential application in the study of archaeological objects it is necessary to understand the evolution of that structure. This can be explained relatively easily for pure metals, but is rather more complex for impure metals and alloys, though the basic principles are the same. In the case of the pure metals, if a piece of pure metal is melted and the liquid poured into a mould, as the temperature drops and the melting point of the metal is reached, small particles of solid start to form in the liquid. As time goes on, these particles grow in size until they eventually meet and the material is totally solid. Thus the solid consists of a number of blocks of metal (grains) that meet at grain boundaries; the size and form of these grains are significant because the patterning is very sensitive and can be readily altered by any subsequent stressing, working, or heating applied to the object.

In metallographic analysis, a sample is taken from the object, the surface is polished and then etched with a chemical. This etch attacks the surface preferentially at the grain boundaries and the net result is that, when the surface is examined under a microscope, the grain boundaries appear black and the individual grains can be seen (Fig. 9.3). The sizes, shapes and distribution of the grains can then to be used to elucidate the history of the manufacture of the object. If the object was simply cast, the structure will be in the 'as cast' state; if it was hammered to harden the metal or to finish shaping, the grains will be distorted; if it was a non-ferrous object heat-treated (annealed) to remove brittleness introduced by working, then evidence for this treatment should remain; if it is a piece of wrought iron worked solid from the smelting furnace it should contain particles of slag from the smelting process.

The evolution of the microstructure of impure metals and alloys, and their interpretations, are governed by the same basic principles, but the structures are more complex because they vary with the detailed composition of the metal. Space does not allow a full description here, but Thompson (1969) provides a well-illustrated guide to some of the types of microstructure seen in archaeological objects, both ferrous and non-ferrous. Ferrous objects, those of wrought iron, steel and cast iron, are all basically composed of iron, and the various materials owe their radically different properties and structures to very small variations in carbon content. Definitions differ, but material described as wrought iron in the archaeological literature generally means iron with less than 0.5 per cent carbon, steel has 0.5–2 per cent and cast irons 2–5 per cent carbon. The type of ferrous material that will be produced by smelting iron ores depends primarily on the ore and smelting process, and from the start of iron usage through to the medieval periods, wrought iron and steel were the main ferrous materials produced in the western hemisphere, with steels and cast irons predominating in China and other parts of the Far East (Needham 1958).

As wrought irons and steels have melting points around 1300 to 1500°C, objects of these materials were normally shaped by hammering the solid metal, rather than by casting, and to aid that working or change to their properties they were also subject to a whole range of heat treatments. Although they are essentially iron with very small variations in carbon content, wrought irons, steels, and cast irons show very different properties—wrought iron is malleable, steel tough, cast iron brittle—because their structures are altered by these small changes in composition. Their structures are also very sensitive to the effects of working and heat treatment. There are a few elements other than carbon in irons, and chemical analysis of ferrous materials is used, but it is neither particularly informative on the type of material, because few methods can give an accurate measure of carbon content, nor overly reliable because of the susceptibility of iron to corrosion, and so the study of ferrous objects usually concentrates on metallographic examination. Metallography can be used to determine the type of metal, act as a guide to composition, and also to elucidate the various working processes, including carburization to convert wrought iron into steel, used to manufacture anything from a wrought iron nail to a complex sword of steel (Lang 1988).

The production of ceramics, here defined as objects of fired clay, is theoretically much simpler—the clay fabric is moulded to form and the object fired. To go beyond that, to examine conditions or temperatures of firing, it is necessary to start at the beginning with the nature of clay itself. There are many different ways of classifying clays, but the most useful for archaeological purposes are those based on the formation of the deposits and those relating to the major minerals present. In terms of formation, clays are divided into primary (residual) clays that are still near the parent rocks from which they derived and secondary (transported) clays where the particles have been moved far from the parent rocks by the action of water, wind, earth movements and so on. This is a useful distinction if only because it is a clear reminder that clay deposits are likely to show variability in composition based on their genesis. Primary clays are generally high in a few specific minerals, whereas secondary clays can comprise aggregates of minerals derived from several sources, and during the course of transport and deposition they can incorporate high proportions of organic matter and impurity minerals. White china clays are typical examples of pure primary clays, and red earthenware clays with high levels of iron oxide contributing to their colour are common secondary clays.

The other aspect that influences the nature of the clay, and thus determines the appropriate firing conditions, behaviour during firing, appropriate uses for the clay and so on, is clay mineralogy. Since the major sources of clay minerals are felspathic rocks which contain appreciable levels of aluminium and silicon, the main clay-forming minerals have these two elements as their main constituents and are thus aluminium silicates in various forms, described overall as phyllosilicates and divided into the kaolin group, the smectite group, and the illite and chlorite groups on the basis of other components. Different proportions of the various mineral species give clays with specific properties: clays rich in illite minerals, for example, yield a very dense fabric with a glossy surface on firing (Maniatis *et al.* 1993). This gloss is the result of the development of a glassy, vitreous, phase, and the formation of this phase raises another basic distinction between clays—what happens when they are heated. When an object made of clay is fired, the main requirement is that the surfaces of the particles within the clay fuse together to produce a solid, water-resistant material. This fusion can be achieved by a solid—solid reaction where the particle surfaces sinter together or via the formation of a liquid phase which eventually solidifies around the particles and holds them together. Depending on the conditions and its composition, this liquid may solidify as crystals or as a glass, just as each individual clay mineral would eventually melt if the temperature was raised sufficiently high and would then solidify as a glass or a crystalline phase. However, as with the production of man-made glasses, the generation of the liquid phase can be promoted by the presence of other minerals, fluxes, that react with the clay particles to yield compounds with a lower melting point. Suitable fluxes include minerals containing sodium, potassium, calcium and various oxides of iron; if these are naturally present in the clay, or are added as a separate ingredient, they will have a major influence on the way the clay reacts during firing. Hence when, as in Table 9.1, optimum firing temperatures are quoted for types of clay, they have to be given as temperature ranges because each particular sample of clay will react slightly differently.

Clays, therefore, are extremely complex mixtures which show variations not only in their basic ingredients but also in other important aspects such as particle size and water content. This variability is often further compounded by the addition of a second component, temper. This is a possible second ingredient mixed with the clay—not in any fixed proportion but often in sufficient amounts to be visible with the naked eye. It could have been added, as it is today, for a range of practical reasons including improvement in the workability of the clay, to promote resistance to cracking during firing, or to reduce porosity in the final fabric and/or in response to cultural tradition. Various forms of temper addition have been recognized amongst archaeological ceramics, including blood, crushed pottery, shells, grass, rock

Table 9.1 Firing ranges for different types of clay and the temperatures at which certain changes occur on firing

Temperature (°C)	*Changes in clay minerals*
100ï 200	Clay begins to lose absorbed water
450ï 550	Kaolinite loses OH ions: metakaolin forms
500	Organic material oxidizes
550ï 650	Montmorillonite loses OH ions
573	Silica changes its mineralogical form
600ï 800	Micas lose OH ions
600ï 800	*Firing range for terracottas*
800	Iron chlorides volatalize
870	Calcium carbonate dissociates to calcium oxide
900-1200	*Firing range for earthenwares*
950	Calcium oxide reacts with clay minerals to form calcium silicates
960	Metakaolin recrystallizes on cooling
1000	Calcium ferrosilicates form
1100	Mullite forms
1100ï 1200	Vitrification range of ball clays
1100ï 1200	*Firing range for china clays*
1200ï 1350	*Firing range for stonewares*
1160	Potassium feldspar begins to melt
1170	Sodium feldspar begins to melt
1200	Calcium sulphate dissociates
1300-1450	*Firing range for porcelains*
1712	Silica melts

Source: Adapted from Rice 1987:103.

fragments and minerals. As discussed previously in the context of thin-section analysis, pottery is often classified on the basis of its fabric, including the visual identification of a second component described as temper. It is not, though, always easy to distinguish between material deliberately added as temper and natural impurities already in the clay, but this only really becomes a problem following the chemical analysis of archaeological ceramics when it may be necessary to separate the contributions of the various components towards the overall composition. When looking at changes produced during firing, and thereby trying to establish the conditions of firing, it is behaviour of the fabric as a totality that is being examined.

As discussed above, when a clay body is fired it can undergo several possible alterations, and the different changes that occur, and the temperatures at which they theoretically take place, are used as the basis of many methods of thermal analysis

(Table 9.1). Many techniques are used to try to assess the maximum firing temperature experienced by a sherd of pottery, but they are all based on the same principle: that the changes produced on firing are permanent and that if the sherd is reheated no further changes will occur until the original maximum temperature is exceeded. Most materials, including ceramics, expand when they are heated, but clays on firing can also suffer shrinkage as various minerals decompose or change their form, a liquid phase develops or the particles sinter together, and it is the combined effects of expansion and contraction that are investigated during thermal expansion tests. In this form of analysis the sherd is heated and its expansion or contraction measured as the temperature rises. The basic principle is that the material will show normal thermal expansion up to the original maximum firing temperature but, as that temperature is exceeded, the expansion continues but starts to be counter-balanced by the various contractions in the fabric until the point is reached where contraction exceeds expansion, with the net result that the sample starts to shrink. It is not quite as simple as this, because the duration of heating is also a factor and so the sherd has to be reheated, held for an hour at 50°C above the temperature when shrinkage was noted in the first experiment, and the final assessment of original firing temperature is calculated from the results of the two experiments. In thermo-gravimetric analysis, weight changes caused by water loss during heating are investigated, whereas in differential thermal analysis mineralogical changes above a certain temperature evidenced by the evolution or absorption of heat are used to estimate the original maximum temperature for the sherd.

A detailed discussion of these methods and their limitations is provided by Rice (1987:432–35), but the main problem, as with several other methods of investigation of ceramic technologies (including the interpretation of results of experimental firings), is that the modifications produced during firing depend not only on the maximum temperature reached and the types and proportions of clay minerals originally present but also on the form and distribution of any temper, the rate of increase in temperature, the length of time the material was held at any temperature, the cooling cycle and the atmospheric conditions. The other major difficulty is that these methods of thermal analysis examine an overall change of weight or size with temperature, and this may be merely external observation of the combined effect of several morphological alterations. For this reason there is increasing interest in the use of scanning electron microscopy in the study of ceramics, including assessment of firing temperatures and conditions (Maniatis and Tite 1981; Fig. 9.1). When dealing with this latter area it is often still necessary to examine the sample in the as-received state and then re-examine it after various sequences of heat treatment, but the SEM is thought to offer a particular advantage in that it allows the detailed examination of the actual structure of the fabric and any alteration in morphology related directly to the mineralogy can be identified, rather than relying on observation of effects that could be the result of several changes.

The general investigation of the effect of heat on materials, and the application of techniques of thermal analysis in particular, has been mainly confined to the study of ceramics and clays, but there is now increasing interest in the possibility that lithic artefacts might show evidence of heat treatment and in the means by which this could be detected. During the early history of archaeology considerable significance was attached to the first appearance of pottery firing in any area because, apart from the natural effects of the sun and the use of heat in the preparation of food, this seemed to mark the first extensive application of heat to translate materials from one form into another. Once this concept had been grasped, it might have opened up the whole area of pyrotechnology. There are a few tentative suggestions that heat treatment of lithics might pre-date pottery firing in particular areas, but interest in this heat treatment lies less in this pyrotechnical aspect (in any case now largely abandoned as offering any form of explanation for technological innovation), and more in that it might have produced sufficient changes in the lithics to allow the date of heating to be determined by thermoluminescence or electron spin resonance. As the rationale behind heat treatment seems to have been to improve working properties, it would also give a clear sign that these properties were considered important in those particular instances.

Despite the variety of tools and techniques postulated for the working of lithics over the last two million years, the underlying processes, whether in quarrying, shaping, or finishing, can be reduced to three—flaking, pulverizing and abrasion. The basis of flaking is that a blow is delivered to the surface of the material, a small fissure forms and this crack then runs through the material so that a piece of material, a flake, is removed. All lithics are amenable to working by flaking because they are brittle, and therefore likely to break when struck; whether they are particularly suitable for this technique depends on the degree of control over the direction the crack takes. The actual material can have an influence because cracks will tend to follow pronounced lines of structural weakness, and lithics show great variations in these. At the one extreme, the amorphous glassy structure of a piece of obsidian, particularly one with no flaws, gives equal strength in all directions, and the material has little influence. The length and direction of the crack, and the shape of flake removed, are far more affected by the strength, angle and sharpness of the blows at the surface. They are therefore under the control of the worker. On the other hand, in contrast to the structure of obsidian, boundaries between mineral grains in rock are major lines of weakness and once a crack has been initiated it is likely to move along connecting boundaries, with the worker having far less influence. Hence in a very coarse-grained rock, where the boundaries are relatively few in number and very pronounced, the direction the crack will follow is difficult to control externally. Rocks classed as having good flaking properties tend to be fine-grained, reasonably homogeneous, brittle and hard; the majority are acid igneous rocks with a glassy silicate component. As with their structures, crypto-crystalline cherts lie somewhere between the rocks and obsidian. With the exception of novaculite which behaves like a coarse rock, cherts are akin to extremely fine-grained rocks. There are grain boundaries but the networks are very fine and the boundaries very numerous, and the net result is that the fracture surface could move in a multitude of directions, structure therefore exerting only a limited influence and the direction and angle of the blow from the knapper also being significant factors.

Trying to improve the flaking properties of cherts still further, and thus increase the degree of control offered to the worker, is the main explanation proposed for heat treatment. The idea that this treatment might have been carried out first came from nineteenth-century accounts of various procedures then used in several parts of the world (Hester 1972), prompting an interest in establishing whether it had been used in earlier periods. This has now been recognized by direct examination of archaeological objects. The early accounts describe various heating methods, including burying chert under a fire or pouring hot water over it, but they all suggest slow heating to relatively low temperatures. Various experiments have confirmed a limit of around a 50°C temperature rise per hour if the material is not to spall or crack, and they suggest that the optimum temperature to produce improvement in working properties depends on the particular sample, but normally lies between 300 and 500°C. There is general agreement from the various researchers that the flaking properties of poor quality material are definitely improved, though less consensus on the reasons for this. Some research has suggested that chert acquires a more amorphous glassy structure, but other work led to the idea that microcracks may form within the grains thus reducing their strength (Olausson and Larsson 1982). Whatever the mechanism, the historical accounts alone provide clear evidence that flaking properties were important in the situations described and that the subtle changes in properties produced by heat treatment must have been recognized and appreciated.

THE USE OF ARTEFACTS

This section is concerned with some types of direct evidence for the possible use of objects, coming mainly from the objects themselves. These forms of evidence include the shape of the object, context of final deposition, associations, textual and other historical data, the artefact's material and properties, traces of wear related to use and any diagnostic residues. The depth to which this evidence is explored depends to some extent on the reasons for trying to establish use, such as (for objects with an apparently utilitarian use): establishing specific activities represented on a site, particularly those such as food processing for which little other evidence may survive; determining the type of site—trading centre, kill site, workshop and so on;

establishing whether the appearance of certain types of object seeming to have a particular use can be taken as an indication of an increase in that form of activity (for example, weapons being linked to warfare); assessing whether all objects classified as similar in use really did have the same use; determining whether variations in the form or typology of objects can be ascribed to differences in use; examining the significance of distribution patterns—for example, are objects containers and, if so, are they where they are because of their contents; and assessing possible reasons for making the objects from particular materials, whether these be local or non-local resources.

The properties of the materials

In terms of use, context and associations may be of assistance in assessing how the object entered its final deposition, but much archaeological material has no clear context or derives from waste deposits. Shape may in some circumstances be a guide to function, but there is such a long tradition of describing that shape in terms of modern artefact types and uses—a knife-shaped object is termed a knife, a hatchet-shaped object an axe—that it is difficult to escape the connotations and it is often the validity of these initial interpretations based on shape that needs to be tested; plus the idea that all objects of a similar form are likely to have had a common function. This is an area where material properties can come into play. They can seldom completely rule out a possible use, but common sense suggests that an axe-shaped object made of a very ductile material like gold is unlikely to have had much of a practical role. In contrast, the jadeite used for some axe-shaped objects of the European Neolithic has been deemed too hard because jadeites are very tough and difficult to work. Geochemical and petrological analysis (Woolley *et al.* 1979) of samples from some of the British axes has indicated that the jadeite itself derives from outside the British Isles, probably from a source in the Alpine area of Europe, and a combination of the source of the material, its resilience, the small number of such objects and their final contexts, plus the absence of any obvious wear from use, has led to the suggestion that these particular axes probably never had a strictly utilitarian function but might represent some form of currency, or be a product of gift exchange. Physical properties, including the suitability of different types of rock for tool use, were also considered by Bradley *et al.* (1992) in their analysis of other neolithic rock artefacts. They saw some correlation between the strength of the raw materials and the material extracted for axe manufacture but argued that all aspects of lithic resource exploitation could not be explained in strictly utilitarian terms.

Another example of the role of material properties in considerations of use follows from Coles's experiments with metal and leather shields (Coles 1962). Hundreds of shield-shaped objects of tin-bronze, wood and leather, plus metal swords and other possible weapons, have been recovered from later Bronze Age contexts in northern Europe. Coles made replica shields of copper and leather—not identical to any original but of comparable hardness—and tested them against slashing swords of tin-bronze. The leather shield survived, the copper one was cut in two by a single blow. This led Coles to suggest that the leather shields could have been protective devices, but this was an unlikely use for the metal ones.

Cooking vessels that are heated during use are subject to even more stringent conditions, and this is an area in which it is possible to theorize on the optimum properties for a material and then assess how nearly the fabric of particular vessels matches these criteria. Several requirements can be suggested, such as good thermal shock resistance so that the vessel does not crack on heating and cooling, high conductivity, minimum heat loss from the vessel's surface and low porosity if used with liquids. As scanning electron microscopy and other techniques now allow direct examination of pottery fabrics, there has been increased interest in looking at archaeological ceramics and ethnographic practices in terms of the physical properties of the materials. Thus Vandiver and Koehler (1986), for example, recognized two basic fabric types amongst Corinthian amphora and considered that calciumrich, illite clays with potassium flux had been deliberately selected for vessels to be used with liquids because this particular combination of raw materials fires to give a dense, non-porous and glassy fabric. In contrast, Schiffer (1990), as have many others, has adopted an experimental approach and looked at the effect of various surface treatments—smoothing, polishing, resin coating and so on—seen amongst archaeological and ethnographic ceramics to see if they have any effect on the absorption and transfer of heat. However, just as there are many examples of postulated uses of ceramics being supported by an apparently deliberate selection of a fabric with appropriate properties, there are also many instances where there seem to be no deliberate modifications and the choice of raw materials cannot be explained by the presumed usage of the vessels (Woods 1986). Therefore, one cannot put too much emphasis on material properties as a guide to an object's function, particularly when dealing with complex materials such as ceramics. 'Because there may be a scarcity of clays suited to special purposes, other decisions [once the clay is selected from those available] —choices about temper, form, thickness and so forth—can be seen as accommodation strategies' (Rice 1987:227). You make the most of what you have, and much depends on the first choice you make.

Use-wear

The most obvious sign that an object had a specific use is an alteration to the object that could only have been produced by that use. One of the most common forms of alteration is wear on the surface, normally the result of some action such as grinding or cutting that involves contact between materials. Observation of these wear patterns forms the basis of use-wear analysis in general—the thinning near a rivet hole in a metal dagger, abrasions on the interior of a pottery vessel (Hally 1983) —and some aspects of the functional microanalysis of lithics. Use-wear can be applied to any type of object, but much of the extensive research over the last thirty years has concentrated on lithics, and objects of chert and obsidian in particular. As it is based on effects that can often be seen with the naked eye, the history of use-wear analysis in archaeology extends back into the nineteenth century when comments were already being made on the changes produced on the surface of objects when they were used and the possible implications for the interpretation of archaeological material. As early as 1892 Spurrell, for instance, made a replica flint blade and used it to cut wood, bone, horn and straw, and he noted that the working of the straw, and only the straw, produced a noticeable shine on the tool edge. The generation of polishes on lithic objects during activities related to cereal processing was confirmed by others in the 1920s and 1930s, and the surface shine seen on many supposed harvesting implements came to be called 'corn gloss' or 'silica gloss'. The latter description was based on the idea that the polish might have been produced through contact between the tool and silica particles in plant stems but, despite a few attempts to try to understand the mechanisms of formation, interpretation of use-wear on lithic artefacts long remained based on empirical observation.

A major impetus towards more fundamental research, and the importance of observations under a microscope, came with the work of Semenov in Russia. He had examined the surfaces of bone and lithic objects at a range of magnifications, and postulated the idea that the use produced a number of modifications at the surface, in particular combinations of edge rounding, striations and polishes (Semenov 1964). Not all of his conclusions have been confirmed by later work, but they did provide a stimulus towards further research into the validity of use-wear and the factors that influence surface morphology. Much of the initial research on the validity of the technique continued the empirical, experimental, approach. Artefacts were made, mainly of flaked tools of cherts and in the form of known archaeological objects. The surface was examined and then, after the artefact had been used for a measured time in a particular way for a specific activity such as whittling dry oak or cutting fresh cowhide, it was re-examined to see if use had produced any observable changes, and whether these could be characterized in any way (Young and Bonnichsen 1984). Some of the main proponents of this approach then carried out blind tests where objects were made and used by one researcher and then passed to another who tried to assess area of the tool involved, type of use and material worked. It would appear essential that this form of test is carried out to give some guidance on the viability of use-wear, but there has been much discussion on the validity of such tests and the methodology employed (Bamforth *et al.* 1990).

Much of the debate centres on the differing views on what is being seen and it has been fostered because of the lack of a common theoretical framework. Also, what is visible depends very much on the magnification used: a chip from a blade edge can be seen with the naked eye, but small areas of sheen might only be revealed at a particular magnification. This has resulted in two somewhat divergent approaches to microwear analysis of lithics: the use of magnifications to around ×100 to look at edge damage; and the investigation of striations, micro-polishes and abrasions at ×100 to ×5000 or more. Advocates of the low-power approach (Odell and Odell-Vereecken 1981) suggest that experiments show that it has a role in use-wear analysis, and that the recurrence of similar patterns of damage on archaeological objects will allow the effects of burial etc. to be recognized more easily. Proponents of high magnification (Keeley 1980) postulate that all forms of damage can be caused by many factors, but that the changes that only become visible at high magnification are more likely to be directly attributable to use.

It has never been suggested that any simple equation could be used to relate surface morphology directly to the use of an object, and as time has gone on more and more variables in the generation of use-wear have emerged. The factors now seen as significant include the mechanical properties of the material of the object; the original form of the surface; the type and duration of any use; the material being worked; grit or other contamination coming between the object and workpiece; multiple use involving a single surface; trampling or other pre-depositional forms of wear; burial; recovery; and subsequent handling. In the last thirty years the influences of all of these factors, singly or in combination, have been investigated via experimental and theoretical approaches. Other issues have also been raised, such as the nature of polishes (Fullagar 1991) and whether the so-called 'corn gloss' is produced by abrasion or by deposition of siliceous material.

The greatest potential of use-wear analysis may eventually be seen to lie in its ability to distinguish objects that have had some form of usage from those that have not, but all these factors will still require consideration. Use-wear studies have so far related mainly to the apparently simple, single-phase, mineral lithics such as cherts and obsidian, as the need to understand the behaviour of the individual mineral phases in rocks would introduce a new level of complexity. However, microwear analysis of structurally diverse, composite materials such as bone and antler has now extended from detection of traces indicating working by lithic objects to wear generated when they might have been used as objects themselves. This introduces a whole new suite of non-use variables, from damage to antler *in vivo*, through butchery, taphonomy and extensive bone diagenesis during burial (Olsen 1989).

The development of microwear analysis of lithics has been looked at in some detail, not because it is a particularly important technique but rather because its history provides a prime example of some general principles relating to artefact analysis. A problem is identified, and a technique appears to offer a solution. Once the potential seems to have been established there is then a long, and often slow and ultimately unrewarding, period of research to confirm this potential. The main requirement is to establish a strong, theoretical basis, and a degree of fundamental understanding to uphold the validity of the approach. Any technique needs to be sufficiently robust to cope with variations in conditions and, particularly important when dealing with archaeological artefacts, not to require knowledge of the object's full history.

Surface residues

With the ability to look in detail at surface layers, there is growing interest in the absorption of material into surfaces, an understanding being necessary for research into decay, diagenesis, conservation, chemical analysis and dating as well as microwear. As this has coincided with the development of improved methods of biochemical assay, one line of research related to the function of objects has been investigations into the possibility that biological residues may remain on or within artefact surfaces. Several thousand lithic objects, for example, have been tested for the presence of blood protein, and traces of blood have been reported for around two thousand objects, with the oldest residues so far identified dating to about 100,000 years ago (Loy 1993). In a few cases it has been suggested that the species of animal involved could also be distinguished via DNA analysis, the form of crystallization of the protein or immunoassay techniques, although the validity of some of the results has been questioned (Hyland *et al*. 1990). This is inevitable at this stage in the development of a new area of research, particularly when dealing with biological material that is subject to decay, exposed on the surface of an object and therefore subject to contamination, and that survives in only trace quantities and can only be detected by very sensitive methods. Susceptibility to decay and degradation depends to some extent on the environment but, taking biomolecules as a whole, the best preserved are likely to be large-chain plant polymers (such as lignin in wood), followed by lipids, carbohydrates, then proteins and finally DNA (Evershed 1993), with blood protein therefore relatively unstable. Much fundamental research on modern blood samples is now in progress to determine the mechanisms of degradation and behaviour in different forms of environment. Whether blood residue analysis ever becomes a routine method in the study of artefacts depends on the outcome of this research and a better understanding of chemical and biochemical modifications through time.

As indicated above, lipids, defined as components of biological materials that are more soluble in organic liquids than in water (Evershed 1993:75) and comprising a whole suite of compounds including cholesterol, fatty acids, and components of waxes, are reasonably stable. Also, by definition, they are little soluble in water and so once deposited onto or into a surface are likely to remain in place and not be distributed into the wider environment. Such transfer and deposition of plant and animal lipids onto artefact surfaces can occur during cooking or where porous vessels are used as containers. This is the basis of lipid analysis to determine artefact function, particularly in the case of the use of ceramic vessels. Traces of residues can be extracted using organic solvents and then analysed by infra-red or gas chromatography/mass spectrometry to determine the presence of any diagnostic components. This is one specific example of the use of these techniques in the general area of identification of organic substances and is subject to the same complexities, limitations and potential. Thus Gerhardt *et al.* (1990) showed via GC/MS analysis that extracts from three sixth-century BC vases contained plant and animal oils and fats suggestive of the presence of perfumed oil, but that a fourth vase, typologically distinct, only had plant residues diagnostic of cedar wood oil. They were thus able to demonstrate that the two forms of vase may have contained different types of substance and had different usages, but they were not able to detect the actual form of the perfumed oil, and whilst the extracts contained over one hundred substances, around half could not be identified.

There are several hundred similar examples of useful data emerging from lipid analysis in archaeology, and its application is in no way invalidated because only a portion of the compounds can be categorized and the level of identification achieved is variable. In this, and in other areas of archaeology, lipid analysis has opened up areas of investigation that could barely be envisaged ten years ago. It also offers a very good example of the way the scientific study of artefacts has altered over the years: samples are no longer packed into boxes, sent away for examination, and the results presented as a set of facts divorced from context and association. Instead, there is a continuous dialogue on what the artefacts represent, why they are being examined and what questions are being asked of them. In many respects the real study of artefacts in archaeology is only just beginning.

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Within the vast range of publications detailing current attitudes toward artefacts within archaeology, several offer a particular scientific perspective of artefacts as elements of material culture. These include Brian Hayden's *Archaeology: the Science of Once and Future Things* (New York: W.H.Freeman 1993), Ian Hodder's *Symbols in Action: Ethnoarchaeological Studies of Material Culture* (Cambridge: Cambridge University Press 1982) and David Kingery's two edited volumes arising from conferences on material culture at the Smithsonian Institution, *History from Things: Essays on Material Culture* (1993) and *Learning from Things: Method and Theory of Material Culture Studies* (Washington DC: Smithsonian Institution 1996). As the range of materials is so large, there are few recent books that attempt to give a comprehensive overview of archaeological artefacts primarily as material entities, but for a very straightforward, practical introduction, there is Henry Hodges's *Artifacts* (London: John Baker 1964) and also John Delmonte's more eclectic and wide ranging *Origins of Materials and Processes* (Lancaster, Pa.: Technomic Publishing Co. 1984). Hodges's later volume (London: Allen Lane 1970) *Technology in the Ancient World* and K.D.White's (London: Thames and Hudson 1984) *Greek and Roman Technology* are very readable surveys of aspects of early technology and, while inevitably somewhat out of date in terms of archaeological interpretations, copiously illustrated with direct representations of technological processes drawn from contemporary documents and paintings. For more detailed descriptions of the nature of artefacts and examples of application of scientific techniques there are a large number of volumes on particular materials or techniques such as Olin and Franklin's edited volume (Washington, DC: Smithsonian Institution 1982) on *Archaeological Ceramics* or M.Hughes, M.Cowell and D.Hook's *Neutron Activation and Plasma Emission Spectrometric Analysis in Archaeology* (London: British Museum Press 1991) in the British Museum Occasional Papers Series, but one of the best and most comprehensive, with a title that belies its extensive coverage of ethnographic and functional interpretations, is Prudence Rice's *Pottery Analysis: a Sourcebook* (1987). More on processes of manufacture, but from the perspective of experimental archaeology and modern attempts at reconstruction, is provided in John Coles's *Experimental Archaeology* (London: Academic Press 1979), which sets out clear guidelines for the experimental work that is becoming such an integral part of artefact studies. Specific detail on the potential and limitations of many of the techniques now available for the scientific examination of artefacts and examples of their application can be found in Julian Henderson's *Scientific Analysis in Archaeology* (1989), Sheridan Bowman's *Science and the Past* (London: British Museum Press 1991), and in Mark Pollard and Carl Heron's comprehensive *Archaeological Chemistry* (1996).

10

PRESERVING AND PRESENTING THE EVIDENCE

Mike Parker Pearson

INTRODUCTION

Many people might think that the archaeologist's tasks are over once the fieldwork, analysis and publication have been completed. In fact two of the most important aspects of archaeology are the preservation of archaeological remains and the presentation of those remains, and of their interpretations, to a wider public. Preserving old ruins and presenting the past might not seem as exciting as making archaeological discoveries, but in recent years archaeologists around the world have been drawn into a number of important ethical, philosophical and political debates: who owns the past?, what should be preserved?, what should be presented?, whose history is it?

From beginnings in the last 500 years, nation-states developed legislation to protect their archaeological monuments. Today every nation has laws in some form or other that refer to archaeology. There is also a growing body of international laws and conventions to protect and present the archaeological heritage. The philosophy behind preservation is now widely accepted, though many cultures around the world may not share such concepts of antiquity and authenticity. From this philosophical position, principles for repair and restoration and for presentation and display can be set out. Archaeology has always had a political dimension, and the ways that the past is presented may bear on issues such as nationalism, ethnic identity and power in the local community, as well as education and tourism. Putting into practice the principles behind archaeological conservation and presentation requires particular knowledge and training. Finally, some of the most serious problems for archaeology are to do with looting and the art market. Many developing nations want their cultural treasures returned from the museums of Europe and North America. All round the world sites are looted and artefacts illegally sold. Also many people in many different countries are coming into conflict with the authorities about their access to sites and to knowledge about the past.

A HISTORY OF PRESERVATION AND PRESENTATION

Every culture has a sense of history, whether constituted as a radical break with the past or as a long tradition of continuity and change. Prerequisites of the practice of archaeology are a sense of curiosity and a respect for the artefacts, monuments and landscapes which constitute the archaeological resource. The roots of European concern to preserve the physical vestiges of the ancient past can be found from the fifteenth century onwards (see Chapter 1). In China, antiquarian interest had developed by the tenth century.

The rise of archaeological preservation and the education of the populace that accompanied it, in western Europe and especially in Scandinavia, were aspects of the consolidation of state power which had been going on since the Renaissance. These European states, and the gentry who pursued antiquarian interests, were incorporating hitherto ignored ‘prehistories’ into the ideological fabric of society. The ancient past might be viewed as a vista of development towards civilization, within which national character and identity were gradually forged. At the same time, a spirit of scientific enquiry was also replacing rural superstitions surrounding the antiquities. Whereas the Scandinavian presentation of the past was aimed at the rural working classes, interest in Britain was largely confined to the upper and professional classes. By the 1870s in Britain there were many local archaeological societies whose members were nearly all men and were drawn from the clergy, from the aristocracy or from respected professions (Hudson 1981).

Within Europe, legislation concerning ancient monuments gradually gathered momentum after the Renaissance, though its application varied considerably between nations. In 1425 Pope Martin V ordered the demolition of new buildings which might cause damage to ancient monuments, whilst in 1462 a Papal Bull pronounced the protection of the ancient monuments of Rome. In 1624 in Rome an edict forbade excavation without prior authorization. In England in 1560 a proclamation by Elizabeth I forbade the ‘defacing of Monuments of antiquity, being set up in the churches or other public places for memory, and not for superstition’. In Sweden a State Antiquary was appointed in 1630, whilst in 1666 the destruction of ancient monuments and relics, whether on private or public property, was prohibited. During the eighteenth and nineteenth centuries a number of European nations drafted protective legislation or set up organizations and individuals to preserve ancient monuments and relics. In 1721 the Secretary of the Society of Antiquaries of London paid ten shillings for erecting two oak posts to protect the Waltham Cross, a medieval monument, from damage by traffic.

Some nations were considerably ahead of others. In Denmark systematic protection began in 1807, when recommendations were issued for the preservation of monuments, the informing of the peasantry of their value and the establishment of a state archaeological museum. In 1847 the post of Inspector for the conservation of monuments was appointed. In later years more staff were taken on and in 1873 a fifty-year long project was begun to survey all visible monuments. In Britain the first Inspector of Ancient Monuments, General Augustus Pitt-Rivers, was not appointed until 1882. The first Ancient Monuments Act was also passed in that year, only after considerable opposition from Conservative politicians, like Sir Francis Hervey, ever suspicious of the interference of the state in the individual's rights, who demanded: 'are the absurd relics of our barbarian predecessors, who found time hanging heavily on their hands, and set about piling up great barrows and rings of stones, to be preserved at the cost of infringement to property rights?' (Wright 1985:50).

Outside western Europe, legislative and organizational initiatives in monument preservation were generally later and varied even more in content, effectiveness and timing. In 1863 the British government in India assumed authority to preserve ancient monuments, well in advance of similar changes in Britain. In central America, Mexico recognized the importance of preservation from its independence in 1821, though it did not pass effective legislation until 1897. Guatemala and Honduras recognized similar concerns for their Maya sites in 1894 and 1889. Similarly important pre-Hispanic monuments in Peru were protected by decrees in 1822, 1837 and 1893. An Antiquities Act was not passed in the United States until 1906. In Africa, the then French colonies mostly adopted a 1956 French law; in English-speaking Africa, many states had heritage legislation in place by the time they gained independence.

In Asia, there had been an interest in preservation in Japan from the eighteenth century, made tangible by the 1897 Law for the Preservation of Ancient Temples and Shrines. In 1950 two subsequent laws, on national treasures and on historic sites, were combined in the Law for the Protection of Cultural Properties. In China, despite the early antiquarian interest, appropriate legislation was not passed until the twentieth century. In 1930 a Law on the Preservation of Ancient Objects was enacted, asserting state ownership of all ancient objects found underground. Among the South-East Asian states, legislation generally came late—for example 1966 in the Philippines and 1970 in Singapore. In Australia, legislation to protect Aboriginal relics and early colonial remains was also slow to arrive, with the Northern Territories the first area to be protected in 1955.

Today, throughout the world, the protection and preservation of archaeological remains are a significant component of archaeological practice. By 1975 American

New Archaeologists had coined the term 'Cultural Resource Management' (CRM) to refer to the ongoing process of archaeological conservation, embracing salvage archaeology as well as preservation strategies. Nineteen seventy-six was declared European Architectural Heritage Year and in subsequent years the notion of 'heritage' gained increasing significance in archaeological conservation, as well as being used in a multitude of contexts from building houses to selling cheese! In Britain, it became a statutory term in the 1983 National Heritage Act. Later on, UNESCO (the United Nations Educational, Scientific and Cultural Organization) created an International Committee on Archaeological Heritage Management (ICAHM) within its International Council on Monuments and Sites (ICOMOS). Today the term 'archaeological heritage management' (AHM) is used widely in the same sense as CRM, though perhaps more emphasis is laid on public presentation within the meaning of AHM.

Not all archaeological sites can be preserved for the immediate future because of unavoidable threats from construction or from longer-term agricultural practices. Of lesser magnitude are natural processes of erosion and decay. The recording of remains in advance of destruction, known as rescue archaeology in Europe and as salvage archaeology in North America, is a common response to endangered sites around the world. In many countries such work is funded by the state, as has been the case in Britain since the Second World War. In some countries, including Britain and Scandinavia, developers in the private sector also contribute to rescue work in advance of their construction projects. In Britain there was a state-funded boom in rescue archaeology between the 1960s and 1980s, when amateur and professional archaeologists effectively lobbied local and central government, as well as winning over a supportive public. With legislative changes, and the reassertion of a conservation ethic, there has been a change of emphasis to preservation *in situ*, with rescue excavation as a last solution. Nevertheless, rescue projects continue to thrive and there is increasing awareness of their need to address research issues. In the United States the story of salvage archaeology is similar. The 1974 Archaeological and Historic Preservation Act authorized federal agencies to fund salvage work on sites endangered by federal projects. In 1969 the National Environmental Policy Act had already required the involvement of archaeology in the preparation of Environmental Impact Statements in advance of developments. This requirement for prior archaeological evaluation in advance of planning permission for developments is also common practice in England.

NATIONAL LEGISLATIONS AROUND THE WORLD

The most effective protection for archaeological remains is in Denmark, where an enlightened public, a long tradition of archaeology, and an integration of archaeology and nature conservation, have been successfully combined. The 1937 Act protected all visible monuments (whether recorded or not) without compensation to landowners. A large number of monuments that were being ploughed away were also taken out of cultivation. In 1961 all monuments were given a 100-metre protection zone around them. In 1969 archaeological investigation of non-visible ploughed sites and monuments became obligatory prior to damaging construction works. Today, monument preservation is administered by the Agency for the Protection of Nature, Monuments and Sites, while rescue archaeology is coordinated by the National Museum.

Other nations of northern Europe have similarly effective legislation. In England, the 1979 Ancient Monuments and Archaeological Areas Act established the proper protection of Scheduled Ancient Monuments (SAMs). SAMs had been identified since 1882, but previously a landowner only had to give three months' notice to the government before destroying one. The number of SAMs in England is currently being increased to 45,000, but this figure is still less than 10 per cent of all known sites; with many others still undiscovered, only a small percentage of the total is therefore protected. In 1988 archaeologists funded by developers uncovered the remains of the Elizabethan Rose Theatre in London. The theatre was to be excavated archaeologically and 'preserved by record', but the general public, led by an on-site protest by groups of actors, was outraged that the theatre's remains would not be preserved. The developers changed their plans to accommodate the remains within the development, and English Heritage (the government agency created by the 1983 National Heritage Act to preserve ancient monuments and historic buildings) were subsequently asked to advise the government on a guidance note for unprotected sites (*Planning Policy Guidance Note 16: Archaeology and Planning*—known as PPG 16), which was issued by the Department of the Environment in 1990. Similar guidance notes have also been issued for Wales and Scotland. Although not legislation, this guidance advocates the prior evaluation of development proposals in archaeologically sensitive locations, encourages the preservation of sites which are not SAMs, and identifies the developer's responsibility for the preservation or recording of archaeological remains affected by the development.

The 1973 Protection of Wrecks Act attempts to protect such sites on the seabed, but is difficult to enforce, due to looting by scuba divers, and does not cover submerged settlement sites of the last glacial and postglacial periods. All around the world, in fact, the problem of protecting underwater sites, both inside and outside territorial waters, is far from solved and the legislation is generally inadequate (Chippindale and Gibbins 1990).

In France, archaeology is regulated by the Law of 27 September 1941 controlling Archaeological Excavations. All excavations for research into monuments or objects require approval and supervision. The state may carry out excavations on private land without the landowner's permission, though compensation is payable. Finds are divided between the landowner and the state, with the state having a right of pre-emption. All chance finds must be reported and protected, and development halted if finds are made during construction. The law was drafted by the wartime Vichy government of occupied France and has been identified with a cultural policy which exalted a chauvinistic and authoritarian politics. There has been an Antiquities Service since 1964 (after 1979 the Sub-Directorate for Archaeology), but the administrative and operational infrastructure is rather weakly developed in comparison with the rest of northern Europe. The French system is acknowledged by French archaeologists as inadequate, but its importance lies in its adoption by most of the other French-speaking countries of the world (O'Keefe and Prott 1984).

In the United States, legislation protects only sites on government land. The 1979 Archaeological Resources Protection Act improved the protection of sites on federal land and extended the protection to sites on American Indian reservations. Since the 1960s, the vast majority of states has also passed protective legislation, including laws to protect living traditions of Native Americans. The respect for living traditions has also become a key issue in New Zealand and Australia. In New Zealand, Maori and early colonial remains are protected by an Antiquities Act 1975 and a Historic Places Act 1980. In Australia many of the Aborigines' sacred places are natural features such as rocks, water-holes, trees and mountains, which are now protected by the 1975 Australian Heritage Commission Act.

As with western Europe, Russia developed its archaeological interests through collecting, including the nineteenth-century foundation of the Imperial Archaeological Museum. Within the old Soviet Union, sites were protected by the 1976 Law on the Protection and Use of Historic and Cultural Monuments. Each state within the CIS has separate legislation. A similar process of decentralization has occurred in China, though there is covering legislation provided by the 1982 Regulation on Preservation of Cultural Relics. All cultural objects are the property of the state and all excavations must be approved. An important feature is the emphasis on detailed consultation and planning of construction work. Archaeology has been directed at educating the people in patriotism and revolutionary fervour, and has become a major tourist attraction. In Japan, the 1950 Law for the Protection of Cultural Properties provides protection through historic site designation. The Agency for Cultural Affairs can require site investigations prior to construction and also request the developer's cooperation to preserve a site. In recent years, Japanese rescue archaeology has increased dramatically, employing thousands of excavators and involving huge rescue projects.

In Peru, a law from 1929 protects archaeological monuments in public and private ownership. Clandestine excavation and the export of relics are forbidden. Excavations require permits and are organized or monitored by the National Archaeological Service, which conserves pre-Hispanic monuments, relics and works of art. It is notable that such a strong legislative system was implemented so early, though implementing it effectively in the face of organized and large-scale looting has proved another matter.

In Africa, much of the protective legislation is the legacy of previous colonial powers: the Portuguese and Spanish colonists left none; the French imposed their own system; and the British colonial legacy varies from nation to nation. One of the greatest problems has been the removal of artefacts for sale in the Western art markets and many countries have legislation which protects ethnographic objects of recent date. In Nigeria, for example, antiquities regulations came into effect in 1957 to restrict exportation, while in 1974 the buying and selling of antiquities (defined as made before 1918) between unaccredited agents was banned.

INTER-STATE OR INTERNATIONAL PROTECTION

UNESCO was founded in 1946 as an intergovernmental organization made up of delegates of national governments. It is closely linked to ICOM (the International Council of Museums) and to ICOMOS, and has developed a major body of heritage law. UNESCO has also developed major preservation programmes, for example at the Aswan Dam in Egypt (Fig. 10.1), the Buddhist *stupa* (shrine) at Barabodur in Indonesia, and the ancient city of Mohenjo-Daro in Pakistan. UNESCO has also produced three conventions relevant to archaeological preservation and presentation: the Convention for the Protection of Cultural Property in the Event of Armed Conflict 1954; the Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property 1970; and the Convention for the Protection of the World Cultural and Natural Heritage 1972 (also called the World Heritage Convention).

The World Heritage Convention includes major archaeological sites from all over the world such as Machu Picchu in Peru, Petra in Jordan, the Egyptian pyramids, Great Zimbabwe and Carthage (Fig. 10.2). Whilst UNESCO is funding repairs to the temple complex at Angkor in Cambodia, the site is not included due to past political instability. Israel is not a party to the Convention and thus only the Old City of Jerusalem (nominated by Jordan) is on the list. Iraq has only nominated Hatra, but not earlier Mesopotamian sites like Babylon and Ur. There is a World Heritage Fund which has a small budget for conservation, including emergency repair: it was used, for example, after earthquake damage in Quito, Ecuador, in 1987. There is also a list of World Heritage Sites in Danger, including Timbuktu (becoming engulfed by sand) and Chan Chan (which has suffered from looting and mudbrick erosion). UNESCO has also issued a series of recommendations, including international principles for excavation, safeguarding the beauty and character of landscapes and sites, protecting and preserving cultural heritage, protecting movable cultural property, and regulating the international exchange of cultural property.

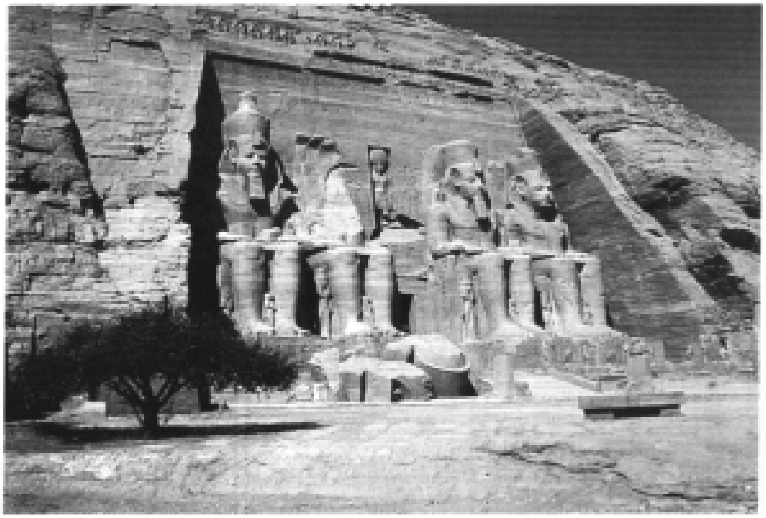

Figure 10.1 The temple at Abu Simbel, Egypt. This enormous monument was moved in advance of flooding by the Aswan Dam. It now forms part of World Heritage Site 211. Photograph: P.Nicholson.

The Council of Europe has also created rules of international law on the archaeological heritage. It has twenty-one member states and makes reports on archaeological issues such as the use of metal detectors. In 1992 it passed an updated European Convention on the Protection of the Archaeological Heritage and has prepared other conventions on offences against cultural property and on the underwater cultural heritage (Chippindale 1993). The European Community also issues directives which may have relevance to archaeology in its member states. The directive on Environmental Impact Statements has been relevant for the inclusion of archaeological considerations in evaluating the impact of proposed major development.

PHILOSOPHIES AND ETHICS OF PRESERVATION

> It is again no question of expediency or feeling whether we shall preserve the buildings of past times or not. *We have no right whatever to touch them.* They are not ours. They belong partly to those who built them, and partly to all the generations of mankind who are to follow us. The dead still have their right in them…whatsoever it might be which in those buildings they intended to be permanent, we have no right to obliterate. What we have ourselves built, we are at liberty to throw down…
>
> (Ruskin 1849:201)

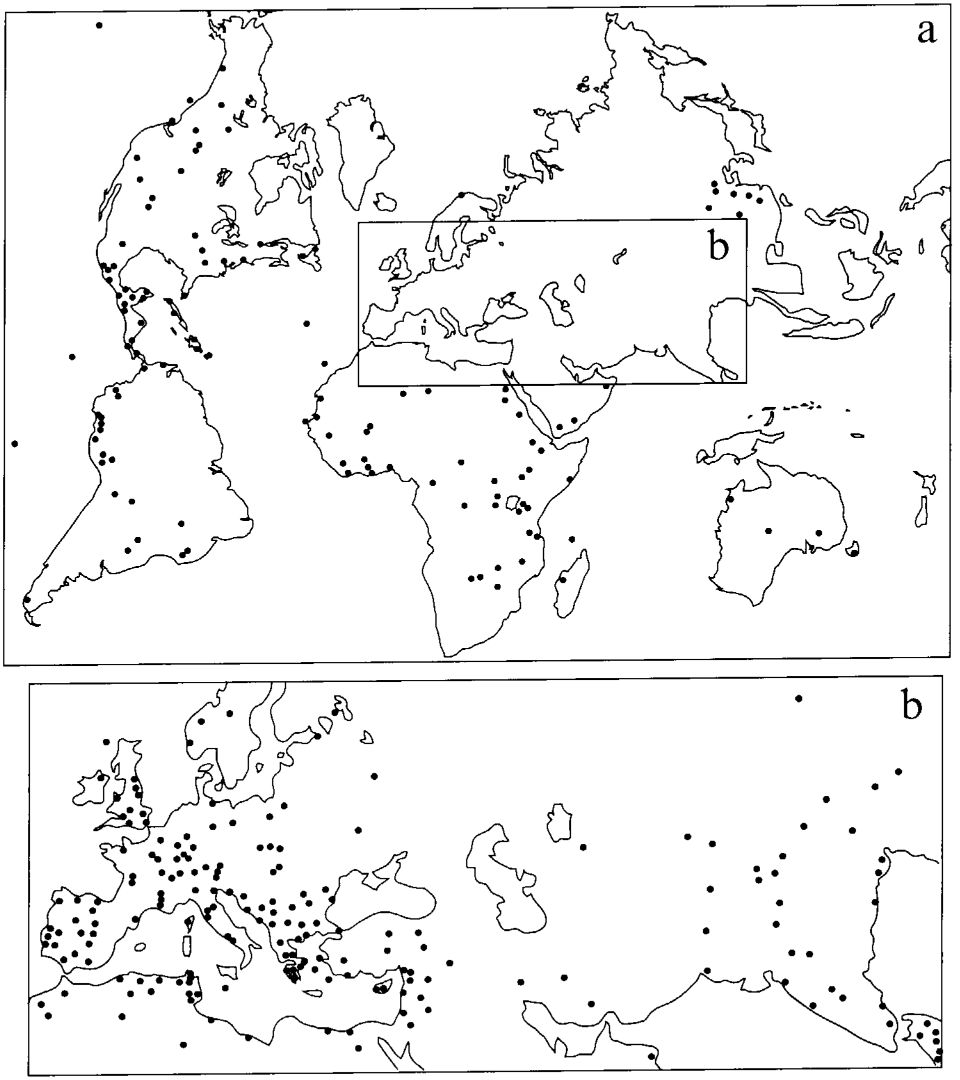

Figure 10.2 Map of UNESCO World Heritage Sites. Drawn by D.Miles-Williams.

Many people working to preserve historic buildings and archaeological sites would consider Ruskin's philosophy to have considerable relevance today. His values helped to change attitudes to demolition and restoration in the second half of the nineteenth century and have since guided generations of Inspectors of Ancient Monuments in the United Kingdom, as well as archaeologists in other countries. A more recent formulation of the theoretical, philosophical and ethical basis for conservation by an American archaeologist (Lipe 1974, 1984) highlights similar concerns: the need for a set of values and attitudes about the continuity of life and culture (especially as the author saw them threatened by imminent nuclear holocaust); giving past lives and works the respect of our attention (and thereby respecting the rights of the future); and a concern with the long-term past, to remove our thoughts from the immediate concerns with the here and now, thus bridging the mortality of generations for us to reflect on the condition of humankind.

These concepts of value and meaning are very much bound up with Western philosophical notions of the importance of an objective materiality, where artefacts embody meaning in their own right and where temporality is reified and retained as knowledge. Amongst other cultures, however, the material vestiges of the past may count for little. Instead, the continuity and the permanence may reside in the living community and its continuous reproduction. In Japan, for example, individuals may be honoured as 'living national treasures' because of their artistic skill. In such instances the past is referenced as a living tradition, rather than as mute and sometimes incomprehensible relics. The Igbo of Nigeria stock their *mbari* houses with art objects but leave these to rot as soon as the process of collecting is completed (McBryde 1985). The Tandroy of southern Madagascar build massive tombs for their dead, but shun them on completion and leave them to crumble (Parker Pearson 1992).

European and American concepts of conservation have become widely accepted by archaeologists and legislators around the world (Cleere 1984, 1989; O'Keefe and Prott 1984). The material remains of the past are conceived as a non-renewable resource which is to be handed on intact to future generations for them to treasure and enjoy. There is no doubt that, in recent years, comparison and integration with the 'green movement' has influenced archaeologists' attitudes to the object of their study (Macinnes and Wickham-Jones 1992). As elements of the cultural environment, archaeological sites are treated in similar ways to the habitats of rare species or areas of outstanding natural beauty. In a number of nations, consideration for archaeological remains is one of many planning requirements for property developers. In these countries, the concept that 'the polluter pays' applies equally to archaeological sites unavoidably threatened by development as to chemical and other forms of pollution.

After the 'rescue' philosophy of the post-war period, archaeologists have become increasingly aware of the damaging effects of their own investigations: they destroy their evidence as they collect it. The concept of 'preservation by record' —creating an archive of finds and paper records—has been considered to be an acceptable substitute for an intact site, though it implies an objective and total retrieval which can never be achieved (Romer and Romer 1993). Archaeological investigation involves more and more non-destructive techniques, but excavation is a 'once only' intervention. The resource has to be carefully husbanded if it is to survive beyond the foreseeable future. In a world without the *in situ* and intact remains of the long-term past, we face something of an Orwellian future where there are no landmarks or physical presences of the ancient past in the landscape. In contrast, complete preservation restricts the very purpose for which we value the resource, as a means of finding out or of recovering the lost memory of humankind. In any case, how we decide what to preserve—and by implication what to let go—depends on the values and research aims of the present. These have changed through time and will continue to do so. There is thus an uneasy contradiction between a ravaged resource, plundered for short-term research goals, and a fossilizing knowledge based on limited interventions and ancient excavations of long ago.

PRINCIPLES OF RESTORATION AND CONSERVATION

> Watch an old building with an anxious care; guard it as best you may, and at *any* cost, from every influence of dilapidation... Its evil day must come at last; but let it come declaredly and openly, and let no dishonesty and false substitute deprive it of the funeral offices of memory.
>
> (Ruskin 1849:200–1)

A distinction was made between preservation and restoration as long ago as 1849: Ruskin considered restoration to be 'a lie from beginning to end' (1849:200); to restore was to mislead, to falsify and to destroy the authentic materials by manufacture of a copy. The Society for the Protection of Ancient Buildings (SPAB), formed in England in 1877, advised that all repairs should be honest and conspicuous, so that they might not be mistaken for the original fabric. To that end, many structures had their fabric repaired using mortared tiles instead of new stonework. The old conundrum of Alexander's axe illustrates the dilemma. As the wooden haft rotted so it needed a new handle. A while later the iron had rusted so badly that it needed a new blade. What was left of Alexander's axe? All of the original materials had been replaced: this was only Alexander's axe in that it was a copy. In Britain certain monuments have been restored so heavily that little remains of their original fabric—Nelson's warship HMS *Victory* and Westminster Abbey are two notable examples.

The aim of monument conservation is to arrest decay and preserve *in situ*. Ruskin and the SPAB abhorred any restorative work, realizing that all remains had a finite lifespan. In 1923, Frank Baines, HM Director of Works for ancient monuments and historic buildings in Britain, distinguished the concept of preservation from restoration, replacement, renovation and renewal. Instead, he defined preservation as 'a method involving the retention of the building or monument in a sound static condition, without any material addition thereto or subtraction therefrom, so that it can be handed down to futurity with all the evidences of its character and age unimpaired' (1923:104).

Over time, however, the Office of Works was to alter its views on this theoretical divide. In 1931, Charles Peers outlined a more pragmatic approach: 'repair must neither deface nor obscure old work, but it is better to risk a deception by inconspicuous additions than to proclaim them by conspicuous and unsympathetic materials' (1931:320). This approach guided much of their subsequent work. Restoration and renewal were employed when structurally necessary, for example on decayed roofs, windows and lintels. Techniques of restoration were used to conceal internal structural work such as concrete beams. The Office of Works never adopted the 'puritanical approach' of the SPAB, though aiming for unobtrusive yet unmistakeable substitution, particularly with modern materials. For example, at the late neolithic henge of Avebury, in Wiltshire, concrete markers were set up to indicate where standing stones had once been set, and at Stonehenge the eroded base of a stone was supported with concrete underpinning. Restoration was carried out only where a true replacement could be guaranteed and not where the original form was a matter of conjecture. At Stonehenge, fallen stones were set upright because there were records of their falling and their re-erection would aid the intelligibility of the monument.

During the course of the twentieth century conjectural restorations and reconstructions have become more acceptable. Mortimer Wheeler reconstructed the iron age defences of the hill-fort at Stanwick (Thompson 1981). More recently, South Shields District Council won a planning appeal to reconstruct a conjectural Roman stone gateway. Proposals for the Roman amphitheatre at Chester to be reconstructed were withdrawn in the face of strong opposition from conservation groups. Many other proposals on archaeological sites involve elements of conjectural reconstruction or representation in order to appeal to the public. There is undoubtedly a contradiction between an honest presentation of the evidence and intellectually accessible promotion. Such difficulties can be overcome by constructing replicas in the vicinity of the archaeological site, rather than attempting to reconstruct directly on the site itself, as in the case of the Eketorp fort in Sweden (Fig. 10.3).

The attempt to halt decay may also be considered in a philosophical sense as an attempt to end the history of particular monuments: they are thus suspended in time, set in the aspic of a dehistoricized present. But which physical aspects of their past should be preserved? In the early twentieth century the Office of Works in Britain shovelled out the moats, fishponds, refuse heaps, later rebuildings and destruction debris of medieval castles and monasteries in order to better preserve and display the medieval masonry remains. Today, however, we view the more ephemeral archaeological deposits and the post-medieval remains as having equal validity as the medieval stonework, although there are still problems with regard to where a cut-off point is made: should we so stringently deny or subdue our own impact on the remains of the past?

Figure 10.3 A reconstruction of the first-millennium AD fort at Eketorp, Sweden. The reconstruction has been built adjacent to the original site. Photograph: M.Parker Pearson.

UNESCO's recommendations, as exemplified in the 1966 Venice Charter, are clearly set out on these issues. Ancient monuments are a common heritage to safeguard for future generations in the full richness of their authenticity. They require permanent maintenance, the preservation of their settings, *in situ* preservation and the retention of component elements in context. Restoration should stop where conjecture starts and should be limited to reassembly. There should be respect for contributions of all periods of the monument's formation; there should be no additions if possible; and replacements must be harmonious but distinguishable. Additional recommendations were made in the 1987 Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (known as the Burra Charter). Existing fabric should be respected. There should be the least possible intervention and the evidence of the fabric should not be distorted. Techniques of repair should be traditional, but tried and tested modern methods may be acceptable. Reconstruction should be used only where it is necessary for a monument's continued existence or to recover its cultural significance, and it should not constitute the majority of a monument's fabric. Adaptation of a monument to other uses must be limited to situations when conservation cannot be otherwise achieved, and it must not detract from the monument's significance.

The Burra Charter usefully summarizes definitions: *conservation* includes preservation, restoration, reconstruction, and adaptation; *preservation* is the maintenance of fabric and the retarding of deterioration; *restoration* is the removal of accretions, reassembly without new material, and returning to an earlier state;

reconstruction is the introduction of new materials but in a non-conjectural way; *adaptation* is modification to suit proposed compatible uses.

PRINCIPLES OF PRESENTATION AND DISPLAY

> The chief aim of interpretation is not instruction but provocation.
>
> (Tilden 1957:9)

> To display only what is authentic must surely on moral, logical or economic grounds be the proper aim.
>
> (Thompson 1981:96)

The promotion of archaeological sites and monuments has changed radically in the last twenty years. The previous philosophy is well summarized by Michael Thompson's book *Ruins—their Preservation and Display* (1981). He made a distinction between monuments—reminders of events, persons or activities, where moments of history might be revealed—and museums—repositories of objects out of context, places for study, self-instruction and education. The display of monuments required a series of steps. The site should be excavated to its last major phase of use, to reveal its formation and construction. Facilities for visitors should satisfy their physical needs (such as toilets and access points) as well as their intellectual needs (publications about the monument, on-site exhibitions, *son et lumière*). The scantier the remains, the more exhibits or on-site explanation were required. The appreciation of ruins required concentrated effort to understand their layout, their fragmentary survival and their multi-period additions. One of the standard characteristics of ancient monuments in Britain was the mown lawns surrounding stone masonry. These were considered an aesthetically satisfying contrast with the stone, a soft and dry surface and a means of exposing the lowest masonry walls and courses.

This was a purely 'archaeological' approach to appreciation. Within an ordered and controlled environment, the visitor had to work hard to understand why such sites were originally built and what they might have looked like. The evidence was stripped bare for investigation, guided by texts which were difficult to read and dry on interpretation. This approach was very different to eighteenth- and nineteenth-century concepts of the picturesque, the romantic (as championed by Walter Scott) and the Gothic revivalist movement, yet it was inherently elitist and increasingly out of touch with a society of mass cultural consumption. Archaeological excavations were similarly unfriendly to the general public, despite some notable exceptions such as Pitt-Rivers's excavations on Cranborne Chase at the turn of the century, or Mortimer Wheeler's excavations at Maiden Castle in the 1930s (Hudson 1981).

Despite Wheeler's overtures to the general public (in the form of postcards, finds for sale, reports, public lectures, press conferences and newspaper reports), he maintained that two kinds of history were needed: one factual for scholars and the other fictional and mythical to keep the rank and file interested and in good heart (Hudson 1981:67). Pitt-Rivers had also been a keen exponent of élitist notions, whilst emphasizing the need to educate the working classes so that they might be made 'cautious how they listen to scatter-brained revolutionary suggestions' (1891:116). Doubtless such attitudes still exist in some quarters today, but many archaeologists would consider their relationship to the public as one of mutual dependence and respect. Archaeology is largely funded from public sources and the general public resents snobbish and patronizing attitudes by the experts.

World-wide there has been a growing professionalization within archaeology. Interested amateurs, or 'avocational archaeologists', have found that participation in field archaeology has become increasingly restricted. Results of recent surveys in Britain show that the general public, of all backgrounds, are more knowledgeable and receptive towards the work of archaeologists than before (Merriman 1990), but public access to archaeology is increasingly as passive consumers rather than active participants.

Today we can recognize several main strands to public involvement (Jameson 1997). These are archaeological tourism, political issues of national identity and ethnicity, applied archaeology, and the relationship of local communities to conservation/investigation projects.

Archaeological tourism

There has been an explosion in imaginative and informative presentations of archaeology and archaeological sites (Binks *et al.* 1988; Boniface and Fowler 1993). Many museums have abandoned the stuffy cases of artefacts in favour of more interpretive displays and accessible exhibitions which show how archaeologists make inferences about the past from material remains and depict vividly what life may have been like (Belcher 1991; Hooper-Greenhill 1990, 1992; Horne 1984; Pearce 1989, 1990, 1991; South worth 1991; Stone and Molyneaux 1994; Walsh 1992). There are outdoor museums, such as the reconstructed iron age village at Lejre in Denmark, where visitors can also gain an idea of how people lived. Archaeological centres such as the Jorvik Viking Centre (Fig. 10.4) and the Archaeological Resource Centre (Fig. 10.5) at York have also helped to undermine the traditional distinction between museums and archaeological sites and to enliven public understanding. Many archaeological excavations make arrangements for the visiting public in the form of site guides, guided tours, audio and audio-visual devices and interpretation boards. Similar arrangements can be found on monuments open to the public and there are trails and itineraries for archaeological visitors to landscapes as diverse as the Nile and its Egyptian monuments, the landmarks of an

Figure 10.4 A reconstruction of the past at the Jorvik Viking Centre, on the site of the Coppergate excavations in York, Britain: visitors are conveyed in ‘timecars’ around this presentation of life in the first millennium AD. © York Archaeological Trust.

English medieval town, and the archaeological landscapes of an upland valley in the Derbyshire Peak District (Hodges 1991).

Two ethical dilemmas are apparent. First, visitors cause wear and tear—Stonehenge, for example, has been roped off to the public since 1979 because of erosion to the stones (Fig. 10.6). Second, many attractions are run by the private sector and in some cases there has been concern about the degree to which presentations are bogus or severely misleading. There are even major disagreements about museums, heritage centres and archaeological monuments in public ownership. Many charge admission fees, in addition to receiving state funds, discouraging the poorest sectors of society from visiting. The ‘heritage industry’ has received severe criticism in recent years (for example Ascherson 1987; Fowler 1992; Hewison 1987; Horne 1984; Walsh 1992) for its ‘Disneyland’ sensationalist promotion of bogus history for commercial gain.

Figure 10.5 Children and archaeology: at the Archaeological Resource Centre (ARC) in York, Britain, visitors are encouraged to handle archaeological finds. © York Archaeological Trust.

National identity

Archaeology has been for many years a tool of nation-building (Lowenthal 1985). Even attempts to transcend nationalism, such as the World Heritage Convention or the World Archaeological Congress, tend to highlight it as an intellectual version of the Olympic Games. National monuments like Great Zimbabwe or the Athenian Acropolis act as metonyms for the nation-state. National identities are nurtured and sustained by investment in the selection, preservation, and promotion of nationally important monuments. Excavations at Masada in the 1960s fostered Israeli beliefs in their historic rights to land, whilst Palestinians today claim that archaeological remains which record their ancestry in those lands are either ignored or bulldozed by Israeli archaeologists looking for Jewish remains, especially of the Roman period. In Mexico, the construction of a major national museum for pre-Columbian archaeology has been viewed in a similar vein (Trigger 1984). Nazi Germany promoted a particularly warped notion of Germanic supremacy, using the ideas of

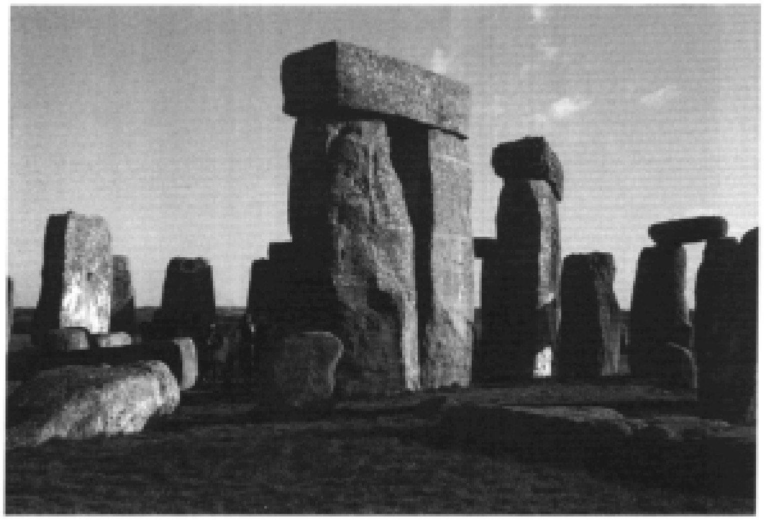

Figure 10.6 Stonehenge in Britain. This monument has been the scene of violent confrontations between solstice-goers and police, and, since 1984, access has been carefully controlled by police and security guards. Photograph: M.Parker Pearson.

Gustav Kossinna to contend that all progress in prehistory had come from Indo-Aryan groups successively migrating out of what is now Germany (Arnold 1992). In addition, racist notions of blood and land were employed in defining 'Germanness'; the SS even included a section called the 'Ahnenerbe' (ancestral heritage). The small nation of Denmark has employed symbols and metaphors drawn from archaeological discoveries to promote national identity, particularly in the face of nineteenth- and twentieth-century German encroachment. The concept of the Vikings has a firm hold in the Danish consciousness, where one in eight of the population read *Skalk,* a popular archaeological magazine. In the United Kingdom, public concepts of the national heritage are dominated by stately homes and other historic buildings. The most symbolically resonant archaeological monument is Stonehenge (Fig. 10.6), the scene of a brutal attack in 1985 by police on 'New Age travellers' wishing to attend the midsummer solstice, from which they had been banned. Amidst considerable public resentment (they were reviled in the media as vagrant criminals), the travellers were targeted by the police as undesirables whose massed presence at Stonehenge solstices should no longer be tolerated because of their threat to public order.

Ethnicity

> If we Aborigines cannot control our own heritage, what the hell can we control?
> (Langford 1983)

The archaeology of colonialism has also caused political strife over rights to the archaeological past. Increasingly, minority indigenous groups in North America, Australasia, the Pacific and the Arctic have become politically concerned about the loss and desecration of their cultural heritage. The most intense controversy has been over the recovery and removal of human bones, raising a major ethical problem about the disturbance and display of human remains. Some scholars would maintain that all human remains should be re-buried. Others consider that their potential scientific value far outweighs any ethical concerns. As archaeology has become more accountable to its public, so archaeologists have had to enter into negotiations and compromises with ethnic groups (Layton 1989a, 1989b; Green 1984; Parker Pearson 1995; Rahtz 1985).

In the United States, Native Americans were appalled by racist treatment of burial evidence: Indian graves were excavated and curated by archaeologists, while contemporary remains of white settlers and soldiers were either exhumed by morticians or re-buried after analysis (such as the remains from the Little Big Horn battlefield of 1876). Political resistance to archaeologists' insensitive behaviour formed around pressure groups such as American Indians Against Desecration. The archaeologists initially refused to make any concessions, but in 1986 the Society for American Archaeology agreed to a set of guidelines recommending re-burial where some ancestral connection could be shown between excavated Indian burials and a present tribal group. Not all Native Americans have been happy with this compromise and problems still arise. The most far-reaching effects of the 're-burial' issue have been agreements to reinter often-extensive museum collections of Indian human remains, notably from the American Museum of Natural History, the Smithsonian Institution and Stanford University.

In Australia, there has been a similar history of confrontation and compromise. Palaeolithic bones have been returned and cremated. Other similarly ancient remains from Lake Mungo may well be kept by Australian Aboriginal groups in 'keeping places', sacred locked stores to which scholars may be admitted. Another scene of confrontation is the rock art of Australia. In 1985 Aborigines requested that they might paint over ancient rock paintings with new designs. A number of archaeologists were upset that this important prehistoric art was to be destroyed and considered that, as an asset to world heritage, it should be spared. Others viewed the Aboriginal case as more valid: for Aborigines, they pointed out, the value of the art resides in its practice rather than its age.

In New Zealand human bones have been removed from display. There have been conflicts over exhibitions of Maori culture, but these have been resolved through cooperation between museums and Maori groups. The *Te Maori* exhibition, which was taken to the United States, was accompanied by Maori elders and performers who conducted ceremonies at each city where the exhibition was set up. However, there were still misgivings that these treasures belonged more to the museum trustees than to the Maori. There were also clashes over interpretations given in the exhibition book. Whereas previous displays of Maori culture had been in the form of artefact typologies, the Hawkes Bay Museum set up a new kind of exhibition called *The Awakening: the Treasures of Ngati Kahungunu*. The design team included Maori advisers and attempted to instil a spiritual feel into the exhibition, abandoning the 'textbook on the wall' approach for a more shrine-like atmosphere.

Applied archaeology

In the 1970s Colonel Quadaffi of Libya agreed to a multinational archaeological project, on the grounds that the past must be used to serve the present. The project was funded by UNESCO to investigate why the productive farming areas of Roman Libya had turned to desert and what could be done to improve the suitability of the desert margins for agriculture. Archaeologists discovered that the climate was not so different in the Roman period and that Roman agriculture had been sustained by cleverly designed water catchment and irrigation systems built of stone in the dry river courses. After even a light rainfall, the wadis filled with water which could be trapped and diverted to small fields. With no great effort the Roman systems could be rebuilt and reused (Barker *et al.* 1996).

In Peru, an archaeological project along the Cusichaka river resulted in the discovery of ancient stone irrigation canals built by the Inca. The canals were abandoned at the time of the Spanish conquest and, after the canal system had been archaeologically recorded, a programme of repair and clearance has been started so that the canals may once more carry water from the mountains to irrigate arable fields (Erickson 1988).

Local communities and archaeology

Non-professional involvement in archaeology varies widely throughout the world, from active field projects by independent groups (as in Britain), to assistance of professionals (as in many European countries), to responsible clubs of metal detector users, to unlawful looting (or pot-hunting as it is called in North America) and collecting. Most national legislations and international agreements make some provision for the archaeological heritage as the public right of all citizens. Nevertheless, the unrecorded looting of archaeological sites has become a major archaeological problem and ancient artefacts are more sought-after by collectors than ever before. In many parts of the world, illicit looting of sites forms a steady income for poor, rural communities who sell their 'mined' antiquities on to middlemen and international dealers. In other circumstances, local communities have reclaimed their history through such remains (as is the case among many Australian Aboriginal or North American Indian groups), actively preventing their destruction by illicit looters or even archaeologists.

In Europe, non-professional involvement in the conservation of the archaeological heritage includes not only the formation of local pressure groups but also the active management of archaeological sites, especially if they involve elements of nature conservation (Baker 1983; Hughes and Rowley 1986; Lambrick 1985). Pressure groups in recent years have been as diverse as the actors campaigning on site for preservation of the remains of the Shakespearean Rose Theatre in London (see p. 393), to local groups in Dorset, England, protesting at English Heritage's arrangements for excavations on the iron age hill-fort of Maiden Castle, which they claimed was being dug needlessly ('Don't rape the maiden' was one of their slogans).

In Britain and elsewhere in Europe, much active management of archaeological sites by local communities is carried out under the umbrella of wildlife conservation. Organizations such as the British Trust for Conservation Volunteers (BTCV) use volunteers to manage wildlife habitats, which occasionally will include archaeological sites. Other organizations such as the National Trust and the Prince's Trust tackle projects which are specifically archaeological in their conservation objectives, but these are relatively few in contrast to the upsurge in public participation in nature conservation. Worryingly, public participation in British archaeology has declined as volunteers in nature conservation have increased.

THE METHODOLOGY OF CONSERVATION MANAGEMENT

The stabilization of decay is a continuous activity which requires varying inputs of labour and funds depending on the nature of the remains and the circumstances of their setting. The concept of a management cycle has been proposed to outline the different stages of monument management and to highlight the need for continuous attention. For example, sites cannot simply be fenced and left: grass cover will regenerate to woodland; stonework and other upstanding remains will decay and collapse.

The management cycle can be characterized as:

1 *Identification:* archaeological remains in the landscape must be located, ideally by systematic survey, though of course, many important sites are discovered by chance, often in the course of their destruction. Identified remains can be recorded on local or national Sites and Monuments Records (Larsen 1992).

2 *Assessment:* archaeological sites and landscapes must be assessed in terms of their importance or significance and their prospects for continued survival. Priorities for preservation have to be established and decisions taken about which sites can be saved and which must be excavated and recorded before destruction (English Heritage 1991b). These choices should be made in terms of local and wider research objectives, as well as the physical circumstances of survival. Survey and recording are particularly necessary at this stage.
3 *Stabilization:* a management plan should be drawn up to indicate the immediate and long-term steps that need to be taken to preserve the remains. The short-term stabilization may involve repair of masonry, burial of exposed deposits, or protection from artificial or natural forces. The most dramatic example is UNESCO's Egyptian project when temples and other structures were moved in advance of the floodwaters of the Aswan dam. Other examples include the provision of a protective roof over the remains, stabilization of river banks, immediate repairs to damaged masonry and clearance of damaging vegetation.
4 *Long-term management:* all archaeological remains require long-term attention, whether by incorporation into an agricultural regime (for example, regular grazing of buried sites), or by intensive monitoring and constant work involvement. Archaeological remains which require the most intensive looking after are waterlogged sites and standing monuments.
5 *Research:* without a research framework to promote interpretation and understanding, all archaeological conservation is pointless; research is required at all stages of the management cycle, both into suitable methods of conservation and into the sites themselves (Darvill *et al.* 1978; English Heritage 1991a).

Different conservation strategies are required for different archaeological environments. In many ways, a 'cook book' approach is not possible, since each particular site, monument, or landscape has its own unique combination of environmental, landholding, financial, and legal problems. The management plan drawn up for a particular site will have to be tailored for its specific circumstances. Nevertheless, we can group archaeological sites into six categories according to character and context.

In the case of wet sites, if organic remains are permitted to dry out, they will perish in a very short time. The bronze age wooden fort of Biskupin, in Poland, has seriously deteriorated due to de-watering (Fig. 10.7). In contrast, a large portion of the bronze age timber structure at Flag Fen, in England, has been preserved in a waterlogged condition by the construction of an artificial lake on the site. On the Somerset Levels, in England, large expanses of peat, containing prehistoric

Figure 10.7 Biskupin: a defended settlement of the first millennium BC. Parts of this extraordinary archaeological site have been reconstructed, but little survives of the original timbers, which are drying out. Photographs: M.Cressey.

wooden trackways, have been kept waterlogged by continuous pumping of water (Darvill 1987; Cox *et al.* 1995; Coles 1995).

Standing stone and brick monuments may suffer considerable problems of subsidence, stone damage, salt corrosion, weakening of the fabric and collapse. Regular repair and maintenance of stone structures require replacement of damaged or collapsed stonework, re-pointing of eroded masonry joints, gravity grouting (pouring liquid concrete into the top courses of the masonry core so that it percolates into all the crevices in the core), underpinning and shoring (incorporating concrete or steel beams into the fabric), rough racking (stabilizing exposed core surfaces) and protection of wall-tops (perhaps with a 'sacrificial layer' of stone or brick which must be regularly replaced as it erodes). Fired brick structures suffer similar problems to stone ones, but in addition are more vulnerable to corrosion by mineral salts. Plaster wall surfaces and floors are especially vulnerable to the elements (English Heritage 1994).

The third category consists of exposed stone, brick and mud-brick structures. The major problem of archaeological excavation is the long-term maintenance of newly exposed structures. In cold climates, freshly exposed stone and brickwork is likely to shatter and flake due to freeze-thaw action. Mosaic floors are similarly vulnerable. Occasionally, cob structures (walls built of mud and dung) may be excavated, for example at Banbury Castle, England. If these remain exposed they will crumble without an adequate cover. Mud-brick structures in warm climates are vulnerable not only to erosion by wind and rain but also to salt corrosion. For example, the prehistoric city of Mohenjo-Daro, in Pakistan, is the subject of a UNESCO project attempting to stem the damage caused by the joint action of salt corrosion and a rising water table. Sites exposed by archaeological excavation make good places for tourists to visit, but the maintenance costs and the problems caused by exposure to the elements can be severe. There is a case for the backfilling of excavations so that buried structures will be available for examination only when adequate resources have been found.

Sensitive closed environments form the fourth category. The palaeolithic cave of Lascaux in France has been closed to visitors for many years, though a replica has been constructed. Similar problems of condensation and bacterial attack have developed with other cave art at sites in France and Spain. The burial chambers in Egypt's Valley of the Kings are similarly at risk from moisture and salt penetration of the painted plaster (Romer and Romer 1993).

The most extensive damage to archaeological sites has occurred in the northern hemisphere due to mechanized agriculture within the last century. Wetlands have been systematically drained. Large expanses of heath, upland, pasture and woodland have been cleared and cultivated with a variety of ploughs, subsoilers and pan busters, which may penetrate between 20 and 50 centimetres below the surface. Large tracts of land have been mechanically planted for forestry and the timber trade, involving considerable damage to buried remains (Proudfoot 1989). Legislation varies between countries in its effectiveness to manage sites. Invariably, the sites are only discovered after the damage has been done, and only recently, in England's 'Monuments at Risk Survey', has anyone quantified the losses sustained.

Effective management here depends not only on legislation but also on the cooperation of farmers and landowners. Sites under pasture should be grazed but not over-stocked (which can lead to soil erosion). Sites in woodland may survive as earthworks but are vulnerable to damage from tree roots, and their improved management requires the designation of clearings through selective felling. Earthworks such as burial mounds will not survive more than twenty years of ploughing. Sites such as these and sites with intact cultural layers need to be taken out of cultivation and put down to pasture. Sometimes minimally destructive cultivation methods, such as direct drilling, are acceptable alternatives. Sites under cultivation are also particularly vulnerable to looting by metal detectors, a major problem in the arable landscapes of East Anglia, England, where organized gangs plunder sites under cover of dark. 'Seeding' of such sites with metal waste has been suggested but not implemented.

Finally, many towns and cities of the world are built on centuries or even millennia of development. Beneath the streets and buildings lie metres of complex archaeological stratigraphy (Carver 1987). The development of high-rise and other major architecture, especially in the last forty years, has posed a major threat to the survival of these deposits. In many European cities the archaeological response was too late and too little. In Britain and Scandinavia, particularly in the 1960s and 1970s, major urban excavation projects were initiated. Good examples are Winchester, London and York in England, Dublin waterfront in Ireland, and Trondheim and Bergen in Norway The management of above-ground industrial remains from recent centuries has also become a concern of archaeologists in both urban and rural settings (Palmer and Neaverson 1996).

There have been two recent developments in urban archaeological management which have ended the 'rescue' response approach. One is the provision of three-dimensional resource maps showing findspots, depths of deposits, areas destroyed and zones of differing significance. This approach was pioneered in Norway and has become a useful planning aid in Britain, Denmark and Sweden. The other is the capability of new legislation such as PPG 16 (see p. 393) to prohibit damaging development where there are deposits that justify continued preservation. In the same four countries there have been experiments to modify the development proposals so that archaeological deposits remain intact or relatively undamaged. After an archaeological evaluation to establish the character, depth and extent of archaeological deposits, it has been possible sometimes to change the layout of the development so that archaeologically sensitive areas remain unaffected. There have also been experiments with shallow, rafted foundations and with piled foundations to sit new buildings on top of archaeological remains without causing more than minimal damage.

The approach may have been successful in some instances, such as on the Roman forum site in London, but it requires considerable negotiation and control over site works and causes de-watering and disturbance (Biddle 1994). In many parts of the world the pressures for urban and industrial growth far outweigh any concerns for preservation within the urban setting. An international project into urban origins in East Africa is bringing to light new evidence beneath modern cities (Sinclair and Wandibba 1988). This may be a first step towards identifying and eventually preserving urban deposits in Zimbabwe, Somalia, Tanzania, Mozambique, Madagascar, Kenya, Zanzibar and the Comores.

METHODS OF PRESENTATION AND DISPLAY

In most parts of the world the display facilities for archaeological sites are limited or non-existent. In Cambodia, for example, the war-damaged temple complex at Angkor is still in need of emergency repairs. Many of the Egyptian temple sites have little on-site presentation material and visitors have to rely on idiosyncratic local guides or guidebooks brought by themselves. The wars in Iraq and the former Yugoslavia have damaged sites like Ur and Dubrovnik. A recent assessment of tourist needs at the Great Pyramids at Giza has identified inadequate parking, excessive harassment and insufficient information presentation as major drawbacks to be overcome. In war-torn Mozambique soon after the Frelimo revolution, an initial call for the people to visit their national museum, to reclaim their history, was immensely successful, but afterwards few ever bothered to come again. Presen-tational sophistication is most evident in North America and western Europe, among nations where the luxury of archaeology, and the facilities for its enjoyment, are most affordable.

On-site presentation

On-site presentation can take the form of written guidebooks, leaflets, brochures, booklets, catalogues, books and pamphlets, organized guided parties, interpretation centres or site museums, wayside exhibits, audio devices (both fixed and portable), and audio-visual interpretation (film, tape-slide, multiple projector tape-slide and dissolve units). The Carnac Archeoscope, in Brittany in France, is a new visitor centre for the prehistoric stone alignments there: it incorporates the latest audio-visual technology, with lasers, film, mirrors, artificial sunrise and scale models. At Stonehenge, in contrast, where the visitor facilities have been called 'a cheap mess' (Chippindale *et al.* 1990), entry is via an underground concrete bunker and the stone circle is roped off from the public. Presentationally and politically, Stonehenge is deeply problematic: there are controversial plans to build a new centre half a mile away, and to raise awareness of the prehistoric landscape that surrounds the site. At most archaeological sites open to the public there are only rudimentary noticeboards and signs. Attractions such as the *son et lumière* shows in Egypt at the pyramids, the Sphinx at Giza and the temple at Karnak are rare outside Europe.

Archaeological landscapes

In many parts of the world there are concentrations of archaeological remains in relatively small areas which can be visited and explored. The Aboriginal rock art sites of Australia, the deserted neolithic and bronze age landscapes of England, and the Pueblo sites like Chaco Canyon in the United States, are all examples of areas where ancient landscapes can be appreciated.

Archaeological excavations

Visitor facilities have been installed at many excavations, either ongoing or long after excavations have ceased. At Olorgesaile, in Kenya, visitors can traverse a walkway above completed excavations that have revealed a lower palaeolithic occupation surface. At Kostienki, in Russia, a concrete visitor centre has been built over the remains of an upper palaeolithic mammoth-hunters' camp. Impressive Chinese sites, such as the imperial tomb at Xian, are also preserved *in situ* and receive millions of visitors. Excavations throughout Europe and North America have recently made considerably more effort to enlighten the public. One of the first sophisticated attempts was at Coppergate in York, where audio posts, a visitor centre and guided tours were arranged during the rescue excavation.

Reconstructional centres

One example of this approach is the West Stow Anglo-Saxon Village in East Anglia, England (Fig. 10.8), but the most developed is probably the Jorvik Viking Centre in York, on the site of the Coppergate excavations referred to above. This has proved extremely popular for its reconstructed people, smells and sounds within a realistic full-scale model of Viking York (Fig. 10.4). It also provides a mock-up of the dig and laboratory. This concept has been taken further at York's Archaeological Resource Centre (the ARC), where the public can learn how archaeologists interpret

Figure 10.8 Combining experimental archaeology and tourism: a visitor to West Stow Anglo-Saxon Village in East Anglia, Britain, uses a reconstruction of a woodworking lathe. Photograph: M.Parker Pearson.

from the raw evidence of excavated material (Fig. 10.5). The Archeodrome, in central France, is an outdoor theme park of reconstructed archaeological buildings conveniently sited at a motorway service station. The iron age village at Lejre in Denmark combines outdoor reconstructions with working displays and experiments in prehistoric agriculture and manufacture. Annapolis and Williamsburg, in the United States, are recreated colonial towns which combine archaeological investigation with detailed reconstructions, including costumed inhabitants.

Museum displays and exhibitions

The permanent collections of museums have, in many cases, yet to shake off the ‘glass case’ syndrome of rows of artefacts arranged in geometric patterns and illustrated with a minimum of information or with densely written labels which remain unread. By the 1970s a few museums developed less artefact-orientated and more interpretive exhibitions, such as the Museum of Man in Ottawa, or the Jorvik Viking Centre, which has labels for some exhibits saying 'please touch!' Reconstructions, attractive interpretive panels and imaginative displays of artefacts in context have become commonplace in Europe and North America.

Education in schools

Archaeology is not considered a proper subject of study for schoolchildren in most countries, but the work of a few dedicated teachers has ensured that it is incorporated into subjects such as history and geography (Corbishley 1992). School teachers can use teaching packs, experimental archaeology (such as making and firing pottery), role-play and a wide variety of introductory books and booklets. In England, English Heritage supports an education service which encourages the teaching of archaeology in schools and develops links between archaeological organizations and schools in their areas.

Literature

Mortimer Wheeler's distinction between academic facts and popular fiction is beginning to dissolve: accurate yet accessible publications are increasingly available. Professional archaeologists are increasingly interested in archaeological fiction, particularly its contextual and ideological aspects. The building block of archaeological publication is the project report, normally rather specialized for all but the keenest enthusiasts. Nevertheless, the scientific presentation of survey and excavation results is normally through publication, available in local libraries or in specialist national libraries. The inaccessibility and cost of these reports are also compounded by the long delays between excavation and publication. Some archaeologists consider that there has been a scandalous lack of publications in recent years, with more than half of excavations unpublished. In addition, results from new projects in Britain, the United States and Scandinavia are increasingly put into archives with only brief summaries published. There is an enormous literature on more general topics, directed both at specialists and the general public. Amongst archaeologists there is an increasing desire to draw the public into the subject, to guide rather than teach, in order to encourage and tap the undoubted enthusiasm and expertise of many non-professionals.

Other media

The popularity of archaeology in the 1990s may owe as much to fictional best sellers such as the Indiana Jones films or the Clan of the Cave Bear books than to a steady and sustained influence from more serious treatments. Archaeology has become the subject of theatrical plays, modern art and sculpture, television or radio dramas and documentaries, poetry and novels. Archaeological discoveries are reported on regional and national news, in documentaries and even in programmes devoted entirely to archaeology, such as *Down to Earth* and *Time Team,* two weekly series shown recently on British television.

ARCHAEOLOGICAL DEBATES AND PROBLEMS

The restitution of cultural property

> [Between 1750 and 1830 English travellers] stole and purchased for trifling sums large quantities of items which formed part of the heritage of the countries they robbed in the name of science and scholarship, and with very rare exceptions this material has never been returned to its rightful owners.
>
> (Hudson 1981:70)

The British Museum and a large number of public and private collections in Britain and north-west Europe are crammed with the antiquities of Greece, Italy, Syria,

Figure 10.9 Advertising the past: a bus in Cambridge is festooned with advertising slogans for an archaeological museum. Photograph: M.Parker Pearson.

Palestine, Egypt, Africa, South America and the Pacific. Negotiations continue for the return of such cultural property, either between governments or directed by ethnic groups as in the requests for re-burial of human remains. The Egyptian government has recently requested the return of Cleopatra's Needle, an obelisk set up on the bank of the Thames in London. In Athens an empty museum has been constructed to house, one day, the marble sculptures which adorned the façade of the Parthenon until they were removed by Lord Elgin in 1801–3 and sold for £35,000 to the British Museum in 1816.

A number of arguments for and against cultural restitution have been rehearsed in the last fifteen years. The taking of cultural property in colonial times has been seen as unlawful in international law. It also deprives peoples and emergent nations of a cultural and national identity. Another argument is that antiquities and other works of art are best appreciated in the environment where they were made. Arguments for retention are as follows. Many of the items were collected legally according to the collectors' domestic law and their reading of international law. Certain museums, such as the British Museum, are regarded as world heritage in their own right and should be maintained for international culture (though all such 'international' museums are in fact on two continents, in the West). Another argument is that objects are best conserved in these museums until other nations' legislation and resources are satisfactory. The artefacts have also become part of the cultural history of the holding states. Finally, there is the fear that accession to one or two requests will 'open the floodgates' and these major museums will be emptied.

The various arguments for and against restitution have taken place within a post-colonial situation where some newly emergent nations complain that their heritage is ironically better represented in the museums of North America and Europe than in their own countries. Some Western curators are increasingly sympathetic (and there is a growing ethical concern amongst archaeologists world-wide), but others have not been prepared to make any concessions to restitution claims from countries of origin. Strong feelings have been aroused on both sides, but sometimes agreements have been successful, as in the case of the return of 1,200 objects to Zaïre by the Belgian Museum of the Congo. The British Museum has returned numerous objects since the last century, such as the beard of the Sphinx to Egypt in 1984. Some curators and archaeologists are concerned that the logical outcome of the restitution movement will be cultural isolation of many nations: for example, the only place to view Maori heritage would be New Zealand. As a result of this geographical restriction of access, they argue, we might encounter increased ethnic and nationalist chauvinism and racial intolerance, whereas we should be developing more tolerant attitudes to difference and diversity among the cultures of the world and exploring these differences with respect for peoples of other cultures. What is perhaps required is a true spirit of exchange amongst the nation-states and museums for the loaning of artefacts, the interchange of staff and skills, and the setting up of international travelling exhibitions.

The illicit collection and export of cultural property

The looting of archaeological sites has been going on for centuries (Prott and O'Keefe 1989). As the interest in antiquities developed in the Western world from the eighteenth century onwards, so the interest in public and private collecting has grown. As previously humble artefacts, such as pots or brooches, have become items of sometimes considerable financial value for collectors, the archaeological resource is under considerable threat. In Guatemala, for example, Maya tombs are looted by armed gangs who regularly outwit the insufficiently resourced government officials. In Peru in 1987, a staggeringly rich tomb at Sipán was looted of hundreds of gold and other grave-goods by local *huaqueros* (looters), though one archaeologist managed to document the tomb layout and its contents and to rescue some remains. This was just one incident among many in South America. In West Africa, archaeological sites have been almost completely destroyed in the search for terracotta figurines of the previous millennium. As is the case in the other developing nations of Africa, South and Central America and Asia, the culprits are often local impoverished peasants who earn small sums of money for their efforts. The winners in these situations are the middlemen and dealers who purchase the loot from the peasants for a pittance and then sell on for large sums in the international art markets.

In most cases the artefacts are taken illegally out of the country of origin, without an export licence. The Sipán treasures were exported initially to Britain and thence to the United States, since Britain does not have the kinds of legislation banning the import of unlicensed cultural treasures which are in place in the United States. Britain has also not signed the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property. London is a major world art market and British politicians are more concerned to support that role than to eradicate the illegal trade. The problem is also shared by British archaeological institutions: until recently, for example, the Oxford Archaeological Laboratory carried out dating tests to authenticate collectors' objects without requiring to see an export licence from the country of origin.

It is not simply the developing nations that are continuing to be plundered of their archaeological heritage. The Mediterranean countries all have to contend with illicit excavation—in Italy, for example, the pickings from robbing Etruscan tombs are such that organized crime has been involved. In Britain, the 1970s craze for metal detectors has led to the widespread loss of coins, brooches, and other metal artefacts from archaeological sites, many of them protected by a law which is often difficult to enforce. In East Anglia, even on protected sites (Scheduled Ancient Monuments), many of the artefacts are loose in the ploughsoil and can be easily extracted, either clandestinely or with the landowner's connivance. In a recent case an East Anglian farmer attempted, unsuccessfully, to reclaim Roman bronze artefacts which had been stolen off his land and exported to America. Of course, many people who use metal detectors are aware of the protected sites and work with landowners' permission, often taking finds to local museums so that they may be identified and provenanced.

In North America there is a long tradition of 'pot-hunting', where amateur and professional looters have even employed bulldozers to dig out archaeological sites in search of artefacts to sell. Their work has been particularly devastating in the southwestern United States, where they have looted sites of the Mimbres culture for their attractive pottery. Despite concerted preservation efforts by archaeologists (including purchase of intact sites), so many sites have been destroyed that our future knowledge of the Mimbres is now severely restricted. As in so many situations we may know much about the individual artefacts, which now adorn various collections, but we know nothing about their archaeological (and thus past social) context.

Who owns the past?

In England until 1966 there was a medieval law of Treasure Trove, recently updated, whereby newly discovered items of gold and silver belonged to the Crown providing that they had been hidden with an intention of subsequent recovery. This law was originally devised so that the king might lay claim to such treasures, but it has been wholly inadequate to protect archaeological discoveries in England (Palmer 1981; Sparrow 1982). Today in Britain, archaeological sites are owned by a multitude of largely private and some public concerns. Some are owned in the name of the British people, notably properties managed by English Heritage, Cadw, Historic Scotland and DoE Northern Ireland (the respective government agencies for England, Wales, Scotland and Northern Ireland), by the National Trust (a charity), or by local authorities (County and City Councils). Recent proposals by English Heritage to sell off 200 of the 400 monuments which they have statutary responsibility to care for on behalf of the nation, caused considerable concern. Their aim was to abandon the unprofitable monuments to local authorities and the National Trust, and to concentrate their efforts on the money-making attractions. The unsatisfactory access to one of these, Stonehenge (an English Heritage property surrounded by National Trust land), has prompted archaeologists and others to ask for whom and against whom the monument is being protected (Chippindale *et al.* 1990). The 1985 'Battle of the Beanfield' (see p. 406) and subsequent confrontations between police and protestors have raised questions about individual freedom in a democracy. Some groups such as the New Age travellers, geomancers or the Order of Druids consider Stonehenge to be a place of real and continuous spiritual meaning, and that they should be free to practise their religion without hindrance. English Heritage consider that such activities may lead to archaeological damage, as has happened with fire damage to stones at the unprotected neolithic tomb at West Kennet. The various groups laying religious claims to Stonehenge cannot point to anything more than a contrived relationship with the monument's construction, but in other parts of the world, as we have seen, the issues are considerably more problematic.

The re-burial issue is a key element in this conflict between indigenous ethnic groups and imposed governmental structures over ownership of the past. Though land ownership is a culturally relative concept, many native peoples consider that their pasts have been taken away from them. For Australian Aborigines, the dwelling places of the ancestors may be sacred sites which are not to be disturbed. The past also was never a separate, divisible, entity but, through concepts such as the Dreamtime, formed part of the present (Langford 1983; Layton 1989a). In 1982 the Australian Archaeological Commission passed a resolution acknowledging Aboriginal ownership of their heritage. A quote from an Aboriginal representative puts the position well:

> You have come as invaders, you have tried to destroy our culture, you have built your fortunes on the lands and bodies of our people and now, having said sorry, want a share in picking out the bones of what you regard as a dead past. We say that it is our past, our culture and heritage and forms part of our present life. As such it is ours to control and it is ours to share on our terms.
>
> (Langford 1983:2)

Hot interpretation

Many archaeologists and heritage specialists have complained that the past is sanitized or that aspects of it are excluded from public involvement (Stone and MacKenzie 1990; Uzzell 1989). Heritage is a concept that has acquired undertones of racial inheritance, a history of 'us' as opposed to a total human story. Critics have also pointed to heritage as the presentation of a cosy and romantic past, with the unpleasant and potentially sensitive aspects often ignored. For example, the massacre of medieval Jews at Clifford's Tower in York (England) is not alluded to in the on-site interpretation. David Uzzell has exhorted archaeologists and others to provide 'hot' interpretations of the past, in order to shock and challenge. The recent discovery of a Nazi SS command post bunker in Berlin has highlighted these issues (Meyer 1992). The fears that the site will become a shrine for neo-Nazis are matched by concerns that the physical remains of the brutality and atrocities of the Second World War should not be erased. The city archaeologist for Berlin, Alfred Kernd'l, considered that it would be more honest for Germans to confront their past than to pave it over. The bunker has been sealed up for the time being. Other reminders of the Nazi atrocities have deliberately been saved, such as the Active Museum's *Topography of Terror,* a display of the excavated basement of the Gestapo's headquarters and torture cells (Arnold 1992).

CONCLUSION

The philosophy of preserving the past is justified by a number of ideas about the notion of social continuity, lessons from history, national and cultural identity, world cooperation, and a desire to save a finite resource for the less-damaging investigative methods of future generations. It is a political tool that can be used to justify claims to land or to treasures, as well as claims of racial chauvinism or equality. What may seem to some to be a 'dead' past is to others a very real component of the present. Archaeologists are continuously engaged in sifting through the rubbish heap of history and re-presenting selected aspects of previous worlds, bringing those lost and forgotten pasts into the present.

It may be said that the job of finding out about the past is too important to be left to specialists such as archaeologists and historians. Everyone should be empowered to research the rubbish heap and select for themselves the knowledge that they seek. Equally, the judgement of what to preserve and what to present is open to abuse and falsification, either in pursuit of profit rather than knowledge or in the promotion of political ideologies. However, there is no escape from the dilemma. Countries like Egypt, Mexico, Britain and Greece have considerable incomes from tourism relating to archaeological sites. Archaeology is invested in partly because it pays, if only in an indirect way. We cannot conceive of a past free of political ideology or without contemporary political overtones. Whether these are the ideologies of living traditions and their sacred sites, or the writing of the past in terms of the political present, there is no escape. Yet we have to learn to exercise critical judgement about the claims that are made, including the contexts in the present in which they are made.

Archaeology can be used for so many ends. The time depth of the European past was used to promote concepts of political and racial supremacy. Some might also argue that the adoption of archaeology in developing countries was itself a second wave of colonialism. Archaeology teaches us to transcend the territorial boundaries of the modern nation-states and to challenge the accepted wisdom, oral traditions and official myths. We can use it to debunk long-held notions, as well as to recover the memory of humankind. In doing so, we must constantly question and examine the myths that are created by archaeology's practitioners.

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There are a number of what might be called textbooks, but all are weighty and fairly heavy going! The two books edited by Henry Cleere (1984, 1989) contain a variety of case studies from around the world. The more faint-hearted might prefer to stick to the relevant section of Renfrew and Bahn (1990). To get a flavour of the conflicts and controversies around the world, readers should look at the One World Archaeology books edited by Gathercole and Lowenthal (1990), Layton (1989a, 1989b), and Carmichael *et al.* (1994), though the individual contributions are very varied. Uzzell's two volumes (1989) are a useful guide to presentational approaches. Hunter and Ralston (1993) is the best coverage for Britain. There are several journals which regularly publish articles, opinions and controversies in Britain, notably *British Archaeology* (formerly *British Archaeological News*), *RESCUE News, The Field Archaeologist* and English Heritage's *Remnants* and *Conservation Bulletin.* On the international scene there are occasional articles in *Antiquity,* in the *International Journal of Cultural Property* and in various ICOMOS and UNESCO publications.

Part II

THEMES AND APPROACHES

11

CULTURE AND IDENTITY

Julian Thomas

WHAT IS CULTURE?

Throughout its history, archaeology has concerned itself with the cultural lives of past peoples. Moreover, throughout the twentieth century, nationalist and ethnocentric interpretations of the past have been built upon the understanding that there was some direct relationship between assemblages of material culture preserved in the present and human groups which existed in the past (Champion and Diaz-Andreu 1995; Graves-Brown *et al.* 1995). However, precisely what archaeologists have considered themselves to be investigating has differed radically from one time to another. The word 'culture' has come to mean quite different things to different archaeologists, and in part this has been a consequence of the manifold interconnections between archaeology and other disciplines. A series of debates within those disciplines has penetrated into archaeological thought, which in turn has generated quite different traditions of inquiry of its own.

At base, many of these debates have centred upon opposed points of view adopted in relation to the problem of naturalism: that is to say, the question of whether and to what extent the philosophies and epistemology of the natural sciences can be applied to the study of the social and cultural lives of human beings (Bhaskar 1989:67). Such a question is one which could not have arisen prior to a particular historical juncture, although one might argue over precisely when this occurred. It has been suggested that the specific notion of culture, conceived as a set of human products which can be transmitted from one person to another by non-biological mechanisms, did not exist before the nineteenth century (Kroeber and Kluckhohn

1952). It was at this point that Tylor came to define culture as those knowledges, arts, beliefs, customs and morals which human beings come to acquire as members of a society (Leach 1982:38). For Tylor, culture was the equivalent of 'civilization', a set of traits which arise as the consequence of achieving a certain stage of evolutionary advance; 'culture' is thus a singular body rather than a plural set of entities. In medieval Europe, the word 'culture' was generally taken to refer to the nurture of living things. The notion that culture represents a mental phenomenon opposed to, and enabling, the manipulation of nature, seems to have developed with the emergence of western modernity (Jordanova 1989). This division paved the way for the separation of the human and the natural sciences, which would eventually be formalized by Dilthey (Foucault 1970). Yet the separation of culture and nature into separate spheres is not one which is recognized by many non-western communities (Strathern 1980), and its application to the distant past must consequently be regarded as suspect. In some circumstances, it may be more appropriate to think of culture as a means by which people engage with the material world (Thomas 1996).

The identification of culture as a distinct entity rests upon the understanding that there is something about human beings which makes them fundamentally different from other living systems. Culture is rooted in consciousness (Ingold 1983), and the character of human consciousness is given by the ability to consider one's own being as an issue (Heidegger 1962). Consciousness 'brings the selection of behavioural instructions under the control and direction of intentional agency. Human beings, in short, are selectors of their cultural attributes, not merely objects of selection' (Ingold 1986:9). Thoroughly bound up with this capability is the question of complex language, and the ability to refer to one's self, and thereby to constitute oneself as a distinct social actor. So from the start, the issues of culture and identity are deeply connected, and it is through culture that both personal and group identity come to be constructed.

None the less, while it is generally accepted that culture, having emerged from a biological background, is transmitted by a quite separate mechanism, opinions vary as to the extent to which biological concepts can still be used in its understanding. At an extreme of naturalism, one position would hold that cultural instructions which result in particular behavioural patterns are genetically programmed, being reproduced according to the inclusive fitness which they impart to their 'carrier' (Cloak 1975). Thus in sociobiological terms, individual units of culture can be seen as the equivalent of genes, which survive or are eliminated by their ability to be copied into the heads of offspring. Under this rubric, culture is simply a much more efficient means for the transmission of selective advantage than heredity. A less extreme form of cultural evolutionism would merely suggest that particular forms of cultural behaviour tend to confer a greater survival chance upon a given population (Kirch 1980). Such a perspective often points to the 'speciation' effects of culture, the way that the adoption of culture makes particular groups more unlike one another, thereby introducing a model of group competition. Biological analogues for the process of cultural change thus have a tendency either to end up with a kind of genetic reductionism ('cultural traits confer selective advantage on the individual') or with functionalism ('cultural traits contribute to the adaptive potential of the group').

Within the forms of anthropology which have exerted a major influence upon the archaeological conception of culture, the aspect of the debate over naturalism which has been most prominent has been the contrast between organic and linguistic analogies. Thus culture may be compared to an organism which adapts to its environmental conditions, and whose attributes are explained in terms of their contribution towards the functioning of the whole; or it may be presented as the equivalent of a language, composed of rules and codes and held together by sense. Both of these models have a long history, yet their recent development in social thought takes the form of two traditions which both stem from the work of the sociologist Émile Durkheim (1858–1917). Thus in France, it has been Durkheim's interests in the way in which people classify the world, and collectively represent their societies (Durkheim 1915; Durkheim and Mauss 1963), which have proved most influential. These concerns, taken up by his students Robert Hertz (1916) and Marcel Mauss (1954), were the first steps towards a theory of culture as a symbolic cognitive structure, in which the significance of each element lies in its relation to the whole. It is thus quite legitimate to plot a line of development which leads from Durkheim to Lévi-Strauss (for example: 1966, 1969). Yet another side of Durkheim's work was deeply functionalist and concerned with the way in which the actions and predispositions of the subject formed a part of the organic social whole.

As Harris (1969:473) points out, Durkheim's theories pre-empted the thinking of several American social anthropologists, notably Alfred Kroeber and Leslie White, while the influence upon the sociologist Talcott Parsons is well documented. His influence is generally connected with the re-emergence of evolutionary and nomothetic approaches in the mid-twentieth century. The convergence of thought between Durkheim and Kroeber is thus an intriguing circumstance. Kroeber's background lay in the historical particularist anthropology of Franz Boas, which dominated the American scene in the earlier part of the century. Rejecting the explicitly racist evolutionism of the nineteenth century, Boas maintained that each human society was unique, each had to be seen in its own terms, and that no value judgements could or should be made between them (Boas 1948). Boas, and his pupil Margaret Mead, followed this line of thought towards a consideration of the interaction between personality and culture, a trajectory which eventually led Mead into a turn towards Freudian psychoanalysis (Harris 1969:422). Kroeber, by contrast, came to think of culture as a superorganic totality which dominated and determined the acts and preferences of the agent (Kroeber 1917).

It was with the return to evolutionism in American anthropology that the form of the organic analogy for culture which was to inform the New Archaeology came to be established. The two variants of cultural evolutionism concerned have been designated by Sahlins and Service (1960) as 'unilinear' and 'multilinear'. Thus the unilinear evolution promoted by Leslie White (1949, 1959) was concerned less with the specific cultural adaptations through which human groups move, and far more with supposedly universal evolutionary mechanisms which lie behind these changes, at the level of the living system. Julian Steward (1955), however, pursued an approach which insisted that cultural systems might progress along a series of parallel paths dependent upon the host ecology within which they developed. Steward's evolutionism was thus a 'cultural ecology', concerned with the interconnections between the cultural organism and its environment, and sensitive to the ways in which each affected the other. As such, it provides a very clear case of individual cultural units being seen as functional and adaptive units, although Steward expresses this more in the idiom of the machine than the organism.

American cultural anthropology, which maintained close ties with archaeology and which provided the context within which the New Archaeology emerged (see Chapter 2), was by the 1960s maintaining a functionalist view of culture derived to a greater or lesser extent from Durkheim. In Britain, a school of anthropology had developed which was functionalist without being evolutionary. In the period after the First World War, Malinowski's method of detailed field recording had contributed to a decline in an approach which compared cultural traits from different parts of the globe in the attempt to construct 'speculative histories' of culture areas (Leach 1982:28). Studies like Malinowski's of the Kula exchange system (1922) or Firth's of the Tikopia (1936) emphasized that all aspects of culture had to be seen in context, as parts of an integrated whole. Both Malinowski and Radcliffe-Brown presented a picture of society which draws on the Durkheimian organicist view of culture. Malinowski's experiences drew him to an understanding that such an entity had the primary function of providing for the biological survival needs of the person. Radcliffe-Brown (1933), however, presented a variant which was closer to the spirit of Durkheim. His 'structural-functionalism' saw the significance of the cultural whole as the achievement of social solidarity and harmony, and strongly evoked a sense that this whole in some way transcended the objectives of the singular members of a society. British social anthropology, then, presented a model of culture which was strongly functionalist. However, the rejection of the use of anthropology in the construction of rather dubious schemes of global human development resulted in an almost total disregard for the issue of change through time. The societies presented by structural-functionalism strove to maintain their stability, and ideally remained unchanging and atemporal. This lack of a diachronic perspective is doubtless partially responsible for the greater academic distance between anthropology and archaeology in Britain than in America. Structural-functionalism may have provided the British archaeologist's notion of what anthropology was all about, and it may have been drawn upon at times for inspiration, but its evident shortcomings meant that archaeology in Britain never had the comfortable feeling of nestling within a parent discipline.

These factors may have contributed to the circumstance in which it was in Britain rather than in the United States that archaeology first came to criticize functionalism and experiment with linguistic notions of culture. Structuralism, as the movement which brought linguistic concepts into the study of culture, originated with Saussure's epochal *Course in General Linguistics* (Saussure 1959), which introduced the vision of language as a structured set of differences, coherent within itself but with no necessary connection to the world of things which it purports to describe. If language could represent such a deep structure, hidden but showing itself partially in the utterances of day-to-day speech, Lévi-Strauss (1968) argued that similar structures might lie behind all of the manifestations of human culture. His method of investigating this possibility was to analyse diverse phenomena such as kinship proscriptions, exchange transactions, myths, and masks in the search for rules and codes underlying cultural practice. In common with the functionalists, Lévi-Strauss thus saw culture as a 'thing', a totality; however, rather than an organic whole composed of those practices which could be observed articulated in the day-to-day struggle with nature, its unity lay at another level of reality, submerged within the human mind. This deep structure was drawn upon and engaged with the world through human practice, but not so much in the process of adaptation as in the ongoing project of 'putting things in their place', of making sense of the world by classifying it. The way in which people split their experience up, put phenomena into classes, and gave meaning to their exterior surroundings thus reflects in a real way the internal world of the human being. Ultimately, the fundamental structure which gives form to all human cultural experience is the structure of the human mind itself.

While structuralism was a stimulus for change within archaeological thought, there was no real point at which an exclusively 'structuralist' archaeology existed. The turn to linguistic and symbolic notions of culture in the 1980s was connected with the reassertion of the discipline's identity as a social science (Hodder 1981). The early 1980s represented a period in which British archaeologists began to widen the scope of their interests across the human sciences (Hodder 1985). In consequence, the adoption of a new set of ideas concerning culture was not restricted to anthropological sources, and was openly critical of the shortcomings of 'pure' structuralism. One source of inspiration to which a number of archaeologists have turned has been Anthony Giddens's 'theory of structuration'. This is an ambitious sociological project which seeks to integrate structuralist notions of deep structure (Giddens 1979) with Marxist perspectives on historicity and social relations (Giddens 1981) and a conception of the conscious subject as a skilled social actor, the whole grounded in a quasi-Heideggerian critique of Cartesian views of time, space and Being (Giddens 1976, 1984).

Giddens emphasizes that the structures upon which people draw in social action are social and cultural in nature, rather than psychological. They are thus historical and contingent rather than written into the biological constitution of the person. Consequently, it becomes necessary to account for the processes by which people learn a set of cultural resources, yet are able to transform those resources through their practice (Bourdieu 1977). From Marxism, Giddens draws the insight that culture is a sphere of production, in which human beings labour to transform natural raw materials into something else, whether mental or material. Cultural production has the effect that products themselves (words, texts, material things) gain a degree of independence from their authors or creators (Giddens 1987). People thus live out their lives surrounded by a field of cultural products whose meanings they may or may not fully apprehend. It is not for the author to tie down the significance of a cultural product, and the 'reading' of symbols will vary according to context, enculturation and personal life history. Material products themselves construct the context in which utterances and the experience of other symbolic forms takes place (Barrett 1988).

It is evident, therefore, that in the human sciences as a whole, the concept of culture has little unity or integrity. Archaeology, in attempting to understand the diversity of past human experience, has managed to combine many perspectives to provide a singularly broad diversity of opinion. Since archaeologists have drawn upon the many meanings of culture in a somewhat profligate manner, the debates and directions of other disciplines have been rehearsed, rendered down and reconstituted to form a series of different configurations. Probably the best way in which to approach archaeological studies of culture and its relationship to the recognition or formation of identity is thus a chronological one, dealing with each of the major schools of thought in turn.

CULTURE AND ETHNIC IDENTITY: RATZEL AND KOSSINNA

The close connections which existed between geography and archaeology in the late nineteenth century and the early twentieth were underwritten by a changing political climate, in which the forces of nationalism, racism and imperialism jostled with each other. In this milieu, the establishment of past cultural and ethnic identities came to take on considerable importance. As Trigger (1989) suggests, the early stages of archaeological investigation were perhaps concerned more with time than with space. Prior to the final decades of the nineteenth century, archaeology was engaged in setting up universal evolutionary sequences rather than investigating the local variability of culture. Archaeological evidence was largely employed in the establishment of chronologies, and in gaining a general understanding of people's technological achievements at particular stages in the past (see Chapter 5). In the work of Lubbock (1865) or Sollas (1911), such conceptions of sequence were very explicitly linked with the notion of social evolution. Implicitly, these ideas suggest a unilinear evolutionary scheme, in which all races pass through Savagery and Barbarism on the way to Civilization, and in which presently existing hunting or farming societies can be regarded as the equivalent of our own ancestors.

Some forms of universal evolutionism were congruent with the ideal of the nation-state, in which each definable 'people' had the right to form a state, connected with a particular geographical space (Bassin 1987a:474). As long as this notion dominated European political thought, western attitudes to the rest of the world tended to be benign, on the grounds that other peoples might, in time, graduate to the universal 'brotherhood' of nations. However, the period between 1870 and 1914 saw an unprecedented expansion of colonial empires centred on the principal European powers. Processes like the 'scramble for Africa' tended to produce their own legitimation, in the form of new political ideologies which stressed struggle and conflict as central to the health of societies. Germany was at this time in the throes of unification, yet the wide dispersal of ethnic Germans across Europe meant that it was unlikely that they could be brought within a single political entity under the rubric of 'natural justice' of the nation-state. Instead, pan-Germanism and notions of racial supremacy began to rise in popularity. In this climate, a search for the origins of particular races and peoples started to supplant the agenda of universal evolution.

It is important to point out that in different places the decline of universal evolutionism took very different forms. In America, the evolutionary anthropology of Tylor and Morgan was eclipsed in the early twentieth century by the particularism of Franz Boas. As we have seen, Boas argued that each society had to be seen in its own terms, as a unique manifestation of the human spirit which could not be measured against any other, and resulted from a unique sequence of historical events. Contingent factors were responsible for the gathering together of unique combinations of cultural traits, any of which might be equally significant in determining subsequent developments. Boas's relativism and particularism was thus anti-racist and humanitarian, in advocating respect for other peoples.

By contrast, in the late nineteenth century we can discern the emergence of the school of 'Anthropo-Geography' in Germany and Austria, in which the central figure was Friedrich Ratzel. Ratzel's work mixed the growing continental interest in maps and distributions with a strong environmental determinism. Human beings were seen as taking little part in their own destiny, being largely at the mercy of nature (Bassin 1987b:117). While Ratzel's views shared with Social Darwinism a perspective that human societies were governed by natural laws, and that their behaviour was wholly analogous to that of individual organisms, he stopped short of any degree of racism. The identities of human groups had little to do with heredity or language, but were forged by a relationship between people and environment. Thus the basis for the integration of a state was the common occupation of a geographical location rather than race. Ratzel used new techniques of distribution mapping to demonstrate that artefacts like blowpipes and bows and arrows had only been invented once, and had then diffused around the world. As a result of environmental factors, the diffusion of cultural innovations into particular locations created 'culture areas', or geographical areas in which people tended to have similar ways of life and artefactual repertoires. For the most part, then, essentially passive human beings were moulded by the external influences of environmental conditions and the flow of incoming cultural innovations.

Ratzel's ideas were clearly an attempt to understand the ways in which regional identities are formed. His approach was by no means as extreme as that of two traditions which to a greater or lesser extent flow from his work. In Britain, one has the hyper-diffusionists like Perry, Raglan and Grafton Elliot Smith, whose ideas originated in more moderate work of the social anthropologist W.H.R.Rivers. Sceptical of the prevailing evolutionism of his time, Rivers argued that no universal law of culture could be held responsible for the diversity which he encountered in Melanesia (Slobodin 1978). Smith developed this emphasis on the uniqueness of cultural innovations into a theory that all human advances had followed from the emergence of sedentism in the Nile valley, and that all civilizations (including the Maya) were founded by the ancient Egyptians (Harris 1969:382).

In Germany, Ratzel's legacy was to be the *Geopolitik* school of geography, which flourished in the period after the First World War. It is of key significance that maps demonstrating the distribution of persons of particular language groups were used by the allies at the Versailles peace negotiations, since the aim of the settlement was to allow self-determination for the peoples of central Europe after the break-up of the German and Austro-Hungarian empires. The lesson which was learned by nationalistic groups in Germany was that of the persuasive power of maps. Karl Haushoffer, who founded the *Zeitschrift für Geopolitik* in 1924, emphasized the potential of maps for propaganda purposes—in particular, the maps which were drawn of the 'true' geographical extent of the German people and their 'lost' domains in the east (Herb 1989). It was this sort of mapping which was to provide legitimacy for the Nazi expansion in the succeeding decades.

It is in the context of the *Geopolitik* that we can appreciate the eventual significance of the work of Gustav Kossinna, the archaeologist who took up Ratzel's techniques and applied them to the prehistoric material culture of central and northern Europe, at the start of the twentieth century. Kossinna was a strong German nationalist, and had moved from linguistics to archaeology in the hope of locating the original homeland of the Indo-Europeans, and hence of the Germans. His method was to trace historically documented peoples and tribes back as far as he could by conventional methods, and then to push back further using distribution maps of particular artefact types. It is really with Kossinna that we can first recognize the emergence of the concept of the archaeological 'culture', a set of material culture found repeatedly in association and assumed to relate in some way to the activities of a particular group of people (Veit 1989).

In his book *Die Herkunft der Germanen,* Kossinna (1911) presented a picture of how the Germans had started out as the Maglemosian mesolithic hunters of the Baltic area, and had gradually spread south and east through the prehistoric era, eventually creating the Greek and Roman civilizations, though unfortunately diluting their line by interbreeding with swarthy Mediterranean types in the process. Only in Germany itself did the race remain pure. Only the pure, active Germans were culturally creative, in distinction to the other, passive or retrogressive races. Kossinna describes the prehistoric Germans as 'a slim, tall, light-complexioned, blond race, calm and firm in character, constantly striving, intellectually brilliant, and with an almost ideal attitude towards the world and life in general' (quoted in Veit 1989:38). Kossinna died in 1931, but not surprisingly his works were reprinted when the Nazis came to power and provided the basis for school textbooks on the early history of the Germans and propaganda posters showing the extent of their ancient territories.

NORMATIVE CULTURE HISTORY: CHILDE

Just as Kossinna originally came to archaeology through an interest in linguistics, so Vere Gordon Childe's earliest work was concerned with the identification of the Indo-Europeans or Aryans through the medium of prehistoric material culture (Childe 1915, 1926). In this sense Childe was initially involved with the use of the archaeological evidence as a means to substantiate preliterate ethnic entities which had been identified using written sources and to track them back into the past. Yet as Renfrew (1979:15) has pointed out, this phase of his researches was one which he later came to all but disown, so that *The Aryans* barely merits a mention in his subsequent books.

As Sherratt (1989:178) suggests, it is perhaps possible to distinguish between an 'earlier' and a 'later' Childe. The former was distinguished by an interest in philology, migration and Indo-European origins, the latter was more concerned with technology, evolution and a materialist interpretation of prehistory. However, while these extremes might isolate the starting and ending points of Childe's intellectual odyssey, there is no sharp break between the two, and each of his books appears to find him continuing to wrestle with the problem of material culture and its relationship to ethnic identity. His effort to bring together culture history and evolution, in particular, tends to lead him to contradict himself within any given theorization. There is a further question regarding precisely how much of Childe's conceptual development stemmed from his professed Marxism and its irreconcilability with positions which he found himself adopting: it is probably an oversimplification to suggest that Childe 'became' a Marxist at a particular point, with an immediate transformation of his archaeology (Gathercole 1989).

Thus in *The Aryans,* Childe developed the notion that the character of particular groups derives from their use of a particular language, accepting an innate superiority of the Indo-Europeans arising from their having formulated a language which served as a superior medium for thought (Trigger 1980:52). The consequences of this line of thinking doubtless became clear to him at a later stage (Trigger 1980: 91). Yet what is surprising is that Childe had already devised the central concept of the archaeological culture, which was to be his medium for resisting arguments of Kossinna's kind, in a work which was actually published earlier, *The Dawn of European Civilisation* (Childe 1925). Very much like Marx himself, Childe appears to have been capable of arguing rather different cases at one and the same time, in line with different arguments in which he found himself embroiled.

Childe's notion of the 'culture' certainly does draw upon Kossinna's method, especially in that he sees the integrity of individual cultures as being largely geographical (Childe 1942:27). Yet his own methodology derives largely from Montelius, and he is emphatic that 'culture and race do not coincide' (Childe 1950: 1). As originally phrased, the archaeological culture was seen by Childe (1929:v) as 'certain types of remains—pots, implements, ornaments, burial rites, house forms— constantly recurring together'. Such an entity might reasonably be equated with an ethnic group, a 'people', yet a people was not the same thing as either a race or a linguistic group. What is remarkable about Childe's approach is that, rather than accept the existence of cultures on a purely empirical level, he went on to outline the mechanisms through which they came into being and 'hung together'. In coming to write his epochal summaries of Old World prehistory (Childe 1925, 1929, 1934), Childe condensed his knowledge of thousands of artefacts in hundreds of museums into defining cultural assemblages, made and used by particular groups of people at particular times. These cultures thus became the building blocks of the prehistory which still stands in place (in an elaborated form and with adjusted dating) today (Fig. 11.1).

Childe was willing to see the development of culture (in the generic sense) as a continuation of the evolutionary process. Much as Binford was later to maintain, culture involved means of adapting and coping which were extracorporeal and which could be discarded at will. However, one particular aspect of culture represented a quantum leap which separated human beings from other animals, and this was language: animals could and did learn behaviours from each other, but only human beings could express cultural concepts in the abstract. Thus 'the human parent can teach not only by example, but also by precept' (Childe 1936:27). Human young are frail, requiring a lengthy period of nurture, and it is in this period that cultural

Figure 11.1 Culture history and cultural identity: V.Gordon Childe's map of Beaker and Battle Axe cultures in Europe. Source: Childe 1925.

information can be learned. Yet the process of cultural inculcation requires a relatively stable social context, and hence more formal relations of immediate kinship tend to appear as human history progresses. Here, Childe's arguments draw quite explicitly on those of Engels (1968).

It follows from Childe's stress on language and learning that the acquisition of culture is a profoundly social process. Human beings are the heirs to a body of information and experience which has been gathered together by past generations (Childe 1942:16). By accretion, then, human communities built up cultural traditions which had built into them a great weight of conservatism. New innovations might occasionally be made, but these were rare, and were unlikely to be thought of more than once by the human community at large. Thus the expected norm would be that 'men cling passionately to old traditions and display intense reluctance to modify customary modes of behaviour, as innovators at all times have found to their cost' (Childe 1936:30). Consequently, a particular group of people would tend to make pots, tools and other artefacts in a standardized way, simply because a means of manufacture would be sedimented in social tradition. This much of Childe's argument seems relatively advanced to modern ears, such that aspects of Childe's 'cultural tradition' might be subsumed under Bourdieu's (1977) notion of the *habitus,* a culturally installed and conditioned structure of habitual actions and norms which tends to reproduce traditional practices and maintain social relationships.

However, the picture of prehistoric Europeans as uninventive dupes, waiting around for cultural innovations to be diffused from the Near East rather than as knowledgeable social actors, fits less easily into such a perspective. Childe's prehistory is one in which the iron grip of tradition weighs on the minds of the living, rather than one in which relations of power and dominance have to be invoked in order to explain the reproduction of cultural forms. Similarly, Childe's focus on language leads him into an advocacy of the 'normative' perspective which was to prove the Achilles' heel of culture historic archaeology. Since language was made up of conventional sounds which were taught to individuals as part of their enculturation, it was possible to use them to discuss objects which were not present at hand. Thus reasoning became a project which could be carried out 'in the head', rather than in the external world. By adopting this Cartesian dualism between an internal mind and an external world within which the lived body resided, Childe effectively set up the argument that (in the absence of written sources) a part of past humanity must always remain inaccessible to the archaeologist (for example, Hawkes 1954).

However, being able mentally to manipulate absent objects gave human beings the ability to hypothesize things which they had never seen: demons, spirits, men with wings. Language gave people the ability to transmit and culturally encode a metaphysical realm which had no basis in empirical reality. While in some cases such a metaphysics might atrophy into religion, which Childe saw as the essence of the despotism which stultified the Middle Eastern civilizations, an ideology might equally be favourable to the survival of the community. Abstract ideas might represent stimuli which might inspire people to actions over and above the needs of biological survival, and this in turn might affect the way in which their production of culture might develop. As human communities developed, a form of 'speciation' had taken place in which the material apparatus of particular groups became more and more distinctive and related to ethnic identity (Childe 1942:25). But clearly, Childe saw the difference between this or that way of decorating a pot, this or that way of burying the dead, as essentially arbitrary. While the use of a particular artefact for a given purpose might be a decision which was functional, most of the information which separated equivalent artefacts of different cultures was of a kind which we would now call stylistic. As indicators of cultural or ethnic identity, each of these traits would be of equivalent importance. Each was simply a 'way of doing things', whose arbitrary morphology might be determined by mental and ideological norms whose genesis and significance were probably lost to us.

As we have already noted, a direct contrast and contradiction with this argument is found in Childe's insistence that a culture also represents an adaptation to a given environment: 'hence a culture evolved in the Mediterranean is not likely to be transferred bodily to say England, without undergoing very drastic modifications' (Childe 1950:2). Why should this be so, if the differences between cultures were arbitrary and guided by random contingencies of social tradition and ideology? If cultural differentiation resided entirely 'in the head', why should not cultures in Greece and England be entirely similar? One move which could possibly have been taken would have been to follow that subdivision of the *Annales* school of historians who advocate a consideration of past mentalities (Le Goff 1985), and argue that environmental and climatic conditions are always mediated through mental processes and ideologies. The change of cultural form might thus be less as a means of adaptation to real circumstances than a means of expressing perceived conditions. Childe, however, is somewhat reticent in discussing the precise processes involved in the adaptation of culture to environment. Cultural change in his account is largely seen in terms of diffusion. Only where one entire repertoire replaces another outright might we legitimately talk of migration, while invasions where a ruling élite places itself above a local population might lead to no appreciable change in material culture whatsoever. Thus only the slow filtering of new ideas from one community to another gives a possible explanation for the introduction of cultural traits. At the same time, diffusion formed the central underlying assumption of the system of relative dating essential to Childe's prehistories (Chapter 5). What is intriguing to ask is whether Childe's legacy has suffered more from the empirical fact of the collapse of relative dating in the face of the radio-carbon revolution (Renfrew 1973) or from the theoretical assault on 'normative' culture history.

INVASION VERSUS ECOLOGY: CLARK

Childe's unease regarding invasions and migrations as sources of culture change was doubtless prompted by political concerns, and the parallels being drawn between the movements of past Aryan horsemen and their supposed modern counterparts. None the less, he found himself able to present a series of lectures in Norway in 1946 which dealt precisely with those cultural developments in prehistoric Europe which he could accept as attributable to folk movements (Childe 1950). It is interesting, then, to contrast this with one particular statement by one of Childe's contemporaries of a quite different political and theoretical persuasion, albeit one published some while after critiques of culture history had begun to emerge in the United States. In his classic 1966 paper, Grahame Clark complains of the way in which 'for much of the first half of the twentieth century, British archaeologists felt themselves under strong compulsion to ascribe every change, every development to overseas influences of one kind or another' (Clark 1966:172). Thus, in classifying the iron age phases of the British Isles, Hawkes had chosen to attribute Iron Age A to Halstatt invaders, B to Marnian invaders, and C to Belgic invaders. Clark's sympathies being more with economic and ecological explanations of human behaviour (for example: Clark 1972), he was well placed to lead a critical reaction against the somewhat limited perspective offered by the 'invasion neurosis'. Giving an overview of cultural developments spanning the British Neolithic to Iron Age, Clark demonstrates effectively the monomania of the invasionists. In particular, the revelation that the similarities between the bronze age Hilversum urns of Holland and the Deverel-Rimbury pottery of southern Britain had been interpreted as evidence for an invasion of Holland from Britain by Dutch archaeologists, and the opposite by their British colleagues, demonstrated something of a lack of imagination (Fig. 11.2).

Yet, significantly, Clark had no qualms in asserting that the start of the neolithic period in Britain could be attributed to an invasion. Farming economy and 'the whole complex of technology, practices and ideas that make up our neolithic culture' (Clark 1966:176) could only have come to Britain by way of actual population movement. What this seems to suggest about Clark's preconceptions is in itself interesting. He appears to believe that the flotsam of pottery style or tool

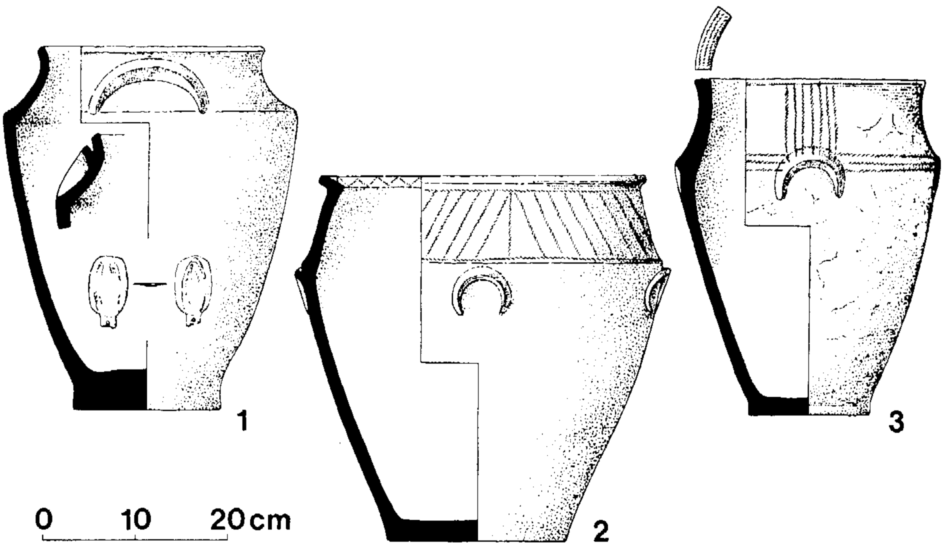

Figure 11.2 British biconical urns (1, 2) and a Dutch Hilversum urn (3): 1. Amesbury, Wiltshire; 2. Bulford barrow 47, Wiltshire; 3. Budel, North Brabant. Source: Megaw and Simpson 1984.

manufacture can easily be transferred from one community to another, but that a deeper and more important level of culture, 'base' rather than 'superstructure', required more fundamental changes to explain its transformation. In common with many of the archaeologists who were working in the 1960s and 1970s, Clark was beginning to see culture as something of a non-question. If radio-carbon dating had rendered relative dating unnecessary, archaeologists could confine their researches to the really important question of human development: how successive generations had provided themselves with subsistence. Such an exclusive focus on economic practice at the expense of cultural variability could certainly give an answer to the question which Childe had avoided: the primary explanation for all forms of human behaviour (at least as represented in the archaeological record) was given as the maintenance of a stable relationship between population levels and ecological conditions (Higgs and Jarman 1975).

ABSTRACT CULTURE SYSTEMS: CLARKE

By the time that Grahame Clark had committed his reservations to print, a quite different approach to culture was germinating in another quarter of Cambridge. While David Clarke had studied under Clark as a research student, his orientation was far more towards a vision of archaeology which was artefact-centred. Clarke's studies of British Beaker pottery had made use of classificatory techniques drawn from the natural sciences (for example, Sokal and Sneath 1963) in order to set up a more objective set of measures of artefact variability (Clarke 1962, 1967, 1970a). At the same time, he laid stress upon the ways in which a more scientific and disciplined approach might change the outlook of the discipline of archaeology, rather than merely the techniques which it made use of (Clarke 1973:10). For Clarke, archaeology was a discipline which was disorganized and subjective, and which needed to reconsider and regularize its practices. Despite this, it was also a discipline with a recognizable identity, which could transform itself by making explicit its assumptions and procedures. Thus while archaeology had affinities with other disciplines, and could learn from contact with them, the character of its subject matter was such that it must develop a distinctively archaeological set of theories and methods. Archaeological data and historical data are not the same, and the narrative structure of written history is not appropriate to archaeology (Clarke 1978:11); archaeology also has an affinity with anthropology and with geography, yet it has a more developed time dimension and a more distinct focus upon material culture than either.

As Shennan (1989a:833) suggests, the consequence of this is that Clarke's archaeology is one which is centred upon the behaviour of groups of artefacts in time: he was concerned not with cultural ecology, but with cultural morphology (Chapman 1979:111). In a way which owes something to Childe, Clarke's vision is one of material culture as a system which should be studied in its own right, which has affinities with ethnic or racial identity, political identity, and linguistic grouping, but which does not map directly onto any of these.

Clarke's approach to culture is most fully articulated in *Analytical Archaeology* (1968, 1978), a work which attempts to reformulate both the practice of archaeology and its perceived objects. As such, it sought to institute a series of models: of archaeological procedure as a systematic and explicit activity; of archaeological entities as composed of multiple, overlapping sub-units; and of archaeological processes as dynamic systems which could be described using general systems theory. Cultural systems, for Clarke, were integral whole units which exist in a state of dynamic equilibrium within an environment or context which is itself a system composed of sub-systems (1978:42–45; Fig. 11.3). As such, the set of traits or elements which a culture historian might describe as a 'culture' might now be seen as a self-contained information system, continuously changing across time. Culture as a whole might be looked at as a system with sub-systems: social relationships, religion, psychological, economic and material culture, but it was only the last of these which was studied by archaeologists. Archaeological entities of this type might be bounded and defined at a number of different levels: artefact, type, assemblage, culture, culture group, and technocomplex. Each of the levels in this

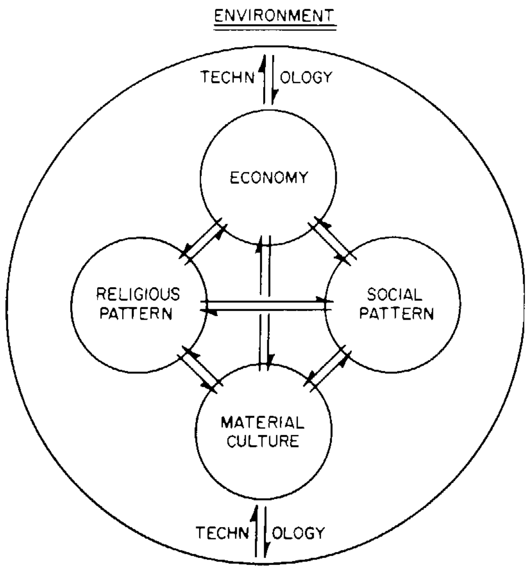

Figure 11.3 David Clarke's schematic model of the dynamic equilibrium existing between a single sociocultural system and its total environment system. Source: Clarke 1978.

hierarchy might be seen as an adaptive unit, operating within its environment (not merely in the ecological sense).

Clarke's expectation was that, in the normal state of affairs, an information system will oscillate around and towards a stable state, a state in which the cultural system maintains a steady relationship with its environment. Where some form of perturbation from outside disturbs this relationship, the adaptive response of a goal-seeking, self-regulating, system will allow it either to return to its stable state or to move to a new equilibrium basin. Clarke clearly imagined that culture, whether material or otherwise, operated 'as if' it were able to regulate its own behaviour, almost without reference to human agency (1978:52). Clarke's culture systems are thus abstract—not merely in the sense that they are modelled on processes of information flow but also in that they represent a framework of analysis which only indirectly invokes a human presence in the past. Taken to extreme, this represents an ultimately pessimistic form of positivism: since the people are dead and gone, we can only study their artefacts, and any meaningful statements which we make can relate only to them.

Towards the end of *Analytical Archaeology,* Clarke began explicitly to address the relationship between the units of analysis which archaeologists might define and the entities with which other disciplines concern themselves. Using the example of the Bantu of southern Africa, Clarke pointed out that the term might be used to denote a racial, cultural, or political grouping, or a technocomplex (Fig. 11.4), none of which directly corresponded with each other (Clarke 1978:372–73). Each of these units might share particular characteristics, yet they were basically different classifications established in different dimensions. Of course, this did not mean that the archaeological entity defined on the basis of material culture similarity and difference was any less real than the racial or political unit: it simply referred to a different order of reality.

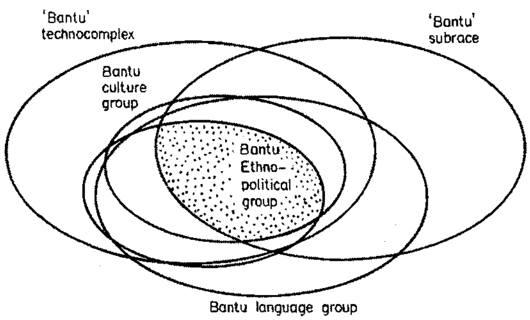

Figure 11.4 The relationship between different aspects of Bantu identity (cultural, technological, racial and linguistic) as expressed by David Clarke. Source: Clarke 1978.

Subsequently, Clarke worked through a more lengthy example of the implications of the model for the archaeological past, by considering the character of cultural groupings in late bronze and early iron age Europe. Here, one has a lengthy sequence of cultural change, in which different entities have been established at different points, based upon different classes of evidence from burial furniture to written testimony. According to Clarke, the consequence was that archaeologists had effectively been committing what Wittgenstein would call a 'category error', seeking to characterize 'Celtic material culture', and thus conflating terms drawn from two quite different systems of classification. The relationship between material culture, language and ethnicity was bound to be a more complex one than this allowed: 'what might be said with a fair degree of probability is that the majority of tribes showing the full La Tène assemblage were Celtic speaking and that, even so, some would belong to other language groups and some Celtic-speakers would possess other material culture' (Clarke 1978:379).

Clarke has a real and important point to make here regarding the complexity of the different ways in which human societies can be bounded and defined. However, we could argue that the outcome is somewhat equivocal, and this may explain the relatively limited impact of the substantive elements of Clarke's approach (Shennan 1989a:831). Clarke was prepared to distinguish different dimensions of the identity of human groups, yet he seemed unwilling to spell out the ways in which these dimensions articulate with each other. Each appears to be equally real, and the limitation which Clarke places upon archaeology is that it must apprehend the past in the single dimension which is open to it: material culture. Consequently, the entities which it will define will be the rather abstracted traits, the 'culture groups' and 'technocomplexes' of his hierarchy—he seems to admit no closer access to past human social life. Similarly, the ways in which the variability within the archaeological evidence was generated appear to emerge from the formal structure of culture itself and its relationship with its environment, rather than being connected with the playing out of human purposes. Inevitably, this approach led him into a retreat from social reality, to a position in which he found himself arguing that culture consisted of a series of quasi-autonomous levels or spheres which are difficult to relate to each other. It may well have been the recognition of this difficulty which later led him to an abrupt change of direction and to the declaration that *Analytical Archaeology* had been 'an old-fashioned book' (Clarke 1970b).

CULTURE AS ADAPTIVE STRATEGY: BINFORD

While Clarke attempted to salvage what he could of the culture concept, in the United States a still more radical reassessment was under way. In the 1960s, the so-called New Archaeology built upon the ideas of the likes of J.W.Bennett, W.W.Taylor and A.C.Spaulding, calling for a rigorous, scientific, anthropological archaeology. A central element of the agenda of the New Archaeology was the replacement of the notion of cultures as the shared ideational framework of groups of people, with one of culture (singular) as a strategy in which people participated. Culture should thus not be thought of as a set of ideas held commonly in the minds of definable groups, so much as a pool of available responses with which to cope with changing environmental circumstances.

The opening salvo of the debate, and the classic exposition of the new perspective, was Lewis Binford's article 'Archaeology as anthropology' (Binford 1962). Here Binford argued that, while archaeologists had long paid lip-service to the goal of contributing to broader anthropological debates relating to the explanation of cultural diversity, in practice little had been contributed at this level. Archaeologists had done much to demonstrate the range of variability of human culture, but had not advanced beyond the descriptive. The reason which Binford gives for this is a failure to think of archaeological data in a systemic framework. Following White, Binford held that culture was 'man's extrasomatic means of adaptation' (Binford 1965:205). It followed that culture could not be localized in any one element of the overall system of relationships between persons and their surroundings but was to be found at the junction between several sub-systems. Culture should be studied precisely through a concern with the interactions of different sub-systems—demography, climate, vegetation, technology and so on.

Binford was quick to stress that he was not proposing a form of environmental determinism. Human beings exist within a world composed of ecological systems, and culture is an intervening variable between the organism and its environment (Binford 1962:219). Thus, while other animals must adapt biologically to changing circumstances, human beings have the option of adopting cultural innovations as a means of coping. Clearly, Binford conceived of the process of cultural change in Darwinian terms. Culture is not limited to the range of behaviours evidenced in the archaeological record (Binford 1973:229); culture represents a 'pool' of variability which is acted upon by selective pressures, the equivalent of the genetic variability which forms the raw material of biological evolution. This variability represents the content rather than the form of cultural systems, and is subject to more or less stochastic variation through time, a phenomenon which Binford labels as 'cultural drift' (Binford 1963:91). Binford's use of this term, as an analogue with biological process, is to be distinguished from any similar usage in culture historic archaeology.

Interestingly enough, in seeking to avoid determinism, Binford's first attempts to define what culture is and how it works allowed a surprising range of phenomena to be studied by the archaeologist. Claiming that material culture and technology should not be conflated, Binford argued that three types of material culture can be defined, and that these function in quite different areas of human enterprise (1962: 220). Thus *technomic* artefacts are those which are directly engaged with adaptation to environmental conditions, *sociotechnic* artefacts operate in the social sub-system, expressing social relationships, and *ideotechnic* artefacts are essentially ideological devices, which secure acceptance of and enculturation into the prevailing sociocultural milieu. Such a conception is clearly functionalist in the extreme, in proposing that each element of culture has its part to play in securing the overall adaptive fitness of the cultural system. However, the immediate upshot of this functionalism was the perception that archaeologists were now able to study and explain a wider range of more interesting phenomena. Far from being limited to those aspects of human practice which could be directly inferred from the material evidence alone (Hawkes 1954), a range of seemingly 'irrational' behaviours could be explained in terms of their contribution to the functioning and integration of the cultural system as a whole.

The particular example which was chosen to demonstrate this greater explanatory range was one which was characteristic of a new mood of optimism. At the start of the 1970s a series of studies appeared which purported to explain prehistoric mortuary practices in adaptive and systemic terms (Binford 1971; Saxe 1970). In these studies, mortuary practice was presented as a communication system which served to express the precise social role at death of particular persons. Its adaptive significance thus lay in communicating to the community as a whole the loss of one of its members, and to facilitate the rebuilding or reallocation of the relationships and functions of the deceased. Binford's prescription for the archaeological study of culture was thus one which allowed a far greater range of phenomena to be studied, even if in a very restrictive way. By definition, culture is important when it is engaged in the adaptation and maintenance of internal homeostasis of the group. Beyond this, cultural manifestations which cannot be directly tied to adaptive strategy are considered to be aspects of a pool of variability, which enables flexible responses to be made to changing conditions. However, the content, as opposed to the mere existence, of this variability was given little consideration, and its involvement in in-group strategies was not addressed.

The contrast between 'normative' culture history and Binford's systemic evolutionism is nowhere demonstrated with such clarity as in the celebrated debate over 'Mousterian variability' (see also Chapter 12). In a meticulous series of analyses of measurements and indices relating to lithic assemblages of the middle palaeolithic Mousterian in south-west France, François Bordes had demonstrated the existence of a series of distinctive assemblages, which he explained in culturehistoric terms as diagnostic of the coexistence of a number of tribes or peoples (Bordes 1973; Bordes and de Sonneville-Bordes 1970). Binford's reconsideration of these materials was to question whether a series of different assemblages need necessarily represent a series of different cultures, or whether it might simply be the case that the same group of people were using a slightly different technology under different conditions (Binford and Binford 1966, 1969). His argument was not that a given assemblage is a type fossil which is produced as a determined response to a given climatic stimulus. The archaeological record represents the use of a set of cultural materials in a strategic adaptive behaviour, and what is evidenced at each particular site is the technology required to carry out a particular set of activities under a given set of conditions:

> I do not wish to imply that there is a causal relationship between the form of the environment and the form of the assemblage, only that the utility of a given location for particular forms of human use is modified with changes in the environment.
>
> (Binford 1973:232)

'CERAMIC SOCIOLOGY': DEETZ, HILL, LONGACRE

The same optimism which characterized studies of prehistoric social structure based on mortuary analysis can be seen in a group of papers published in the 1960s which made use of stylistic variation in ceramics as a means of addressing patterns of residence and descent (Deetz 1968; Hill 1970, 1972; Longacre 1964). All were concerned with pueblo settlements (large, conglomerate residential structures in the American Southwest: Fig. 11.5), and all were attempting to substantiate whether currently extant patterns of social structure had prehistoric antecedents. The arguments began with the observation that, in modern-day pueblo society, the skills of pottery manufacture and decoration are passed from mother to daughter (Hill 1970:37). These communities are matrilocal; that is, husbands at marriage go to live in the family home of their new wife. It follows, then, that microtraditions of potting style build up in the individual matrilineages (Deetz 1968:45). Using data from the excavated pueblo at the Carter Ranch Site, Longacre set out to test the hypothesis that a similar pattern of residence and descent existed during the life of the site, in the period AD 1100–1250. If it were the case that matrilocality and matrilineality existed in the past, it might be expected that particular stylistic elements on pots would be localized in specific areas of the site. For the prediction to hold true, it would be necessary that then, as now, potting had been an exclusively female activity. Moreover, the pottery analysis would have to be compared with a series of non-female associated artefacts, which should not demonstrate the same localized patterning of stylistic traits (Hill 1970:38). If spatial variation was demonstrable over the site, it would still have to be shown that the spatial units so defined were functionally equivalent, rather than representing different activity areas, in which characteristic forms of pottery might easily be employed.

At the Carter Ranch, 175 design elements of pottery were found to have a non-random distribution across the site. Moreover, particular design elements appeared to cluster in contiguous groups of rooms. The results of the investigation of design

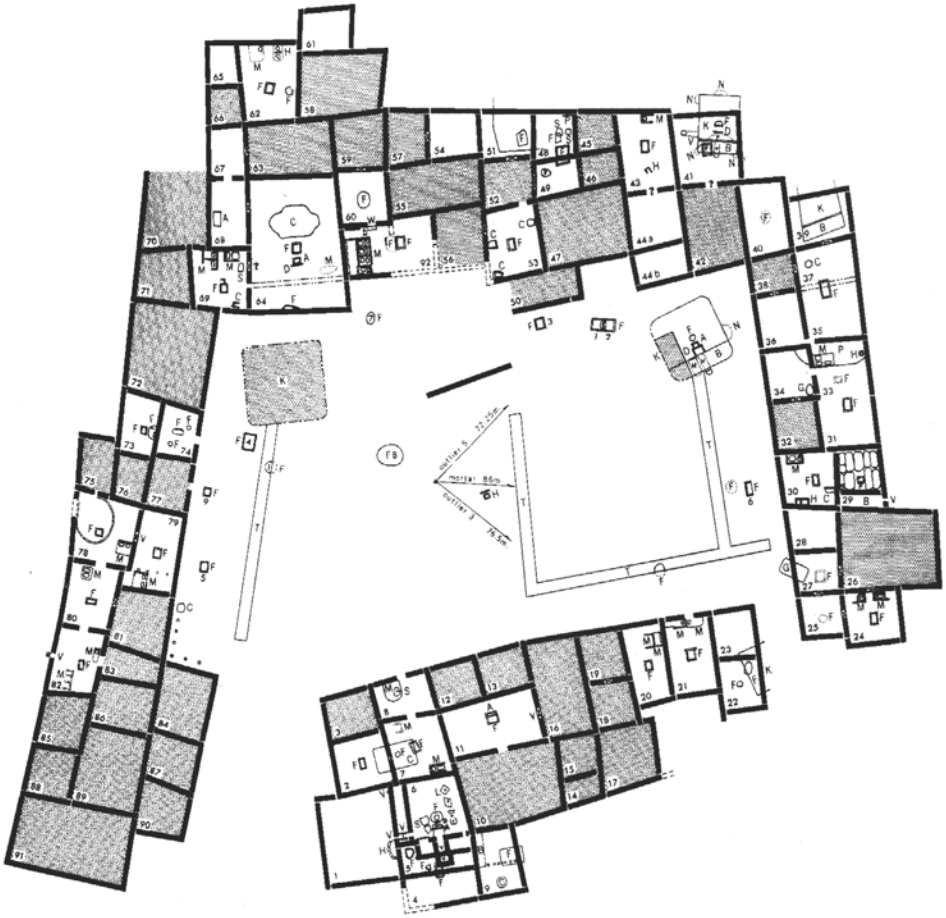

Figure 11.5 Plan of Broken K Pueblo, east-central Arizona. Reproduced with permission of The Field Museum of Natural History, Neg#A99799, Chicago.

structure were then subjected to a multiple regression analysis, which in turn suggested that three major groupings of rooms could be distinguished on stylistic criteria. Each of these groups was associated with a particular *kiva*, or ritual structure, and ceramics recovered in the cemetery associated with the settlement could be linked with the individual groups (Longacre 1964:1455). The results thus appeared to be consistent with the model of developing microtraditions of style in potting, each associated with a particular matrilineage. While the Deetz/ Longacre/ Hill model was originally developed at the microspatial scale, later applications considered its implications at the inter-community level: using very much the same kinds of decorative and other stylistic traits, the attempt was made to measure the degree of similarity between different sites, based upon the supposition that the degree of similarity is a direct product of the intensity of interaction between communities (Plog 1978).

On more sober reflection, some of the enthusiasm for 'ceramic sociology' in the 1960s came to be thought of as misplaced. While the analyses were framed as testable hypotheses in true positivist style, many of the law-like statements thereby generated rested upon a complex series of assumptions. In consequence, while the outcome of the empirical test on the evidence might be favourable, an enormous problem of 'equifinality' remained: that is to say, so much had to be assumed before the analysis could proceed that the results might be generated by a number of different processes which were not accounted for in the hypothesis. Some of the complexities of these processes began to emerge as time went on. For instance, it was evident that across the present-day Southwest neither kinship systems nor the mechanisms by which the skills of potting were passed on were as standardized as had been assumed (Stanislawski 1973). Similarly, there was considerable evidence that pottery had been exchanged over large distances, and while this might constitute interaction it certainly would not result in the clear-cut stylistic consequences of intermarriage between communities. Finally, as Plog (1978) points out, the whole approach was somewhat innocent of the processes by which the archaeological record is formed. There is no guarantee, for instance, that pots will enter the archaeological context in the same spatial location in which they were either made or used, and a distinction needs to be made between those vessels recovered in circumstances which suggest use within a particular room and more generalized demolition spreads. But beyond these procedural and empirical concerns it can also be objected that such an approach to artefact style neglected both the social processes which lay behind the production of material culture and the specificity of the cultural context, in the desire to erect global generalizations concerning stylistic behaviour (Shanks and Tilley 1987:89).

STYLE, INFORMATION AND IDENTITY: SACKETT AND WIESSNER

Binford's original discussion of a systemic approach to material culture had left the issue of style somewhat open. Technomic, ideotechnic and sociotechnic artefacts all had primary attributes which distinctively engaged them in a particular sphere of practice. However, there were particular formal characteristics of artefacts which existed over and beyond that which could be related directly to variability in the technological or social sub-systems, or in the nature of raw materials (Binford 1962:219).

> These formal qualities are believed to have their primary functional context in providing a symbolically diverse yet pervasive artefactual environment promoting group solidarity

> and serving as a basis for group awareness and identity. This pansystemic set of symbols is the milieu of enculturation and a basis for the recognition of social distinctiveness. (Binford 1962:219)

Binford's conception of style at this stage was one which presented it as that element of culture which is left over as a residue, once its prime adaptive significance has been exhausted. As the Deetz/Hill/Longacre argument demonstrates, this leaves some degree of uncertainty regarding the mechanisms through which style operates. At what level does style guarantee group affiliation?

One answer to this problem is provided by Wobst (1977), who suggests that style, rather than being a necessarily integrative mechanism, functions as a means of transmitting information. The character of the message transmitted, and the medium through which it is expressed, will depend upon the social distance between the sender and their target population. Thus any or all items of material culture may contain coded messages in the form of stylistic variation, yet different aspects of the total cultural repertoire will be active in different forms and levels of social interaction. Moreover, it will generally be the case that, within any definable social unit, common encoding and decoding strategies will exist, and that common responses will be elicited by given stylistic elements (Conkey 1978:64). Wobst's and Conkey's arguments open the way for a broader discussion of the ways in which style can operate at different levels and in different contexts. Such a discussion can be found in the ongoing exchange between James Sackett and Polly Wiessner.

Interestingly, the debate has its origins with the question of Mousterian variability. Reviewing the issues which had been drawn out of the Binford/Bordes dialogue, Sackett (1973:320) sought to clarify issues by drawing a distinction between the *functional mode* and the *stylistic mode* of a given artefact. These refer to the respective roles of the artefact in technical operation and as an indicator of cultural tradition. The stylistic mode will potentially be present in all archaeologically recovered artefacts, since it is highly likely that something which could fulfil the same function could be made in a different way. Stylistic variation thus exists between artefacts which are 'equal in use', or as he later termed it, 'isochrestic' (Sackett 1986:268). The particular stylistic variation which the artefact will assume is determined by a given historical and cultural setting, such that objects will tend to fit into traditions of manufacture. 'Thus any statement which concerns the manner in which artefact variability is symptomatic of tradition is by definition a stylistic statement' (Sackett 1973:321). These traditions of isochrestic variation are not generated in any conscious way, but are the consequence of picking up the techniques of manufacture for an artefact in a particular context. While people may be perfectly able to identify the workmanship of another community, this may not be through distinct features which they could easily verbalize. On the contrary, the bulk of the information which we can potentially use to detect ethnic groups in the archaeological record is not so much actively encoded as inculcated (Sackett 1986:268). The element of stylistic variability which Sackett calls 'iconic', which knowingly symbolizes and asserts group identity, he considers to be extremely rare.

It is with this last part of Sackett's argument that Wiessner takes issue. In a way which is closer to the arguments of Wobst and Conkey, she argues that agents can actively manipulate the signifying capacity of material culture in such a way as to elicit a desired response from a defined audience (Wiessner 1984:193). In particular, style is seen as a means by which the relationship between the person and society may be mediated (Wiessner 1989:59). Stylistic variability is thus taken to be representative of a universal human cognitive process—that of social identification through comparison: 'style is one of several means of communication through which people negotiate their personal identity *vis-à-vis* others' (Wiessner 1989:57). Accordingly, archaeologists might conceivably make use of style as a means of monitoring changes in the relationship between individual and society across time. Using her ethnoarchaeological studies of the Kalahari San, Wiessner argued further that different forms of stylistic behaviour could be defined, which have different aims. Where stylistic attributes refer primarily to the self, and are used by the individual as a means of articulating personal identity within the community, style is being used 'assertively'. This, claims Wiessner, is the case with the bead headbands worn by San women (1984:193). On the other hand, where stylistic variation is used as a means of signalling group or ethnic affiliation, one is dealing with 'emblemic' style. Wiessner's example of emblemic style is the projectile points of the San which, while small, are widely exchanged, such that persons will be very aware of the origin of a projectile within a particular community (Wiessner 1983).

While Sackett and Wiessner appear on the surface to be arguing from irreconcilable points of view, at another level of generality their positions are not so far different. Both appear to accept a distinction between stylistic traits which are invested in material items in an unconsidered manner, simply because this is 'the way of doing things', and a more active encoding of messages. Their argument is really one concerning human nature, and the extent to which people routinely conceptualize and account for their actions.

FROM FUNCTIONALISM TO STRUCTURALISM: HODDER

> Suppose we have a virilocal residence situation in which the women who are 'marrying in' alter their pottery-making and other styles to conform to those of their mothers-in-law and sisters-in-law! The question is, will a woman in this situation abandon the kinds of style elements she learned in her natal household and adopt new ones to conform to those of her new household?
>
> (Hill 1970:41)

> So, whatever a woman may feel she really is, she can outwardly express different identities, and there is rarely any ambiguity about which identity she is overtly expressing at any one time.
>
> (Hodder 1982a:21)

In Britain, the decisive move away from organic and functionalist models of culture arose from the vacuum left behind by the demise of the 'culture concept'. Neither Clarke's purely 'archaeological' reformulation of culture systems, nor the agenda concerned with stylistic interaction and information exchange, appeared able to account satisfactorily for the entities which formed the backbone of European prehistory. The rootedness of archaeological thought in a notion of geographical areas characterized by co-variant material culture traits rebelled against these formalizations, yet a return to a normative conception of culture was impossible. The sense of unease which this situation produced is well captured in Ian Hodder's 1978 collection of essays, *The Spatial Organisation of Culture* (Hodder 1978a). The volume contained articles qualifying or expressing grave doubts concerning both the traditional archaeological culture (Shennan 1978) and the Deetz/Hill/ Longacre model of stylistic learning mechanisms (Stanislawski and Stanislawski 1978). Perhaps most interesting of all are Hodder's own contributions, which review 'simple correlations between material culture and society', concluding that some material traits form bounded spatial entities equivalent to the Childean culture, but that others do not. Compounding this uncertainty was the observation by Hodder and Orton (1976) that 'random association groups' of traits might produce entirely arbitrary 'cultures' of no empirical validity whatsoever. Hodder's initial response to this state of affairs was to invoke a closer scrutiny of the social processes which lie behind the distribution and mutual association of artefact types. The first results were speculative rather than conclusive (Hodder 1978b).

It was this concern for the status of the material culture as a heuristic entity which led Hodder to undertake a series of ethnoarchaeological studies in East Africa, eventually reported as *Symbols in Action* (Hodder 1982a). The most sustained example within the book concerns the Pokot, Njemps and Tugen tribes of the Lake Baringo area of Kenya. Questionnaire survey and itineraries of artefacts within hut compounds demonstrated both that the three groups were very aware of their separate identities (Fig. 11.6), and that various types of item showed quite abrupt breaks of distribution at tribal borders (Fig. 11.7). Identification with the tribe was clearly demonstrated in dress, and in particular in the wearing of pendant ear decoration by the women. Particular kinds of pottery, wooden stools, and even the positions of hearths within huts, were also specific to particular tribes. Moreover, verbal testimony made it clear that these preferences were not merely the consequence of unconsidered action, but that these items were perceived as bound up with tribal identity.

The recognition that the maintenance of these boundaries was most marked in locations where there was a particular stress on material resources led Hodder to

Figure 11.6 Artefacts from a Tugen compound, as recorded in Hodder's survey of material culture in the Lake Baringo area. Source: Hodder 1982.

formulate an initial interpretation of these phenomena in processual and adaptive terms (Hodder 1979). Thus boundary maintenance through material expression might be linked in a lawlike manner to the severity of resource competition. The rejection of this relatively formal and generalized explanation appears to have emerged from a combination of attention to the detail of the study material and a developing critique of functionalist models of culture. This latter Hodder (1981, 1982b) clearly saw as the prerequisite for the emergence of a mature social archaeology. Hodder advocated the adoption of a quasi-structuralist notion of deep structure, covering the rules and codes which underlie the surface phenomena of social life or of archaeological evidence (Hodder 1982b:7). None the less, he recognized the lack of a concern with agency within structuralism, and derived from Giddens (1979) the understanding that active human agents transform generative cultural structures through their social practice (Hodder 1982b:8).

In the light of these considerations, a more complex and context-specific account of boundary maintenance was possible. One significant factor was the comparative ease with which persons could move from one tribal area to another, adopting the dress and material culture of the local group and thereby becoming affiliated to that identity. Clearly, what was taking place was quite distinct from the culture-historic view that material culture passively reflected the accepted norms of a society. In the Baringo area, people were quite aware of the potential of things outwardly

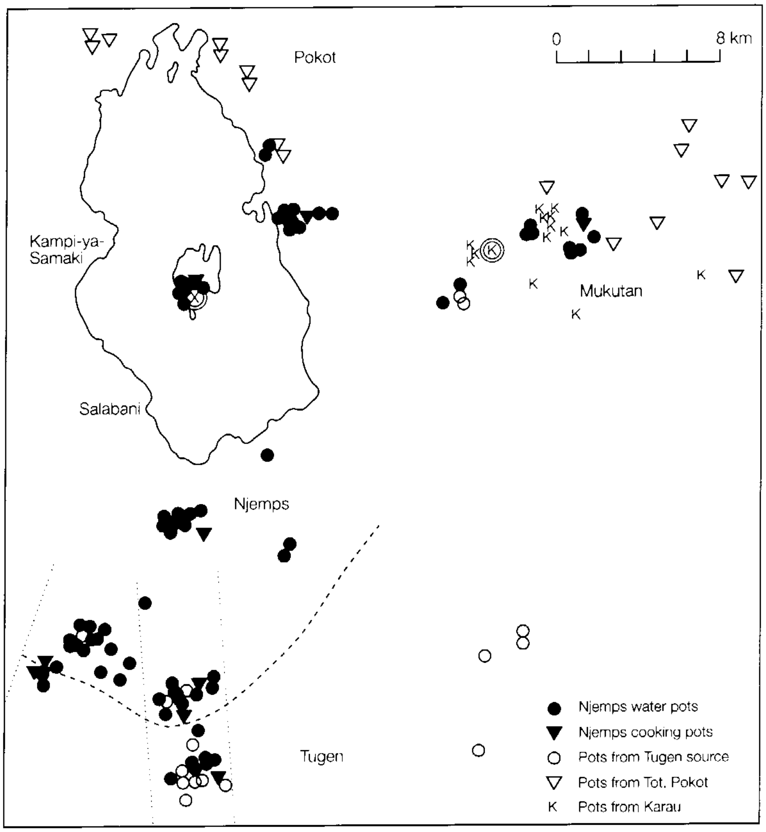

Figure 11.7 Distribution of pottery types in the Lake Baringo area; double circles enclose the potters at Karau (K) and Kokwa (X). Source: Hodder 1982.

to express particular identities, irrespective of whatever ethnic group they might feel themselves to belong to (Hodder 1982a:21). The explanation offered for these phenomena still concerned conflict and competition for resources, but the particular mechanisms involved were contingent ones. The positive adoption of the material trappings of an ethnic identity allowed people to be recognized as eligible for the support and protection of the *moran,* or young spear-carrying men, of a particular tribe. This support was at more of a premium in areas where disputes over property were most likely to occur, and hence it would be in these areas that group identity would be most unambiguous (Hodder 1982a:31). That this process was not limited to the unconsidered action of making particular objects in particular ways is evident from the marked preferences which particular tribal groups showed for types of items acquired from a distance. Stools and pots of particular patterns, although made by persons from different ethnic groups, were none the less held to symbolize particular attributes of affiliation to a given identity (Hodder 1982a:54).

Another point at which the Baringo material challenged both normative and functionalist models of culture was found in the way that not all traits conformed to tribal boundaries in their distribution: these were not simply neutral or null traits without symbolic significance; on the contrary, they demonstrated that cultural entities could not be considered as undivided totalities. Two particular cases are of note. First, the *moran* in each tribe use spears which are quite similar in general style (Hodder 1982a:65). The spear is not necessarily the most effective weapon either for hunting or for warfare, and at marriage it is replaced as a ubiquitous male item by a carved stick. Spears and sticks respectively are symbols of young and elder male status or identity, carrying connotations of sexual prowess or of the prerogative to speak in public. Since the spear symbolism works at a tangent to group affiliation, its variability is not distributed spatially in the same way. Indeed, the way in which the *moran* of the Tugen and the Njemps carry similar spears refers in an implicit and non-verbal way to a degree of solidarity between all young men, who consider themselves collectively to be exploited by the elders. The symbolism of spears is thus a means of expressing a degree of resistance against this state of affairs. In the same way, the calabashes which women use as containers for milk provide 'a medium for silent discourse between women' (Hodder 1982a:69). In areas like the decoration of pottery and their own dress, Njemps and Tugen women conform closely to norms which have been set for them by a male-dominated society. Calabashes, however, represent a field for decorative traits controlled and executed entirely by women: they both comment on and express covert resistance against that society by referencing ties of birth and marriage which extend beyond ethnic borders.

Symbols in Action provided the stimulus for a rethinking of the archaeological understanding of culture, since its evidence would not accord with the precepts of either traditional culture history or the Binfordian model of culture as adaptive strategy. Most significantly, it killed off any lingering impression that a fixed relationship could obtain between social form and material expression. Rather, people knowledgeably constructed identities for themselves using material culture as a medium. Culture was not a superorganic intelligence, working 'behind the backs' of people to enable the adaptation of the group, but a set of affordances passed down by past generations with which people worked. Since these affordances were at any given point the result of a particular trajectory of development, and since they provided the context for human actions which could change the cultural heritage to be passed on to the next generation, the approach came to stress historicity. From a generalizing and law-seeking functionalism, archaeology had moved at a stroke to a (broadly) post-structuralist historical particularism.

POST-STRUCTURALIST AND HERMENEUTIC VIEWS OF CULTURE

What had effectively emerged by the middle of the 1980s was a conflict over the way in which the archaeological record was to be conceptualized. As Patrik (1985) indicates, processual archaeology had represented archaeological materials as being the equivalent of a fossil record, a physical imprint of past patterns of behaviour. By contrast, the emerging tradition of symbolic and structural archaeologies had come to think of material traces as encoded with meaning, and as part of the symbolic construction of personal and group identity. In consequence, the archaeological record was conceived of as being something like a text. Increasingly, the implications of this point of view began to be worked through, and a series of sources within the literary humanities started to be drawn upon in order to enrich the study of material culture. It is important to point out that these approaches were by no means homogeneous, and could lead in very different directions. In particular, we might point to the distinct influences which were exerted by post-structuralism and hermeneutics, and the resulting rather different ways in which the use of culture by human beings was considered.

Hermeneutic approaches stress the way in which meaning is unfolded out of a text through a gradual process of interpretation, and have a lineage which stretches back through German historiography and biblical exegesis. It is central to the hermeneutic standpoint that symbols require interpretation: the reader actively produces a meaning from a text by engaging with it in an act of reading (Moore 1990; Warnke 1987). It is not the case that one simply extracts a meaning which is locked within a text: the reader actively constructs an interpretation for himself/herself (Outhwaite 1985). There is consequently no guarantee that the reader's meaning will correspond with that which was intended by the author. The text escapes the author, and things can be read into it which he or she never intended. The attempt to understand what the author intended in writing cannot come from the text alone, but from a 'fusion of horizons', a recognition of the author's context and attitude (Gadamer 1975). Even then, the interpretation can scarcely correspond entirely with the author's meaning, and interpretation comes to be seen as an endless work of refinement and checking: the 'hermeneutic circle'. Ricoeur (1981) has suggested that the distinguishing feature of a text is that it takes discourse and fixes it, giving it a stable form which can be interrogated in the absence of the author. None the less, he also indicates that the methodology of text-interpretation can be applied in a wider variety of contexts within the human sciences, where purposeful human action is regarded as the equivalent of a text. The potential of this proposition was perhaps demonstrated most strikingly by Moore in her study of the contemporary Marakwet of Kenya (1986). Moore presents a picture in which human existence can be compared to a continuous process of reading and writing, where bodily movement through culturally encoded spaces both draws on and recreates their meaning, a meaning which is nevertheless created by the agent and which as a result may vary from person to person.

It was a not dissimilar notion of culture as text which Hodder adopted in the mid-1980s and combined with a stress on the active human subject in order to develop a post-processual, contextual archaeology (Hodder 1985, 1986). If the meaning of material culture was not fixed, and was open to interpretation, then in order for communication to take place at all the significance of symbols would have to be negotiated between persons (Hodder 1988). By 'reading' the meaning of artefacts and at the same time 'rewriting' their significance, human beings were depicted as constantly redefining their position in the world. Cultural meaning is therefore based in interpretation, although Hodder was at pains to stress that the significance of objects is not entirely arbitrary. Material things always have a context of use and an everyday significance, upon which secondary and connotative meanings may be built up (Hodder 1989). Moreover, the attribution of significance to a symbol was held to be contextual, so that how an object was interpreted might depend upon the other items with which it was associated: Hodder gives the example of a safety pin, which 'means' different things when attached to a baby's nappy or a punk's leather jacket (Hodder 1985).

This emphasis on the role of agents as building culture through interpretation is one which fits with a growing awareness of ethnicity as not so much an objective fact as a subjective attribution (Shennan 1989b). The implications of a more fluid conception of ethnicity are brought out by the plight of the Mashpee Wampanoag, a Native American group whose status of an identifiable bounded community had evidently waxed and waned historically (Clifford 1988:336). Yet in order to claim ancestral lands in court, the Wampanoag had been required to demonstrate an authentic and constant identity since pre-colonial times. But beyond this, a concern with the ways in which human subjects are differentially positioned culturally articulates with a growing archaeological interest in gender issues (Gero and Conkey 1991). This is an area too vast and important to be done justice here, but we might mention Judith Butler's (1993) discussion of the way in which sexed identities are created and continually reinforced through bodily performance, a process in which material culture might be expected to be implicated (and see also the discussion of gender in Chapter 12). On the basis of Hodder's arguments, the task of the archaeologist now came to be redefined as one of 'reading the past', building up patterns of association and contextual location which to an extent parallel the process of reading on the part of the native. Here again there is a parallel with Gadamer's hermeneutics, in the attempt to work towards an interpretation which approximates to that of people in the past.

It is perhaps more difficult adequately to express the content of post-structuralist theories of culture, so diverse are the approaches which might be grouped under that rubric. If we confine ourselves to the notion of text, quite a different way of thinking about material culture can be derived from the approaches to signs taken by the likes of Jacques Derrida and Roland Barthes. Derrida, for instance, elaborated upon Saussure's argument that a language or sign-system is structured not by relationships between things and signifiers (words, symbols) but by relationships internal to language itself, to argue that the circulation of signs endlessly delays any direct encounter with the signified concept or object (Derrida 1986). Language is slippery and impossible to pin down, so each signifier does not lead us to a full grasp of what is being said, but to other signifiers which explode out endlessly. Language is therefore not a set of labels which relate to things in a straightforward, one-to-one way, but is composed of limitless chains of signification. Similarly, Barthes points out that endless meanings can be drawn out of a single text, since any set of words is networked in innumerable ways to other texts, concepts and events. A text is a site of production where a reader labours to produce a meaning for him or herself, *working* the language in order to bring about signification (Barthes 1981). These perspectives would deny the existence of any founding meaning hovering in the shadows behind any text, which one has to uncover through analysis. While an author may have assembled a set of signifiers in a particular way, there is no reason to suspect that he or she had a more perfect understanding of what (s)he was trying to say (but failing) than does the reader. No deeper truth is locked inside the text, and no empathy with the author will lead us to a 'correct' reading.

Applied to material culture, these ideas produce a strikingly different understanding. Material things are seen as having a symbolic content which signifies, which can be worked like language to produce meaning. Like language, material symbols are networked to each other, by connotation and metaphor. As Hodder suggests, context is of central importance, but juxtaposition does not so much tie down the meaning of an object as allow new meanings to be elicited from it. Meaning is potentially limitless, and culture as a whole can be conceived as a vast web of interconnected signifiers (Shanks and Tilley 1987). Moreover, it is not merely the case that human beings make use of material things to negotiate their social position. Neither persons nor things spring into the world fully formed and without precedent. Rather, both people and material culture are the products of the continuous process by which society renews itself (Barrett 1987; Shanks and Tilley 1987). Society is reproduced by people carrying forward the order and values of past generations, and the production, maintenance, and persistence of objects is central to this: a society exists *through* material culture (Miller 1987). Moreover, human beings do not simply take up culture in order strategically to alter or maintain their position within society. It is impossible for any human subject to gain a sense of identity without first inserting himself/herself into culture and language (Lacan 1977).

In several respects, a perspective informed by both hermeneutics *and* post-structuralism requires a radical rethinking of the practice of archaeology. First, the degree to which society, personal identity, and material culture are inextricably bound up makes the whole notion of an 'archaeological record' difficult to sustain. It is not the case that societies or people move through time spewing out material culture like a trail behind them. Rather, the whole material world, natural and cultural, represents a set of resources which are constantly encountered, interpreted, encoded and transformed by human beings. Thus, as Barrett (1988) suggests, archaeological traces are not so much a 'record', a blueprint of past social relations, as *evidence for* past processes of social reproduction. The web of signification and meaning was one within which people gained their identities as human subjects and struggled through their existence. Second, if we come to recognize that our reading of these traces is most unlikely to map directly onto a past understanding of the world, and that it represents a labour in itself, the emphasis shifts from *reading* to *writing* the past. This is not a case of passively allowing the remains to 'speak' to us of the past: it is an active production which is of and for the present.

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As this chapter has hoped to demonstrate, archaeological understandings of culture have been varied and contradictory, so that some breadth of reading is needed to gain a sense of the diversity. Trigger (1989) can be recommended as an overview of the issues concerned, while Harris (1969) provides a wide-ranging if partisan introduction to the anthropological background. Childe (1950), Binford (1962, 1965), Hodder (1978a, 1986) and Barrett (1988) can be taken as statements characteristic of different stages in the development of the debate. The contemporary political significance of ethnic interpretations of past identities is well covered by papers in Shennan (1989b), Graves-Brown *et al.* (1995) and Champion and Diaz-Andreu (1995). The implications of the arguments for gender identities have barely been touched on here, and the reader is referred to Gero and Conkey (1991) as a first step in this direction.

12

THE ORGANIZATION OF SOCIETY

Chris Gosden

INTRODUCTION

The notion of social organization refers to the form, structure and pattern of relationships of people within society, which can include the interweaving of institutions, economic structures, familial or kin organization and position of a local group within the world system existing at the time. One of the most contentious questions asked by archaeologists has been 'what sorts of social forms existed in the past?' This question has been linked to the more pessimistic query 'can we understand past societies on the basis of archaeological evidence?' The fact that no convincing answers exist for either of these questions provides this chapter with a structure. My aim here is to provide an outline of the debates that are taking place at present within archaeology as to our understanding of past social forms and to sketch their historical genesis. I shall divide approaches into four: culture history; functionalist/ evolutionary approaches (also known as processual archaeology); Marxist views; and the post-processual/hermeneutic stance (hermeneutics being the study of meaning or interpretation). This division necessitates an exaggeration of the differences between views which overlap on some points, but it will serve to give the flavour of present disagreements.

The term 'social organization' is questionable. Culture historians have often had little use for a general concept such as social organization, preferring to concentrate on the specifics of local cultural form and sequence as they arise from ethnic affinities or diffusion from neighbouring groups. Functionalists spend much time attempting to define sub-systems within society and to measure the nature of their interrelations; such an analytical stance splits the social world in order to see how it fits together, facing the obvious objection that it is the analyst who does the splitting. Marxists employ the idea of social organization, whilst being wary of its mechanistic overtones: power is central, and many positions of power are defined in relation to people's access to the means of production, whether this access is structured through class or kinship networks. Hermeneutic approaches see social forms as symbolic structures which cannot be split into well-defined parts, reacting to the attempts of the analytical method to divide the world and to the feeling that terms like organization make us see society as a mechanism with certain ends or functions, rather than a symbolic structure which creates meanings by which people can live. They highlight the ways in which power relations derive from and make use of differences of gender, age and class in the field of social conflict.

Running parallel with the different views on the nature of society are varying views on social change. Functionalism, Marxism and culture history have a tendency to see change as directional, moving from simple to complex forms of organization. This may be framed in progressive terms, where it is said that complexity is in some ways superior to simplicity: complex societies have greater capacity to process energy or more efficient structures of administration. Or change may simply be seen as teleological: history has of necessity to move from clan- to class-based systems. The notion of prehistory as charting the nature of growth and complexity has come under fire, often by those with hermeneutic interests. Complexity is often judged by our standards, focusing on a greater technological capacity, a greater number of divisions and ranks of society and a greater specialization of tasks. Durkheim's use of an organic analogy underlies much of this thought (Giddens 1978): this compares biological evolution from single-celled organisms to creatures like ourselves with multiple organs with particular functions, to the movement from hunter-gatherer to state systems. The use of the organic analogy, however, ignores the fact that societies may be complex in different ways. Australian aboriginal groups have extremely restricted forms of material culture, but a huge profileration of kinship and ritual knowledge. If modern-day Sydney were compared to Arnhem Land groups on the basis of complexity of ritual knowledge or kin links there is no doubt which society would look simple and which complex!

Criticism of the teleological structure of much of the argument about past social change (teleological in the sense of history being drawn towards a particular end state) has been extremely useful in opening up the parameters by which we try to understand past societies. But it must also be said that the 'onwards and upwards' view of human prehistory did provide a coherent narrative structure through which to tell the story of the past. In its absence, there is considerable experiment in our approach to past social forms, but no new coherent directions have emerged to replace the old framework.

In addition to the model of society they employ and the view of social change, each approach to past social structure must also look at the nature of the analogies they use between present and past social forms. Here the relationship between archaeology and anthropology is crucial. Over the last 150 years archaeology has drawn upon the findings and approaches within social anthropology and this still continues today. Thus culture history is closely allied to an ethnology which collated information on cultural differences and probed local sequences of change. Functionalism drew on both British social anthropology of the 1920s and 1930s, where Malinowski and Radcliffe-Brown hammered out much of the intellectual apparatus of functionalism, as well as on the evolutionary writings of Leslie White in America (Kuper 1996; Stocking 1987). Hermeneutic views of society are closely modelled on a recent turn to symbolic anthropology. Marxism obviously takes a framework from Marx and Engels but blends this with the work of Morgan, who himself influenced Marx, and French Marxist anthropologists such as Meillassoux, Terray and Godelier (Seddon 1978).

Criticism is necessary not just of the biases of these anthropological sources of inspiration, but also of the special problems with the nature of the archaeological data. The first and foremost of these is the chronological grain of archaeological evidence. For much of prehistory, our minimum unit of analysis is a century, or four human generations, given the imprecision of the radio-carbon method. For the Palaeolithic, we may not be able to define periods of less than one or several millennia (see Chapter 5). Such broad spans of time bring the whole notion of society into question and make it certain that we cannot tackle social structure and change in the same manner as an anthropologist can. Thus we must include in any discussion of past society the differences between anthropological and archaeological data and the re-ordering of our conceptual apparatus that these differences necessitate. Bearing this in mind I shall first present a more detailed discussion of each of the four approaches to past societies, before going on to consider the problems of analogies between past and present and the differences in the nature of archaeological and anthropological data. This general discussion will be followed by examples of particular approaches to past societies which will be used to discuss the larger issues in a more detailed context.

CULTURE HISTORY

In many ways the approach which emphasizes culture history has the least explicit theoretical structure and the least well-defined discussion of the nature of society and social change. The lack of self-consciousness of culture historians derives partly from the fact that this stance was seen to derive out of commonsense views of the world and the division of human diversity into groups and areas. Culture history as found in archaeology is closely connected with ethnology, which from the nineteenth century onwards was concerned with the classification of different groups, customs and material culture known from travellers' tales and the accounts of missionaries and colonial officers. Culture history was both an attempt at classifying cultural and ethnic groups and an emphasis on local historical circumstances in the generation of social forms. Although linked with diffusion as an agent of social change, much change was seen to be generated locally and to have given life a regional flavour overwhelming broader similarities of social groups over space and time. Culture history was thus opposed to comparative studies stressing similarities in the social process over broad areas and time periods.

Gordon Childe was responsible for the most sensitive and directed handling of culture history. In the absence of absolute dating methods, Childe built on the typological schemes of Montelius in order to bring out and order spatial and temporal differences in the archaeological evidence from Europe. These spatial and temporal differences were indications of archaeological cultures, which Childe defined as 'certain types of remains—pots, implements, ornaments, burial rites, house forms—constantly recurring together' (Childe 1929:v–vi). The geographical extent and duration of these cultures had to be established empirically by means of stratigraphy, seriation and controlled comparison (Fig. 12.1). Furthermore, Childe argued that only a small range of artefacts was suitably sensitive to change to be useful in these comparisons. Locally made pots, ornaments and burial rites derived from local tastes were resistant to change. They were consequently useful for defining local cultural groups. Utilitarian items such as tools and weapons diffused rapidly from one group to another if they represented an improvement on previous technologies. The widespread diffusion of utilitarian items provided the means for broad chronological comparisons which created cultural chronologies prior to the invention of radio-carbon dating.

As his career progressed, Childe moved away from the cataloguing of material culture and became more interested in the distinctive features of local sequences and the historical reasons underlying local differences. In particular, he attempted to account for the different destinies of Europe and the Near East (Childe 1928, 1930). Whereas the Near Eastern centres in Mesopotamia and Egypt had enjoyed a head start on their European counterparts in that they had developed farming, pottery, and metallurgy first, along with a political organization based around the state, it was Europe that had been first to the Industrial Revolution. Others, such as Kossinna, working with the concept of archaeological cultures, had ascribed these different histories to properties of blood or spirit: it was the natural energy of the European Aryans that had led them to build on the initial advances of the Semites (Trigger 1989:163–67). Explanations with such racist overtones were abhorrent to Childe, who looked for the answer in the social structure of the respective areas.

Childe saw the development of agriculture in the Fertile Crescent as a crucial turning point in human history. On the basis of the Neolithic Revolution here, he argued, surplus production increased faster than the population and led to a concentration of political power, the rise of city life and progress in industry.

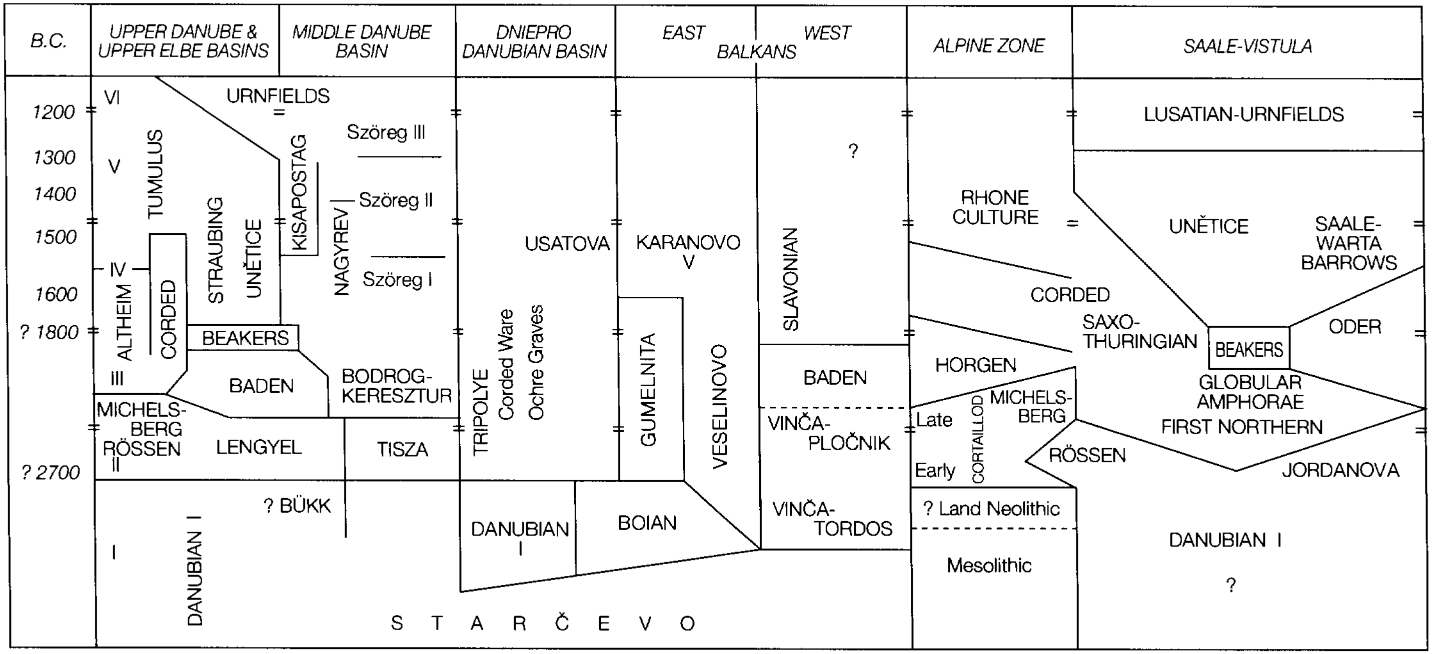


Figure 12.1 An example of Childe's regional cultural sequences. Source: Childe 1957.

Technological knowledge, such as metallurgy, then spread to outlying regions such as Europe as the result of trading surplus food and finished artefacts for raw materials (Childe 1928). Once in Europe, bronze technologies were seen to be undertaken by full-time craftsmen, operating outside the bounds of kinship groups. The smiths, as relatively free agents, broke down previous forms of self-sufficiency and set up long-distance trading networks of raw materials and finished products across Europe. This led to the growth of societies in Europe which were structurally different from those in the Near East. In the latter region the industrial process was directly controlled by the upper classes and much of the product was wasted in conspicuous consumption or military conflict; also, demand for raw materials in surrounding areas reduced the amounts reaching the higher centres. By contrast, in Europe industrial crafts were operated outside the bounds of kinship and individual groups and this encouraged inventiveness and an individual spirit. The looser structure of Europe, not dominated by a theocratic élite, led to continual change and the sturdy individualism in which the Industrial Revolution was eventually grounded (Childe 1930).

I have outlined Childe's ideas in some detail as they are crucial to our understanding of the topic of social organization. Although I have included Childe's work under the heading of culture history, his ideas span pretty well all the approaches I have outlined above. The following features of Childe's scheme are of particular note: although he started off trying to account for the peculiarities of societies localized in time and space, Childe soon moved to broader explanatory frameworks. Basic to these are the three revolutions in productive capacity and social form: the agricultural, the urban and the industrial. Each was predicated on the former, such that city life could only come about once agricultural surpluses enabled some people to live without farming and industrial production developed through the spur to invention provided by city life.

Although Childe felt it necessary to recognize these broad processes at work in the world, he was also sensitive to local time and place, teasing out what was special about Europe. This sensitivity to local conditions and developments derived from Childe's early interest in culture history and is seen by many today as the strongest feature of the cultural historical approach (see Hodder 1986). In his recognition of broad social processes, Childe comes close to more recent processualist and Marxist views on the movement from kin-based to class-based societies, whilst his emphasis on local change and meanings bears comparison with some aspects of the post-processualist approach. The wide span of interests and subsequent influences exercised by Childe makes him a central figure (even *the* central figure, perhaps) in approaches to past society.

Culture history is still the most common mode of archaeology world-wide, concentrating as it does on local social features, whether these be of Slavic groups (Sklenár 1983) or the Polynesians (Bellwood 1980). This popularity is likely to increase with the rise of micro-nationalism in various parts of the world. Although out of favour with elements of archaeology more orientated towards theory, the interest in local distinctiveness and sequence found in culture history may well marry together with recent interests in the links between material culture and ethnicity and the so-called 'contextual archaeology' as developed by Hodder (1986).

FUNCTIONALIST AND EVOLUTIONARY APPROACHES TO SOCIETY

Functionalism and an interest in evolution are not necessarily connected, although over the last forty years in archaeology they have tended to be. Of the two, the evolutionary view is the older approach, going back to the middle of the nineteenth century. Indeed, Childe saw his initial moves towards culture history as a reaction against an older evolutionary view; the development of the notion of culture was closely connected with a view of change based around evolution. The nineteenth-century background needs to be taken into account before we can understand more recent developments.

By the 1860s and 1870s, two sets of influences were developing which helped shape travellers' tales into a nascent ethnography and which from there influenced archaeology. The first was a concept of culture, given one of its clearest expressions by Edward Tylor. The notion of culture was used to tease out general features of all societies which could then be used for comparison between various times and places. 'Culture, or Civilization, taken in its widest ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society' (Tylor 1871: 1). Culture could be investigated on general principles which would reveal laws of human habit and thought. What is most notable about Tylor's use of the term 'culture' is that he always used it in the singular, never in its plural form. Culture was something that all human groups had, although they did not all have it in equal measure: this becomes more obvious when we realize that 'culture' and 'civilization' were equivalent terms for Tylor, some peoples being more civilized than others. The degree of culture could be measured along a scale that ran from savage to civilized:

> the educated world of Europe and America practically settles a standard by simply placing its own nations at one end of the social series and savage tribes at the other, arranging the rest of mankind between these limits according to how they correspond more closely to savage or to cultured life.
>
> (Tylor 1871:23)

The classification as to high or low development depended first of all on technology and practical knowledge, as well as on the firmness of moral principles and the degree of social organization. It was thus possible to arrive at a ranking of types of society—Australian, Tahitian, Aztec, Chinese, Italian, to use examples Tylor cited— that no one could dispute. Such classifications were not simply of present utility, but could also be used to order the past. By assuming an unchangeable human nature, all social forms from all times and places could be placed in their rank—and judged as to how far they fell short of the Anglo-Saxon pinnacle!

The general notion of social progression evidenced in the work of Tylor was combined by the anthropologist Morgan with more specific ideas on social evolution which took their overall inspiration from Darwin. In his most general work, *Ancient Society* (1877), he presented a historical scheme for social change which ran from savagery to civilization. He divided this history into two lines: that of inventions and discoveries, which was a cumulative history, each age building on the last; and that of institutions, in which change unfolded rather than accumulated. These two lines of history were linked and mutually supporting. As far as institutions were concerned, Morgan made another twofold division between the *gens,* in which personal ties of blood and marriage predominated, and political society, which was founded on territory and property rather than on personal relations. This division between kinship and civil society still provides a framework for understanding change to this day and much recent discussion of the growth of the state focuses on the breakdown of kin-based society.

Morgan combined information from ethnography and historical sources to come up with a global scheme of human change, based on the notion that so-called savage groups around the world preserved in their social forms previous stages in the progressive history of humanity. The very earliest stages of people's spread across the globe were not thought to be preserved today, but there were many examples of a savage way of life. Savages lacked pottery and, by implication, the settled village life which brought progress in the simple arts. Australian aborigines and the Athabascan tribes around Hudson's Bay formed examples of this stage of life and were people who also lacked sophisticated forms of marriage, brothers and sisters often marrying each other. Three stages of barbarism spanned the invention of pottery, the domestication of animals and development of metal working. The upper barbarians were known from the earliest historical sources, which gave details of the Greek tribes at the time of Homer or the Italians before the founding of Rome. These groups mark the boundary of kinship society which had been transcended by the 'Semitic' civilizations of the Near East and subsequently the Aryan city-states and empires of Greece and Rome. These ancient civilizations still contained survivals of kinship life, particularly in the form of the *gens,* which could be discerned even within the city of Imperial Rome.

The fact that all the peoples of the earth exemplify these stages, he argued, demonstrated the unity of origins of humanity. Progression up these stages was powered by technical inventions. Here the barbarian ages were the most important for subsequent progress, with their development of the domestication of plants and animals, which secured the food supply, and the eventual mastery of metals. 'Furnished with iron tools...mankind were certain of attaining to civilization' (Morgan 1877:43). This in turn powered the eventual move from kin to civil society and the parallel changes in family type from the consanguine to the monogamous family. Central to all these moves was the developing notion of private property: once this concept had become a 'controlling passion', civilization had begun.

The comprehensive nature of Morgan's scheme, which tied in technical change with familial and group forms of organization, made it impressive to contemporaries such as Marx and Engels, as well as to people like Leslie White in the subsequent century. Not only was Morgan's scheme of influence, but he also mentioned an extra problem which confronted all subsequent investigators into social change: what sort of evidence can we expect to find of different forms of society? Here his concentration on technical change provided part of the answer. Archaeologists like Lubbock (1912) had taken the classification of artefacts produced by Thomsen, Montelius and Worsaae into Stone, Bronze and Iron Ages and used it as evidence of progressive stages in human history. What Lubbock did not provide was a systematic historical scheme in the same manner as Morgan had done. However, the combination of the classification and implied dating of artefacts which had been carried out in Europe and Morgan's scheme made possible the empirical investigation of social forms through archaeological evidence, which set a direction and standard for all subsequent investigations.

To oversimplify somewhat, it is probably true to say that the early years of this century were more concerned with debates about whether change occurred in human society due to diffusion or local development than with the exact nature of society. The broad schemes of progress in which all human groups past and present could be compared were replaced by local particular histories, emphasizing the rootedness of social life in particular environments and the distinctiveness of individual cultures. The lack of large comparisons meant that less effort was expended on outlining the general features of social organization and social change. Instead, culture history became the fashion, which attempted to explain the coming into being of distinctive local ways of life. Whereas Tylor and Morgan had tended to talk of culture in the singular, a plural view of culture was central to culture history and cultural differences were often seen to parallel ethnic differences. Because cultures were seen as self-generating, little attention was placed on how society was organized and the forces for change. However, in the middle of this century the ideas put forward by Morgan were to emerge to have a considerable influence on archaeology.

This re-emergence was due to the influence of writers such as Leslie White, who opposed the historical particularism of Boas, then dominant in American anthropology (Trigger 1989:290). White saw himself as establishing a science of 'culturology' aimed to investigate the laws and principles guiding culture. The central element to any culture was its technical means and the form of interaction with the environment. 'Culture advances as the amount of energy harnessed per capita per year increases, or as the efficiency or economy of the means of controlling energy is increased, or both' (White 1959:56). Due to this stress on energy, social structure was not paid much attention. Culture was seen to have four components: the ideological, sociological, sentimental/attitudinal, and technological (White 1959: 6). These factors were related but by no means equal: 'in the system that is culture, technology is the independent variable, the other sectors the dependent variables' (White 1959:26). Social evolution was a function of technological development, and the main point to focus on in understanding this development was the organization of society around its technical means.

Many of White's views seem outlandish today and we could ignore them completely were it not for the fact that two of the predominant strands of thought in archaeology which characterized the 1960s and 1970s came into being through his work. The first was the flowering of the idea of society as organization, a notion with definitely mechanistic overtones, many of which derive directly from White. The study of social organization concentrates on how different elements of society (subsistence, craft production, ideology) functioned in order to maintain a society in harmony with its environment. The increased differentiation of the individual sub-systems led to greater specialization of functions by people within society, a more efficient processing of matter and information which was the motor for progress up the ladder from simple forms of organization to complex ones. The second element of White's influence was his stress on broad regularities in human history, which could be summed up in generalizations about how culture worked. These in turn could form a firm basis for the study of society in all times and places, including those of interest to archaeologists.

Processual archaeology

Whilst it is overly simplistic to put the development of processual archaeology down to the influence of one man, White's views coloured the approach taken by many processual archaeologists, especially in America. Such influence did not only stem from White directly, but also came through his students. Sahlins and Service (1960) took White's general scheme of unilinear human evolution, modified it somewhat to take into account slightly different local developments, and gave it more specificity by generalizing from detailed anthropological work carried out since the 1920s. They developed the scheme of social evolution which is still most commonly in use amongst archaeologists today. This began with bands of hunters and gatherers, who existed in small groups with few social inequalities and a simple material culture, and ended with large nation-states whose intensive farming and industry produced a massive material culture, internal differentiation and specialization of tasks, plus structures of law enforcement to contain the stresses set up by marked social inequalities. Holocene history for many areas of the globe was thus seen as a move from independent, internally undifferentiated bands extracting little energy from the environment, to interdependent, internally differentiated nation-states, with massive energy budgets (Fig. 12.2).

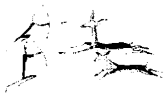
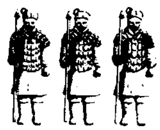
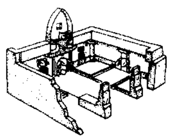
	BAND	**SEGMENTARY SOCIETY**	**CHIEFDOM**	**STATE**
				
TOTAL NUMBERS	Less than 100	Up to few 1,000	5,000–20,000+	Generally 20,000+
SOCIAL ORGANIZATION	Egalitarian Informal leadership	Segmentary society Pan-tribal associations Raids by small groups	Kinship-based ranking under hereditary leader High-ranking warriors	Class-based hierarchy under king or emperor Armies
ECONOMIC ORGANIZATION	Mobile hunter-gatherers	Settled farmers Pastoralist herders	Central accumulation and redistribution Some craft specialization	Centralized bureaucracy Tribute-based Taxation Laws
SETTLEMENT PATTERN	Temporary camps	Permanent villages	Fortified centers Ritual centers	Urban: cities, towns Frontier defences Roads
RELIGIOUS ORGANIZATION	Shamans	Religious elders Calendrical rituals	Hereditary chief with religious duties	Priestly class Pantheistic or monotheistic religion
ARCHITECTURE	Temporary shelters	Permanent huts Burial mounds Shrines	Large-scale monuments	Palaces, temples and other public buildings
				
ARCHAEOLOGICAL EXAMPLES	All Paleolithic societies, including Paleo-Indians	All early farmers (Neolithic/Archaic)	Many early metalworking and Formative societies Mississippian, USA Smaller African kingdoms	All ancient civilizations e.g. in Mesoamerica, Peru Near East, India and China; Greece and Rome
MODERN EXAMPLES	Eskimo Kalahari Bushmen Australian Aborigines	Pueblos, Southwest USA New Guinea Highlanders Nuer & Dinka in E. Africa	Northwest Coast Indians, USA 18th-century Polynesian chiefdoms in Tonga, Tahiti, Hawaii	All modern states

Figure 12.2 The social typology band to state. Drawn by Simon S.S.Driver, from *Archaeology: Theories, Methods and Practice* by Colin Renfrew and Paul Bahn, published by Thames and Hudson Ltd, London, 2nd edn, 1996.

Building on this scheme, processual archaeology attempted to identify broad processes whereby societies became more complex. Local sequences were often seen not to be important in their own right but as instances of global processes. As a generalization, we can say that whereas culture history was interested in the forces that make societies different, processual archaeology focused on what makes them the same. Living societies could be studied in order to throw light on the past, not for any specific parallels they might offer, 'but rather that the more general *processes* at work today in these small, living societies may serve as viable models for such processes in the past' (Renfrew 1976:278). Prime amongst these concerns for processual archaeologists has been the spatial structure of past communities, as expressed both in terms of settlement patterns and forms of interaction between groups (Clarke 1977). Exchange and settlement pattern have often been linked together as indicators of the nature of the social structure (Earle and Ericson 1976). Spatial interests have often focused on the growth of élites, living in large central settlements and regulating the flows of material through trade and exchange, such that more of the products pass through the central places than smaller more peripheral settlements (Renfrew and Cherry 1986). The stress on generalizations about the processes at work in human societies also led to changes in archaeological method, in particular an emphasis on field survey (Foley 1981): as human groups live in areas rather than in single sites and it is the structure of habitation in an area that is important, geographically more widespread sets of data were necessary than those offered by excavation.

The functionalist/evolutionary approach seeks out regularities in society through the implementation of reliable and repeatable methodologies. The strengths and weaknesses of the approach both derive from the broad comparative method. The idea that all of human history can be contained in the movement from simple to complex social forms provides a narrative structure within which global comparisons are possible; this in turn provides some means of looking at stable features of human life and the nature of variability between social forms. However, the very terms 'simple' and 'complex', and the cluster of technological and institutional features on which they are based, provide a limited view of human life and its variations. Critics of the processual approach have argued that it dehumanizes the past, relegating most of the characteristics that make us human to what White referred to as 'ideological, sentimental and attitudinal' and giving ancient societies the look of large modern corporations, struggling to minimize the use of material and energy and to maximize outputs (Shanks and Tilley 1987).

Despite the criticisms that have been levelled at processual archaeology, it continues to be a major strand of archaeological thought and research. This is partly because of the large narrative structure composed around the band to state theme, which many still see to have global utility. Despite the criticism that has been made of this theme, no large alternatives have come along to replace it. Indeed, much of the recent history of archaeology has seen a move away from big narrative structures towards a plurality of small schemes. One exception to such a move is Marxism, a growing force in European and North American archaeology over the last twenty years, as well as in countries of the southern hemisphere.

MARXIST APPROACHES TO SOCIETY

Much of the explanation for the causes of social change within the functionalist/evolutionary approach was based around biological pressures, either those deriving from changes in the natural environment or from growth in human populations. Marxism, by contrast, seeks mainly social causes for change, chief amongst which are power struggles between different elements of society be these clan, class or gender. As is well known, Marx himself took a historical view of human society, holding that no point in time could be understood without looking at the social forces which have led up to that point (Marx 1963). He developed a generalized history of modes of production from primitive communism to present-day capitalism. Marx's view of a mode of production was that it was made up of the forces of production, which were the technological means by which society produced the goods it wanted, and the relations of production, which specified the relations between people pertaining to both the division of labour and the division of the items produced. With the exception of the influences from Morgan, Marx paid little attention to modes of production outside those known from the history of Europe. This has left Marxist anthropologists and archaeologists with a series of basic principles pertaining to the process of labour and the social and ideological relations resulting from that process, but little in the way of specific models to apply to non-capitalist societies. Also over the century since Marx died there have been subtle currents within Marxist thought which have subjected principles drawn from Marx to constant criticism and revision.

Out of this multitude of arguments we can isolate two strands of thought which have been influential in anthropology and archaeology. The first debate concerns the relationship of economic forms to other areas of life. As a generalization, it is possible to say that early in this century there was a tendency to economic and technological determinism on the part of Marxist thinkers. Here the division between base and superstructure in society has been vital. The base is seen to be composed of the economic forces of society: the forces and relations of production. These influence the superstructure of society, made up of the social divisions into kin groups or classes and the ideological apparatus or world-view of the group. Those holding to a strict division between base and superstructure see cause flowing in one direction from the forces of production, such that once one can understand these forces all other elements of society become clear.

It is possible to see in the later writings of Childe a form of economic determinism. In his view it was the relatively flexible position that bronze age tinkers held in Europe which led to their inventiveness and the growth of the individual spirit characterizing Europe. Similarly, the economic revolution brought about by the Neolithic sowed the seeds for the eventual birth of the Industrial Revolution. Criticisms of this view reassert the balance between the economy and the rest of society, such that the superstructure is seen to influence the economic structure. Thus the economy can be seen as first amongst equal sets of causes, rather than as a prime mover (Fig. 12.3). In broad terms the move away from economic determinism was instituted by people like the critical theorists of the Frankfurt school, who saw twentieth-century capitalism as moved by ideological forces ranging from Nazi propaganda to advertising campaigns designed to foster mass consumption (Held 1980). Through these influences, Marxism has come to be interested in structures of power, class and gender as well as the symbolic systems maintaining social forms and inequalities.

More recently the work of Althusser, amongst others, has been concerned to provide theory for understanding the links between economic forces and other aspects of society (Althusser 1969). Structural Marxism, as this trend is known, has been influential on the other main area of Marxist thought influencing archaeology. This is contained in the works of anthropologists inspired by Althusser, who gathered empirical evidence of a variety of non-capitalist social forms. Writers

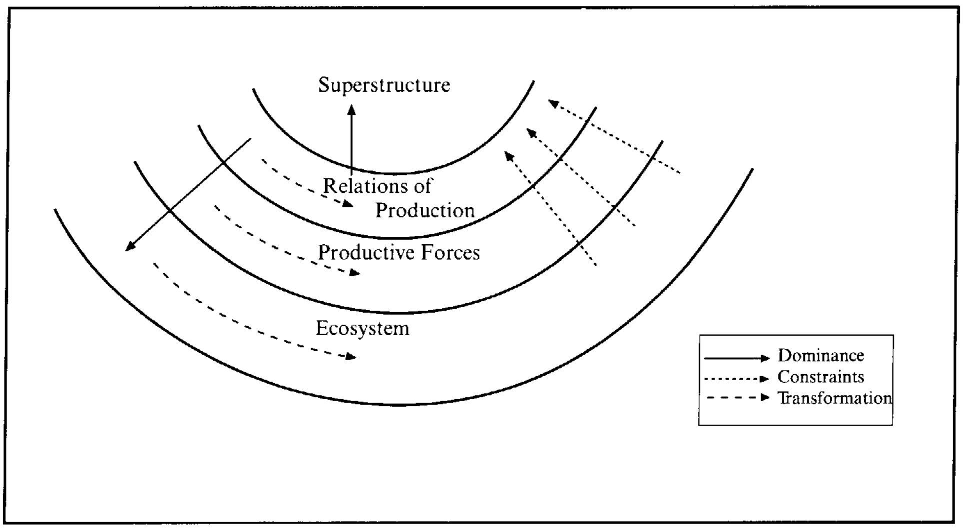


Figure 12.3 Friedman and Rowlands's view of base-superstructure relations. Source: Friedman and Rowlands 1978.

such as Meillassoux (1981), Terray (1973) and Godelier (1977) tackled a particular aspect of the base-superstructure problem: what sorts of relations of production are exercised in the absence of classes and how is the control over production translated into social power and standing? One answer given to this problem was that direct control was not exercised over production at all, but that power derived from the control of the flow of high-ranking items of exchange. These in turn were used to control the flow of people in marriage, which had important consequences for the demographic strength of a group. In societies dominated by kinship, the conclusion consequently was that it was the relations of reproduction which were central to the social process, rather than the relations of production.

These ideas had a direct impact on archaeology in the form of the prestige goods model put forward by Frankenstein and Rowlands (1978) and given more general features by Friedman and Rowlands (1978). The former paper looks at the development of chiefdom structures in Europe north of the Alps under the influence of trade from the Mediterranean. Greek and Etruscan items were incorporated into the exchange networks to the north such that the flow of artefacts could be used to control both the movement of locally produced items and of marriage partners. Here again, direct control over agricultural or craft production is seen to be less important than the flow of people in marriage. The Frankenstein and Rowlands paper also fits in with a further strand of Marxist thought: the spatial structure of economic units within a larger whole or ‘world system’. This influence derives from the work of Wallerstein (1974, 1980), whose interest was in the growth of capitalism. Wallerstein’s main point was that it is impossible to understand the development of capitalism by focusing just on Europe, as many historians had done, and ignoring the rest of the world which contributed raw materials, labour and precious metals to the industrial process. In his view, Europe and the rest of the world were involved in one set of relations which could not be analysed piecemeal, but had to be seen as a global whole, with Europe forming the centre of the world economy and the rest of the world a periphery.

Through the 1970s, archaeologists struggled to reconcile an interest in local development, which had arisen to replace diffusionism, with an interest in trade and exchange as both an indicator and cause of particular social structures. Wallerstein’s ideas are attractive in that they allow us to set local sequences of change in a broader social perspective, which includes links between regions through the movement of materials and people. His influence has thus spurred a number of studies of various archaeological periods and places (Rowlands *et al.* 1987). It is instructive to note in passing the difference between the spatial analyses carried out by processual archaeologists and those with Marxist leanings. Whereas the former tend to fix upon the increased efficiencies brought about by centralized coordination, the latter look at the structures of power and the benefits accruing from being in the centre of a world system rather than on the periphery.

There is no obvious dividing line between Marxist and post-processual approaches, the point of contrast lying in the fact that the Marxists tend to concentrate on the notion of society as a whole held together and torn apart by economic and ideological forces, whereas the post-processualists eschew any totalizing models, concentrating instead on the development of smaller narrative structures to examine finer-grained aspects of social life. Both hold in common, however, a growing interest in practical aspects of consciousness. For the Marxist, the concentration on practice derives from a general materialist orientation, whereby it is felt that action shapes the world and creates human beings at the same time. For those with a more hermeneutic viewpoint, practical consciousness intersects with discursive consciousness through which the group makes sense of the world, discursive knowledge being made effective through practice in and on the world. Both Marxists and post-processualists share an interest in the interaction of discursive and practical consciousness, which they see as providing an escape from the social pigeon-holing brought about by the band to state typology. However, the former would tend to stress the practical as the place to start in generating understanding, whereas the latter stress the idea that the world must be conceived of symbolically before it can be acted upon.

Over the past fifteen years, Marxism has opened up archaeological debate to theory and data from outside the discipline, particularly that within Marxist anthropology (see Spriggs 1984). In doing so it has countered the implication underlying much of the work in processual archaeology, that social formations are benign, operating for the general good and able to supply society's wants with increased efficiency and on a larger scale as time goes by. Marxism in both anthropology and archaeology has had to struggle to re-apply theory developed mainly to understand class-based societies to kin-ordered groups. Such a re-application has focused on the reproduction of people as an issue as crucial as the production of things. The application of Marxist theories to archaeology has not always been successful and this is in part because of the relatively limited range of anthropological models drawn upon. Many of these stem from African anthropological case studies concerned with the nature of lineages and closed spheres of exchange. Such cases provide a rather slender basis for global models applicable to kin-based societies everywhere. Nevertheless, Marxist theory continues to be the centre of energetic debate, which often cross-cuts the issues tackled by the last approach to society I have distinguished: post-processualism.

POST-PROCESSUALIST APPROACHES TO SOCIETY

As the name implies, post-processualism originally defined itself through criticizing the processualist approach (Hodder 1982; Shanks and Tilley 1987). The main emphases of the initial critique were on the functionalist and evolutionary orientations of processualism. As I have mentioned above, the post-processualists dislike the mechanistic and totalistic view of society; that is, the view that society could be seen as a whole made of individual parts which functioned together like the engine of a car. Not only was this mechanistic view bad enough, but it was also contained within a scheme which said that social engines became more efficient through time, leading to the latest superior model: the states of modern Europe and the USA.

In attempting to develop a new view of society, post-processualism, like Marxism, drew on areas of theory outside the discipline. The first of these was an intellectual trend which had come and gone: structuralism. Based upon Saussure's methods for analysing language as a structured set of differences (Saussure 1959), anthropologists such as Lévi-Strauss developed structuralist approaches to all human products (Lévi-Strauss 1968). Just as meaning in language derived from the structured differences between words, human culture as a whole—whether systems of myth, habits of dress, building styles or forms of ritual—could be seen as a series of structures for producing meaning. The meeting of nutritional requirements was a necessary, but not a sufficient, condition for life. In order to live and thrive, people need structures of meaning within which they can create a world for themselves.

Several implications flow from such an emphasis on the centrality of meaning to human life. The first is that society is not a series of physical mechanisms for processing matter and information, but a structure of contested meanings through which life is made worth living. The second is that the external world is not straightforwardly and objectively perceived, but rather constructed and reworked in imagination before it is encountered in practical action. People do not adapt to external physical circumstances in a predictable manner, but can conceive of the same set of environmental conditions in quite a different manner depending upon their culturally created views of the world.

Structuralism as such passed away as a force within anthropology before archaeologists became interested in these matters. Nevertheless, the emphasis on meaning and the construction of the world stayed on as lasting effects. Social forms were not simply seen as the creators of meaning beneficial to everyone. Meaning and power were closely connected; here, the work of Foucault was influential (Miller and Tilley 1984). Foucault (1980) held that power is the ether in which the social world exists; it encompasses everything. Individuals and groups are constantly striving to maintain and enhance their position within the world in a struggle of each against each. Power is not simply repressive, in this view, but the creative spring from which derives all movement. Our position within the world determines how we see and explain the world. It also influences how we try and convince others of our views. Those in positions of dominance have greater scope to develop a wide ranging view, to hem in the meanings of others and to arbitrate as to which meanings are socially permissible and which not. Power and discourse are intimately linked in a to-and-fro motion of dominance and resistance.

Ritual is a point of concentration for many post-processual studies, as it is felt that ritual is a crucial vehicle for creating meaning, but also an area where active contests of power take place. Ritual may mask social inequalities rather than highlight them. For instance, Shanks and Tilley's (1982) study of neolithic tombs in Britain and Sweden looks at how disarticulated human bones are grouped in tombs in a manner which shows distinctions between the left and right sides of the body, the upper versus the lower limbs and the trunk as against the limbs. Although there may have been conflicting groups in life, for instance the lineage heads versus the bulk of people doing the work, these contradictions are hidden in death where all bodies are treated in the same manner according to complex sets of oppositions between body parts. A sophisticated symbolic scheme acted to hide quite simple inequalities.

The hidden nature of much social practice is a recurring theme of post-processual attempts to understand society. One of the major areas which has remained hidden is that of gender relations. Recently explicit attempts have been made to uncover gender relations in the past (Gero and Conkey 1991). The investigation of gender challenges a number of assumptions, prime amongst which is the idea that we have an ahistorical human nature which provides the same well-spring of action in all periods. Countering this is the view that all elements of the human personality are the product of history: we are part of a changing network of relations which shape us. Gender, in this view, is not based in biological differences between the sexes but is rather a changing product of the manner in which men and women relate to each other. Gender is not a static innate quality, but is historically engendered. Furthermore, as Conkey and Gero (1991:3) point out, archaeology has worked with implicit notions of gender which have highlighted activities associated with men, such as hunting and stone tool knapping. Conkey and Gero state three major aims of their book: to expose gender bias in all phases of archaeological enquiry from its assumptions and concepts to the nature of the acceptable evidence; to find women in archaeological contexts and to identify their role in gender relations; and to criticize underlying assumptions about gender and difference (Conkey and Gero 1991:5). A central feature of the detailed investigations of the book is a concentration on the division of labour in past societies and how far this was structured by relations of gender. The discussion on gender links in with more generalized discussions of agency and how far individuals and groups can be discerned as the agents through which social structures are reproduced (Shanks and Tilley 1987: ch. 3).

Recent trends within post-processual thought have brought archaeology into line with current discussions within other disciplines. Radical questioning of all our premisses is the aim here. The very categories of society—social structure, the individual and the author of archaeological works—have been called into question (Bapty and Yates 1990), following streams of thought deriving from Nietzsche and Derrida. A radical questioning of all current assumptions opens the field to many possible ways of approaching the past. Where, how and whether these will crystallize into new directions is unclear at present.

Post-processual views have, of course, not escaped criticism, chief amongst them being the extent to which we can understand meaning, ritual, gender and individual agency on the basis of the archaeological record. There are a number of issues here which take us to the heart of the archaeological endeavour. The first is that question that I have not so far raised: is a social archaeology of any sort possible? There are those who believe it is not. Higgs and Jarman (1975) put forward the view that, over the long term, social and cultural forces are irrelevant: what matters is people's adaptation to the environment over periods of millennia, which is based on ethological forces shaping us as a species. A similar view is put forward by Bailey (1981), who feels that long-term processes, which are mainly to do with the relationship between people and the environment, will show up well in the archaeological record, whereas shorter-term processes, which are mainly social in nature, will be much more difficult to perceive. A counter view has been advanced by Bradley (1991), who notes that many elements of social and cultural forms change extremely slowly, emphasizing continuity, rather than rapid change. Long-lasting elements of social life such as style and ritual may well show up in the archaeological record: in some instances, in fact, social forces may be more visible than short-term fluctuations in the environment which may structure people's forms of subsistence. The attempts by both Bradley (1991) and Hodder (1990) to identify and explicate long-term social trends in the archaeological record from Europe go a considerable way to meeting the objections of those who say that social forces only operate on the short term.

PROBLEMS WITH USING THE PRESENT TO UNDERSTAND THE PAST

One feature that all attempts to understand prehistoric societies share is that they draw on our knowledge of the present to interpret the past. Since the nineteenth century, Europeans have been fascinated by social forms unlike their own. American, African, Asian or Australian societies were of interest, not simply due to their strangeness but rather for the light that strange customs could throw on 'modern' European ways of life. As anthropology crystallized into a discipline in the late nineteenth century, the search was initiated for pristine forms of society which could best exemplify states and stages of human development. Once understood, these groups could say something about us and our origins: the morals, customs, institutional and technical forms of the western world could be thrown into sharp relief by the things that they were not. Observations of other societies were not made at random or left unsynthesized, they were incorporated into narrative structures through which tales were told about the world. As Fabian (1991) has noted, these structures generally had a moral purpose: anthropology's practice was one of

> incorporating strange, disquieting cultures and, indeed, our traumatic confrontations with these cultures (such as discovery, conquest, colonization) into *narratives of cultural evolution,* that is, narratives of fulfillment…these topics were selected and treated such that they served to explain, and often legitimize, the modern state of affairs. The important thing in tales of evolution remains their ending.
>
> (Fabian 1991:193)

As we have seen, the categorization of society into band, tribe, chiefdom and state, which derives from the last century, has been used to structure prehistory and the social changes which took place from the Palaeolithic to the present. Ironically, although various social forms could be lined up to form a global history, individually most social groups were seen not to have a history of their own. The 'simpler' societies in particular were seen to represent pristine examples of their type and thus to exemplify general features of such social forms everywhere: Tongan chiefdoms could then be used as templates for the groups that built Stonehenge. Although recent moves in archaeology have attempted to discard evolutionary schemes, the use of parallels between past and present goes on, such that neolithic groups in southern Britain now often look more like Madagascans than Tongans, as parallels are drawn from more theoretically informed anthropology.

There are two points which are objectionable here. The first is the aspect Fabian alluded to, whereby Europeans fit the societies of the world into a comfortable structure culminating in their present ways of life. The second is the notion that some social forms do not have a history and are thus ripe for comparative purposes, where a moment's thought will show that all societies studied by anthropologists have had a recent calamitous history due to their contact with colonial powers and that the latter forms the latest chapter in each group's local history (Wolf 1982). The encroachment of the modern world system has led to depopulation, enslavement and ecological disaster, as well as forms of resistance to these processes which have had their own social effects. Thus although Europeans have been fascinated by survivals from past times, no group has ever lived outside a web of historical connections which were undergoing a process of constant change.

The groups seen least likely to have histories are hunter-gatherers, with their low levels of technology and lack of pronounced social inequalities, two of the main motors of history. During the nineteenth century, many Europeans viewed hunter-gatherer groups in places like Malaya, Borneo and the Philippines as relict populations displaying ways of life which had vanished elsewhere due to the incursions of farming groups. Modern ethnographers tend to take a different view.

Rather than seeing forest-dwelling groups as being living fossils keeping palaeolithic traditions alive into the modern era, these groups are seen as having a particular position within a 'world system' that came into being some 1,500 years ago.

Huffman (1984) provides the most explicit presentation of this view and argues that the Punan of Borneo were once farmers who now live in the upper forested reaches of river valleys in a close symbiotic relationship with their farming Dayak neighbours who live at the coastal ends of the valleys. The Punan supply forest products (resin, birds' nests, camphor, rattan, rhinoceros horns and so on) to the Dayaks, and more especially into trading networks which transport these items to China. The Punan have positioned themselves in the rain forest for historically specific reasons, Huffman argues, responding to Chinese demands for forest products by specializing in their supply, a form of trade which may go back to the middle of the first millennium AD when the first trading empires were set up. Huffman (1984:144–45) feels that many, if not all, the nomadic groups of south-east Asia may be designated as secondary hunters and gatherers, people who gave up farming to exploit a new set of social and economic opportunities. This example could be multiplied endlessly, showing for instance that the 'Big Men' societies of Papua New Guinea may well have altered in fundamental ways in the last century or less.

There are different reactions to the realization that all groups in the world have a recent history and a prehistory of their own. Marxist thinkers accept the fact of history, but try to pick out well-documented instances of recent history to illuminate the prehistoric past. Thus much of the Frankenstein and Rowlands model of the contact between Mediterranean city-states and groups north of the Alps is based on contacts between the Portuguese and West African groups from the fifteenth century onwards. Post-processualists also acknowledge history, but see past and present as radically different. No parallels can be drawn between groups known from recent history and those evidenced by archaeology. This relativist stance is modified in practice by the use of general ideas to do with the legitimating functions of ritual, or even more generalized notions such as 'habitus' (a set of bodily dispositions to action—Bourdieu 1990) and practice drawn from anthropological writings.

In many ways the major problem facing anthropology and archaeology concerns notions of history and generalization. Since the debates between evolutionists and culture historians, the question has been posed: how far can we pick out general features of society which can be used for widespread comparisons and how far can each society only be understood in its own terms? Neither of the extreme reactions of unthinking comparison or total relativism is a viable option. And we are still faced with the problem as to which aspects of society we can discuss in generalized terms and which not. There is no end in sight to this debate, nor will it go away. All I have been able to do here is to highlight the problem without proposing even the glimpse of a solution.

In the rest of this chapter I offer some brief case studies to illuminate in a more concrete manner the general debates that I have outlined above.

PALAEOLITHIC STUDIES

The Palaeolithic poses some of the 'big questions' that have fascinated the European mind: what were our ultimate origins, what features make us human, how are we related to the rest of the biological world and what sort of history do relations of sex, gender and inequality have in the deep past? I cannot possibly attempt to tackle all these topics here, but will pick out contrasting approaches to the same material which exemplify the four stances on social archaeology I have identified (see also Chapters 18 and 20).

One of the most famous debates concerns the meaning of Mousterian assemblages. Here two approaches, the culture-historical and the processual, can be clearly contrasted as represented respectively by the opinions of Bordes and Binford (Fig. 12.4). Cave sites in south-west France such as Combe Grenal and Peche de l'Aze yielded layers with a series of tool types dating to the Middle Palaeolithic. Bordes (1973) divided these tools into five variants based on a complex classification and analysis of the tool morphologies, interpreting them not as an evolutionary sequence but as evidence of distinct cultural groups moving in and out of the area at various times. This movement explained why the tool types were found interleaved with each other, not in a succession from one type to another. Binford, whilst accepting Bordes' typology of tools, argued that the variation in the Mousterian assemblages is a reflection of different tasks carried out by the same group at different sites or at the same site at different times of the year (Binford 1973). He supplemented his archaeological analysis by looking at the structure of life of mobile people existing in the present, such as Australian Aboriginal groups and Alaskan Inuit. Because the energy and materials necessary for life were differentially distributed across the environment, people would have to move in order to exploit these. Patterns of movement were basically structured by the form of the environment, so what was needed to understand the archaeological record was, first of all, a series of principles specifying how people used the landscape, which could be derived from the present-day models, and second, a further series of principles laying out the processes by which the archaeological record was created.

The idea that the structure of energy and matter within the environment is the main shaper of hunter-gatherer life has been generalized over recent years into what is known as the global hunter-gatherer model (Gamble 1986:34–39). The basis for this model is that there is a differential distribution of energy through the world's ecosystems, with a decrease in productivity away from the equator. As the ways of life of hunters and gatherers are thought to be patterned around the availability and distribution of resources, the decrease in productivity with increased latitude

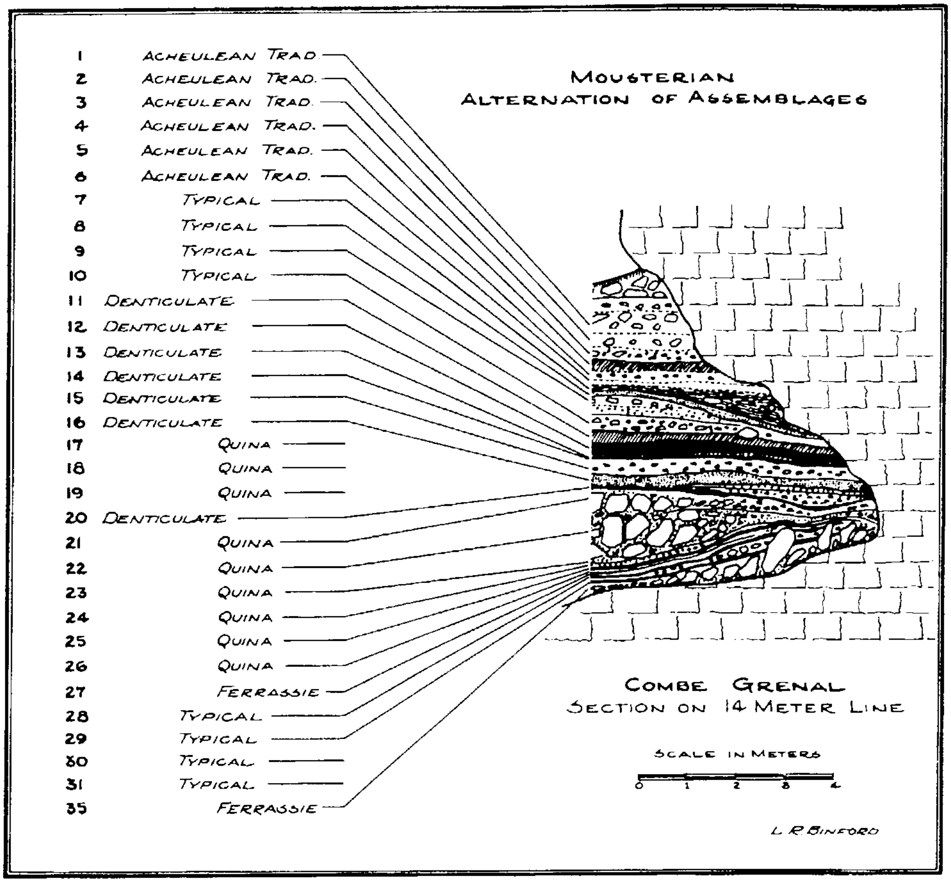


Figure 12.4 Archaeological section from the Mousterian site of Combe Grenal in France, illustrating alternating assemblages. Source: Binford 1983. With permission of Thames and Hudson.

is seen to be of considerable significance: in general terms, groups nearest the equator are most dependent on plant foods, those furthest away on animals or fish. Storage of the relevant foods is also dependent to a degree on latitude. As the length of the growing season shortens and the hunting of large mammals and fish (which may only be available for a short season) becomes more important, then storage of the resulting produce is given greater emphasis. Storage is linked with mobility, in that high mobility is found in equatorial environments with abundant but dispersed resources. Sedentary strategies are most common in boreal and temperate forest areas. Finally, technology is at its most complex in highly seasonal environments, where resources only come on stream for short periods of the year.

Technology has to be of sufficient complexity to ensure success. This imperative influences both the sophistication of the equipment used and the thought and planning that goes into its use.

These generalizations were arrived at by looking at known cases of hunter-gatherer groups around the world today and ignore the fact that these people have a particular set of recent histories, which may not make them good exemplars of the groups found in the Palaeolithic. Such a model emphasizing responses to the environment also plays down the nature of cultural and social perceptions of the physical world, which may in turn structure the strategies used to gain a living and the social uses to which food is put (Chapter 18). On the positive side, the global hunter-gatherer model has provided the basis for understanding the fluctuations in response to the changing environments of the Pleistocene.

A significant milestone in the study of the nature of palaeolithic society was Isaac's attempts to probe the origins of human behaviour in some of the earliest fossil records (Isaac 1978). Looking at the early evidence from East Africa, he argued that central foci on the landscape would have formed an essential component of foraging patterns. He envisaged a division of labour by gender, with the males foraging for meat and the females for plant food, the groups combining at a 'home base' for the sharing of food, places which would also have provided the locus for the care of young and other maintenance activities. The model has been widely discussed and criticized, the main point of much criticism being that the combination of bones and stone tools may be evidence not of central foci of activity but simply of the points on the landscape at which carcasses were butchered (Potts 1984). Potts has argued that an efficient way of exploiting carcasses would be to cache stone tools and move the animals to the tools, the accumulations of stone and bone soon resembling the Plio-Pleistocene archaeological sites. Caching of stones has been observed amongst chimps and these sites demonstrate patterns of behaviour linking hominids to other animals, in contrast to Isaac's view of them as evidence of the elements that make us distinctively human. While by no means conclusive, these arguments demonstrate the power that the palaeolithic evidence has to stimulate thought on the bases of human life and society.

No better demonstration of this can be found than in the recent explorations of gender relations in the Palaeolithic. Many have made the general point that, on the basis of ethnographic analogies, the plant food gathered by women contributes more to the diet of the group than the meat hunted by men: the term 'gatherer-hunter' ought to be employed and the nature of models of the Palaeolithic, which are often based around male activities, should be reviewed (Bender 1978). Also, the nature of gender as a category is being held up to question and its historical transformations probed.

Conkey (1991), for example, has attempted to identify the contexts of life in the Magdalenian phase of the Upper Palaeolithic in which gender may have been at work. Her main focus is large aggregation sites which contain a record of groups larger than the household, and she notes that a feature of attempts to create an order beyond the household are that age and sex differences are played upon. Gender relations are thus a prime structuring principle in the network of social relations. These relations also use material culture as an active and constituting medium and not as a passive vehicle for attaining utilitarian ends. Gender relations can then be sought in material culture. She gives the example of the site of Cueto de la Mina, a rockshelter and a small cave excavated in 1904 situated 1.8 km inland from the Bay of Biscay. It contains evidence of a multitude of activities including engraving bone and antler tools, working sea shells, processing vegetation, working hides, the butchering and processing of animals. The resources collected in the cave came from the coast, woodlands and the plains; a journey of several days would have been necessary to obtain some of these items.

Conkey does not offer specific gender attributions in analysing tasks, but instead attempts to provoke thought in two directions. The first is to question the gender attributions that have been made for artefacts found at Cueto de la Mina. Some 200 pieces of worked bone and antler were recovered from the site, some of which have been seen as harpoons used for male hunting practices, but she raises the possibility that the holes and barbs on these objects could have been used for cordage, producing sets of lines for nets and ropes (Conkey 1991:76). As well as the critique of the unconscious bias towards identifying male activities, Conkey looks at the chains of activities that may have been carried out at the site and the forms of organization lying behind them. She points out that, at any point in time, dozens of people may have been coming and going at Cueto de la Mina engaged in a range of tasks, which would have necessitated a partitioning of people, labour, and space. In addition, tasks would have interlocked, such that the products of one set of activities would have supplied raw materials for another. Technologies are not merely means to exploit the environment, but derive from culturally embedded conceptual frameworks. Artefacts are not simply raw material for classification or evidence of production, but can show us how streams of activity are embedded socially and the relations set up during these activity streams.

The weakness of her study is that she offers no concrete analysis of the abundant archaeological materials, but—like many post-processual archaeologists—she is trying to provoke questions rather than provide answers. This is such a new strategy of thought in archaeology that it will take some time for it to be accepted, but as a means of getting to grips with intractable problems it has obvious attractions. We can say that gender is not rooted in biology and that any assumptions we make about gender roles 17,000 years ago will simply reflect our own society and its world-view, such as that men engage in technical tasks such as tool making and dangerous tasks such as hunting. Once these views have been questioned, there is nothing immediately to replace them with. One reaction is to say that gender relations in the Palaeolithic are not amenable to archaeological analysis. Another is to follow Conkey's strategy of opening up the area to thought without necessarily providing answers or methods for finding answers. This is a courageous move and in line with general attempts within feminist thought to eschew easy answers and linear trains of thought. Gender provides an area of questioning that is likely to destabilize many areas of archaeological thought. It is easy to predict that gender as a topic will provide an arena for heated controversy in years to come.

PACIFIC PREHISTORY

Pacific prehistory forms one of the strongholds of culture-historical thought within archaeology. This may well be because the ethnological impulse to classify cultural differences still has considerable influence on attempts to understand divisions that are often made in the present. When the Dutch established themselves in the Spice Islands of Indonesia during the sixteenth century, they placed an embargo on trade voyages entering the area from the east. As a consequence, the boats of other nations, such as the Spanish, French and British, who carried out the majority of the European exploration of the Pacific, entered that ocean from the east. The peoples they first encountered there became known as the Polynesians, whom the European explorers tried to fit into their view of the world. The Polynesians were often seen as a 'nation' of one ethnic group and from the first there was speculation as to their origins. In 1831 the French explorer Dumont d'Urville divided the Pacific into four ethnic blocks (Fig. 12.5): Polynesia (many islands), Micronesia (small islands), Malaysia (island south-east Asia) and Melanesia (black islands). This emphasis on the Polynesians was reinforced by the fact that much of the early archaeology of the Pacific was carried out in Polynesia, primarily in New Zealand and Hawaii.

Kirch and Green (1987) demonstrate the modern approach to culture history in this region. They begin by noting that Polynesian groups in the present share a physical type, systemic cultural patterns and historically related languages, allowing them to be grouped as a 'substantive segment of culture history'. As these traits are traced back in time they are seen to converge, until they can be localized in a small group in a restricted area: Tonga, Samoa, Uvea and Futuna. Archaeologically speaking, this early group is manifest through the Lapita culture, which can be glossed as 'ancestral Polynesian society'. Lapita sites span the period between 3,500 and 2,000 years ago, and are found from the Bismarck Archipelago to Tonga and Samoa. The Lapita sites display a range of material culture, most striking of which is fine dentate-stamped pottery (pottery with decorations made with a toothed stamp), but which also includes the first well-developed shell industries so characteristic of Pacific life, chipped and polished stone, evidence of marine exploitation and a horticultural subsistence base. It was an eastern sub-group

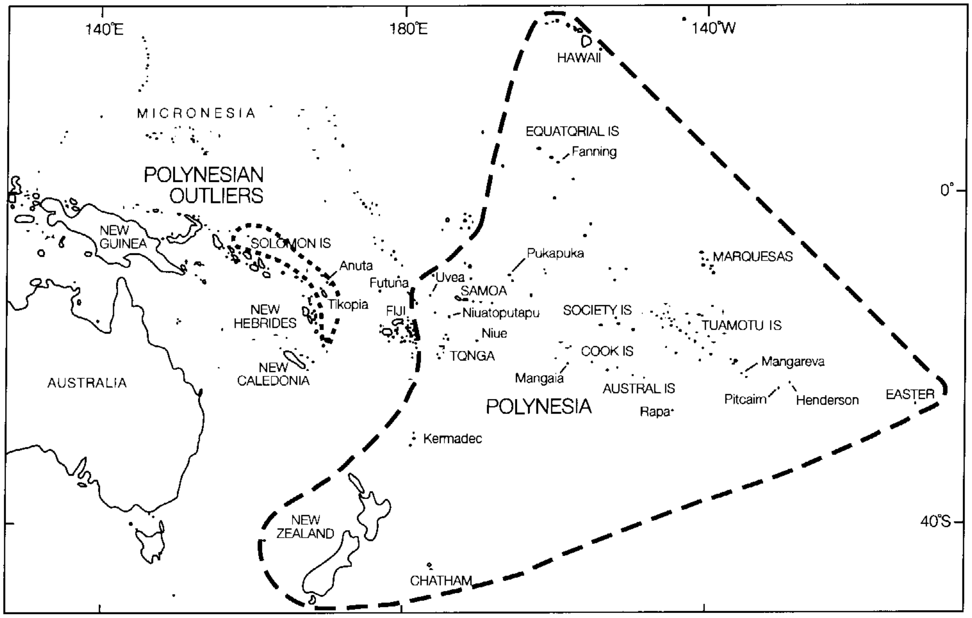


Figure 12.5 Polynesian societies within Oceania. Source: Kirch and Green 1987.

of the Lapita culture as a whole which is seen to be the foundation for Polynesian life. The ultimate origin of the Lapita cultural complex is seen in this model to lie in southeast Asia, the homeland of the Austronesian languages spoken by the Polynesians. The Lapita group thus migrated out of south-east Asia about 3,500 years ago, settled for a while in Melanesia on which it had no ultimate cultural effect, before moving on to meet its destiny in Polynesia. Moving forward in time from this founding movement, culture history linked to an evolutionary framework can look at how individual Pacific islands have diverged from the founder culture through environmental influence, differential demographic pressure and the social processes of colonization (Kirch and Green 1987).

Such a developmental sequence has a ideological structure which attempts to catch the Polynesians in the process of becoming. It ignores the fact that many of the features associated with the Polynesians today may be of relatively recent origin. For instance, the Tongan kingdom, one of the exemplars of chiefly society used in the band to state model, appears only to have come into existence in the last few hundred years. Before that, life may well have been radically different in terms of cultural forms and social hierarchy. A Pacific prehistory centred around the Polynesians also places Melanesia firmly on a lower evolutionary rung, the conduit of the Lapita culture between its south-east Asian origin and its Polynesian flowering.

It also reinforces a distinction reminiscent of Lévi-Strauss's division between 'cold' and 'hot' societies, with the 'Big Man' societies of the Melanesians possessed of less dynamism than the chiefdom societies of the Polynesians.

Studies of contact history in the Pacific have opened up the possibility that many of the social forms witnessed today may have been radically altered through the process of colonization and the nature of indigenous resistance (Sahlins 1985; Thomas 1991). To seek their origins in the deeper prehistoric past is to pursue something that was never there. An approach such as Sahlins's, which focuses on the cultural logics underlying Pacific social action and history, opens up the possibility of more sensitive forms of culture history, able to examine local sequences in terms of patterns of praxis and the cultural foundations of such practice. Archaeology has yet to make use of such a scheme for understanding the rich sets of material culture available from the recent and prehistoric periods in the Pacific.

HISTORICAL ARCHAEOLOGY

The most pressing social questions are those closest to us in time. Historical archaeology sets out to understand the unfolding of the world economy over the last few centuries on the basis of material culture. The process of colonization is tackled in a critical manner by those in former colonies such as the USA, Canada, Australia and New Zealand, whilst in Europe the centre of interest is the industrial process which derived raw materials and labour from Europe's world connections (see Chapters 28 and 29). Wallerstein's scheme of core and periphery commonly provides a general framework for such investigations, although no syntheses on the scale of Wallerstein's original work have as yet derived from historical archaeology (Paynter 1982; Wallerstein 1974, 1980). The process of European expansion brought with it considerable cultural mixing and contact, both between Caucasians and aboriginal inhabitants of the continents colonized and also with other groups, such as Asians, who moved in complex patterns of their own through the colonial world. It is no surprise, then, that issues of ethnicity, class and inequality are common themes in historical studies. As the effects of colonial history still shape the world in which we live, the issues debated within historical archaeology flow into broader streams of political debate over the rights of indigenous peoples and the exact and often bloody nature of the colonial encounter. Much could obviously be said on such topics, but space precludes detailed discussion here (see McGuire and Paynter 1992 for a recent survey of such issues). Instead, I have chosen a single example which will bring out some of the quirkiness of the colonial process and display in miniature a number of the issues tackled within historical archaeology.

Port Essington was a short-lived settlement in tropical northern Australia, close to the present-day city of Darwin. Port Essington was not occupied for long (1838–49) and represents the best known of the aborted European colonies in nineteenth-century Australia. However, the excavator has argued that Port Essington should be regarded not as a failed settlement but as a strategic manoeuvre within a wider political game (Allen 1973). Halfway between its two nearest British neighbours in Singapore and Sydney, some 4,000 km from each (Fig. 12.6), Port Essington represented the only white settlement of the time on the northern coast of Australia. Its position and military nature demonstrate the role the site played in maintaining British sovereignty in a region of strategic importance, which might otherwise have been challenged by the French, Dutch or even the Americans.

The settlement was inhabited almost entirely by marines, there being few convicts or free settlers. The site was on a headland which had defensive advantages and was protected by a gun emplacement and small defensive earthwork. Excavation and historical documents revealed that the settlement was composed of a series of living quarters for officers and men, including a government house for the commander, as well as a kitchen, hospital, a smithy, store, bakehouse and a number of other facilities intended to make the settlement as self-sufficient as possible. Allen sees the colony not just in global strategic terms, but as a microcosm of frontier colonial society. The archaeology and the documentary evidence reveal a small, predominantly male, society living in extreme isolation in inhospitable conditions. As such, Port Essington forms an exemplar of the situations which gave rise to Australian legends of sport, mateship and drinking. The evidence also tells of social division and severe hardship, which receive less emphasis in later legends: nearly a quarter of the inhabitants of Port Essington died of malaria during the life of the settlement, but no estimate can be made of the deaths in nearby aboriginal groups from introduced diseases. There is archaeological evidence, in the form of middens close to the settlement with flaked glass in them, that personal relations between the white colonists and aboriginal groups may have been quite good by the standards of the time. However, even in the absence of much premeditated violence, white presence in the area brought disruption and death to the original inhabitants to an unknown degree.

The archaeology contains evidence of internal divisions and original links to far distant homelands. The men lived in huts with reed walls and thatched roofs with earth floors, while the officers occupied more substantial quarters built on piles which saved them from termite damage. After 1839, when a typhoon destroyed the settlement, building was started in brick, using the products of a brickmaker whose ship had been wrecked in the typhoon. At this time, brick cottages were built for the enlisted men with families by Cornish masons, who included chimneys constructed in typical Cornish style using techniques that can be traced back to the medieval period. The artefacts used on the colony were almost all of British manufacture, travelling from London to Sydney and then to north Australia. The artefactual suite gives an insight into the productiveness of British industry at this

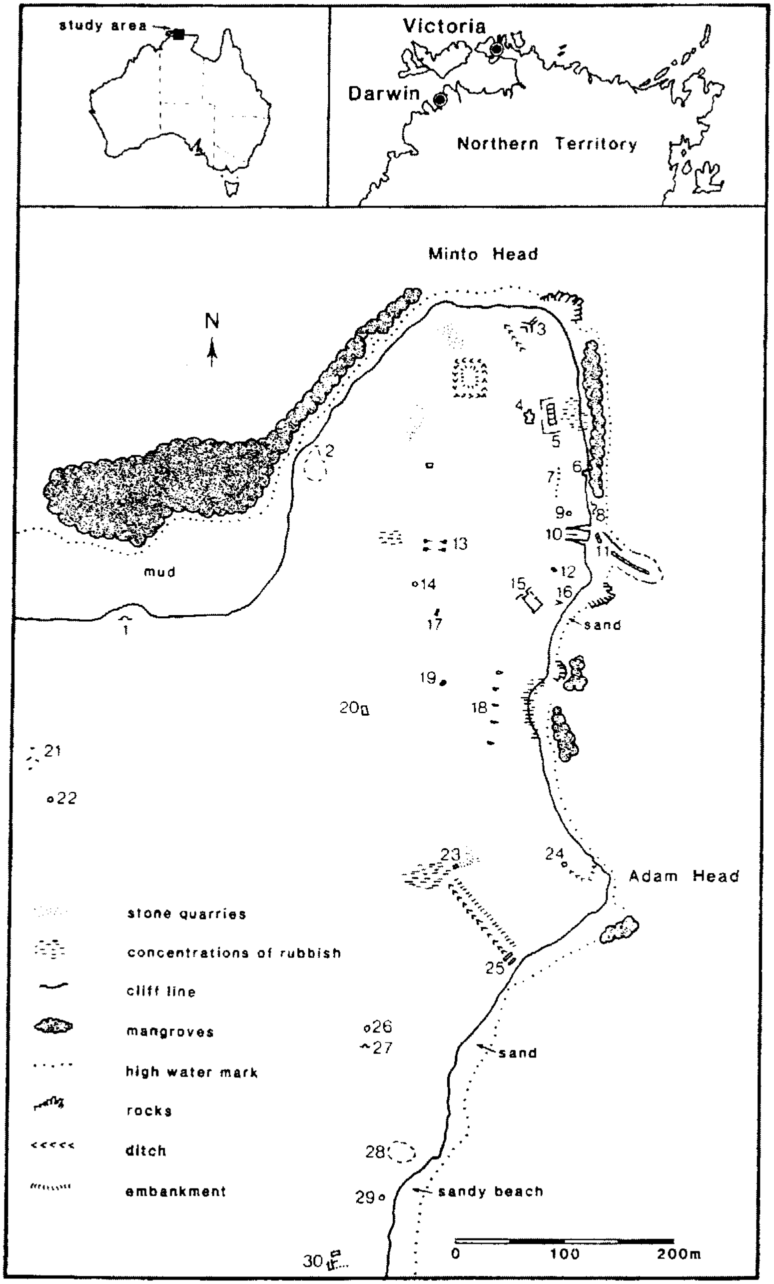


Figure 12.6 Port Essington, a colonial settlement in northern Australia. Source: Allen 1973, Fig. 1.

time, supplying colonial outposts large and small all over the world. Datable artefacts from the excavation also show the speed at which new styles reached the settlement, there being little lag between the introduction of new types in Britain and their appearance in Port Essington, one of the most isolated points of the Empire.

This example illustrates how archaeology provides a grain and quality of evidence that contemporary documents do not. Study of material culture can show people trying to create a world for themselves with known dimensions, either through importing the latest materials or by drawing on folk traditions of construction and manufacture. Similar forms of accommodation were necessary for aboriginal groups, who found their familiar environment drastically altered by the entry of whites and the social fabric of the group under threat. The tensions created by new relations between black and white were played out all over the Australian continent from 1788 onwards, leaving a legacy that contemporary Australia is still attempting to come to terms with. Part of the process of understanding relations between black and white in the present derives from a comprehension and recognition of the nature of the history of those relations. Here, a socially oriented historical archaeology has a vital part to play.

CONCLUSION

In general terms, attempts to understand society on the basis of the archaeological record have oscillated between an emphasis on broad processes and a concentration on fine details. Such a to-and-fro motion has played itself out since the evolutionary schemes of the nineteenth century were replaced by culture histories, being repeated again in the last fifteen years as post-processual archaeology has staged a critique of the global history of processes created by the New Archaeology from the 1960s onwards (see Chapter 2). At present it seems unlikely that such oppositions will either disappear or cease, although the exact directions in which social archaeology is heading are difficult to discern.

A second ongoing argument in which there may be more sign of resolution is over whether social archaeology is possible. As we have seen, a common criticism of attempts to understand past societies has been that social processes are by their nature short term and thus are obscured by the coarseness of the archaeological record. Recent emphases on the long-term nature of social processes by Bradley (1991) and Hodder (1990) have stressed the idea that archaeologists may be able to pick up long-term continuities in human societies beyond the ken of other social sciences. We are not, therefore, condemned to practising ‘ethnography with a shovel’, but can attempt to define and discern levels of social history unfolding over centuries and millennia. Such attempts at long-term history involve not only empirical investigation but also a criticism of the categories we bring to the understanding of society. Notions such as gender, species and ethnicity are mainly derived from our life in the here and now, and may not be appropriate to understanding the long term. For instance, we are used to thinking of gender relations as being worked out in the home or the workplace, and find it hard to conceive of how gendered social structures may unfold over hundreds and thousands of years. We may well question attempts to use the idea of gender in this way, arguing that to see long-term continuities in gender structures may be a means of justifying and naturalizing present inequalities by highlighting the fact that they have a long history resistant to change.

The nature of past society will remain the most controversial area of archaeology as it connects so closely with present-day controversies. In a century which has seen our broad cosmologies break down, archaeology has often been used to orientate our world-views, as evidenced by the proliferation of films and novels set in the prehistoric past. There is much at stake when a discipline can contribute to a society's sense of itself. This is especially true when social divisions lead to different and conflicting interpretations of the past, as they do in each and every area of the world (see Chapter 10). Many of the ideas presented in this chapter derive from white, male, academics living in wealthy areas of wealthy nations. These facts could not help but colour the views of society which have been put forward. With an ever larger number of professional archaeologists drawn from different backgrounds of race, class and political attitude, it is inevitable that differing views of society will proliferate. The challenge of the next few years will be to find a language within which to present and debate competing pictures of society which does not prejudge the issues in advance of the debate. How far the narrative structures through which we presently discuss past societies make such an open debate possible remains to be seen.

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There is no one book which adequately surveys approaches to prehistoric society. An extremely important general account of trends within archaeology is contained in Trigger (1989). Between them, Stocking (1987) and Kuper (1996) provide a good overview of the history of anthropology. Clear programmatic statements of the various positions distinguished here are given by V.G.Childe (1957) *The Dawn of European Civilisation* for the culture historical approach, by C.Renfrew (1984) *Approaches to Social Archaeology* (Edinburgh: Edinburgh University Press) for the processualist stance and by I.Hodder (1986) for some elements of post-processualism. The essays gathered together in Spriggs (1984) give the best single volume overview of the themes tackled by Marxist archaeologists. An enlightening debate on processual and post-processual archaeology by many of the major participants is contained in *Norwegian Archaeological Review* 1989, volume 22 (1). The most recent and varied reading derives from the post-processual school. Notable titles include the first concerted attempt to develop a feminist approach to archaeological data by Gero and Conkey (1991) and efforts to include Nietzsche and Derrida within archaeological discussions by Bapty and Yates (1990), plus a range of mainly historical archaeological studies in McGuire and Paynter (1992). Major case studies include Hodder (1990), who tries to identify long-term symbolic structures in Europe from the Palaeolithic to the end of the Neolithic, and R.Bradley (1990) in his *The Passage of Arms* (Cambridge: Cambridge University Press), where he examines the deposition of hoards over a number of millennia from the Neolithic to the Iron Age. J.Barrett (1994), in *Fragments from Antiquity* (Oxford: Blackwell), also provides an influential case study within a post-processual framework.

13

SETTLEMENT AND TERRITORY

John Bintliff

INTRODUCTION

In 1970 Vita-Finzi and Higgs published a challenging and entirely novel proposition for the archaeological community; namely, that human communities throughout history and prehistory practised territorial behaviour in regard to their exploitation of landscapes. We were thereby offered an exciting new methodology for research in the delineation and analysis of such territories—Catchment Analysis (Vita-Finzi and Higgs 1970). Throughout the 1970s, many scholars adopted the technique in widely separated countries around the world, not least a generation of researchers based in the home of this 'palaeoeconomy' approach, Cambridge University. However, during the 1980s and into the early 1990s only limited publications have appeared in which territorial theory has been employed by archaeologists, despite a continual growth in interest amongst cultural anthropologists. The reasons for the limited success of the approach are varied, but can broadly be ascribed to philosophical and technical difficulties.

During the late 1960s and the early 1970s, archaeology in the West was revitalized in both practice and theory by the impact of New or Processual Archaeology, associated with a proliferation of new ideas and methods. Challenging approaches from ecology were just one strand in this burgeoning of new concepts (Clarke 1972: 6–7, 46–47). By the early 1980s, however, there had occurred a critical redirection of archaeological theory away from processualism into structuralism (Hodder 1982b) and later forms of post-processualism (Hodder 1986). In contrast to the development of theory in related disciplines with a far larger research community such as geography, history and social anthropology, new directions in archaeological theory during this century appear to be associated with the displacement and rejection of earlier theoretical systems, rather than with the cumulative growth of a spectrum of complementary or alternative approaches (Bintliff 1986).

Central to post-processualism is philosophical idealism, which diverts research attention from forms of human behaviour shared with the rest of the animal kingdom towards a supposedly unique capacity for humans to create the world around them. This, some critics say, takes the study of human communities in the direction of an anthropocentrism which is pre-Freud, pre-Darwin and even pre-Galileo. Effectively it has certainly taken human ecology as a variant of general ecology out of the attention of most archaeologists, although contemporary concern about the Earth's resources and our future as an element in world ecology are at a high level of public awareness. In fact this shift towards idealism in archaeological theory and that of all other human-centred disciplines has far more to do with contemporary economics than world ecology (Bintliff 1991, 1993, 1995).

If it can be argued that ecological approaches, especially Catchment Analysis, have been neglected in archaeology for a priori reasons since the later 1970s, we can also identify intrinsic, technical, problems which have prevented a wider recognition of the major potential of such a methodology and hindered its general acceptance as a tool of settlement archaeology. Fundamentally, it must be admitted that after the pioneer paper by Vita-Finzi and Higgs, only limited modifications were made to the theory of human territoriality in archaeology, leaving a growing number of weaknesses and criticisms unresolved and even unanswered by its practitioners.

It is not the purpose of this chapter to seek to restore human ecology to its proper role as a major focus of archaeological interest, but it *is* intended that it should resolve outstanding problems with territorial analysis and thereby provide a firm foundation for the latter's general application to ancient settlement systems.

HUMAN TERRITORIES: THE DEVELOPMENT OF A METHODOLOGY AND CRITIQUES

In the initial publications of Site Catchment theory, Vita-Finzi and Higgs and colleagues were able to cite a limited body of observations from ethnography and human geography (such as Chisholm 1962:73, 142ff.) in support of 'quanta' in human territorial size which could provide the basis for the operation of territorial research in the field. Thus it was suggested that hunter-gatherer settlements might be associated with territories of up to a 10-kilometre radius from the home base, pastoral herder sites with some 7.5-kilometre radius of territory, and farming communities with a 5-kilometre territorial radius. The fundamental explanation for such regularities lay in the related principles of least effort and land rent: as members of a human community travel out into the landscape surrounding their residential base, the work they can accomplish in food procurement declines with increasing distance due to time lost in return travel. With the increased productivity per square kilometre of landscape made possible through the adoption of domestic animals, and even more so through the discovery of cereal cultivation, the large size of hunter-gatherer territories was reduced in societies with a predominantly pastoral and agricultural economy, since smaller areas closer to the settlement both offered equivalent quantities of food and required more intensive labour that could not be diluted through time-consuming travel.

From an admittedly slim number of empirical observations, the Cambridge palaeoeconomy group suggested that a global average of human walking-time of some 5 kilometres an hour would allow archaeologists to set territorial radii for sites in each of the three main economies (hunter-gatherer, pastoral and cereal farmer) at a 2-hour, 1.5-hour and 1-hour distance respectively from the settlement. In practice (Jarman *et al.* 1972), practitioners of catchment analysis had soon realized that map distance for walking-times of 2, 1.5 and 1 hour varied according to physical relief: thus on a completely flat plain without a major river crossing, one might walk as much as 7 kilometres in an hour, whereas in very rugged hill country the same time would find one as little as 2 to 3 kilometres as the crow flies away from the settlement. In most cases the deviation between map distance and walking time is not great, and many case studies have continued to use compass-drawn radii for boundary definition. For detailed work, however, it is clearly advisable that walking-time provides the more exact measure of catchment radii.

Proceeding from the delimitation on a map of these circular boundaries, the catchment analyst would plot the distribution of varying land classes, topographic details, vegetation and water resources within the territory so defined, so as to 'read the mind' of those past settlers who located their residences in order to exploit these particular resources. Not only would one expect to discover that the overall bounded territory was especially favourable for the needs of that past community, but a further consideration of the underlying principle of the friction of distance would suggest that, even within the territory, those resources to be given most attention or demanding most labour would be found closest to the home base. Thus it was predicted that the evaluated contents of the bounded territory would be found to be unusually rich in those resources exploited by the past community, compared with their distribution in the region as a whole (for example, conditions favouring the proliferation of wild plants and animals, grazing opportunities for domestic animals, fertile soil for cultivated crops). Furthermore, following the model of von Thünen, the ancient settlement might have been surrounded by a series of land use zones, up to the territorial boundary, all concentric around the residential focus, with those subsistence activities demanding most labour being practised in the innermost zones, and the least demanding economic activities being carried out in the outermost zones.

A fundamental criticism of territorial analysis takes issue with the central assumption that past human communities have adapted their behaviour to ecological principles, either intuitively or consciously. Confronted with the apparent ethnographic evidence for territoriality, the response has been to cite alternative case studies where human settlements appear irrationally sited for economical use of the landscape, and where 'uniquely human' needs are dominant over ecological pressures (social factors, ritual factors, and so on).

It is certainly the case that territorial analysis deliberately confines its sphere of operation to those past settlements where it is believed that the majority of the inhabitants were concerned with food production from local resources, and excepts sites of an essentially military, cult, industrial, or commercial character. None the less, in the pre-industrial world only a tiny fraction of settlements will not have been predominantly located for exploiting the food resources of their immediate environment, still leaving vast scope for catchment analysis. This criticism is only valid if it can justify the claim that essentially food-producing settlements could be located *without primary concern* for access to areas in the landscape vital for their economy.

Examination of supposedly ecologically irrational settlement systems tends to reveal sound ecological principles. Two examples will suffice. Ian Hodder (Hodder 1982a; Hodder and Orton 1976) cited Jackson's survey of studies on African cultivators, where quite often the village site is surrounded by an extensive zone of the poorest agricultural land, beyond which lies far better soil. In fact a close study of the relevant case studies (Bintliff 1981) revealed that the reason for this situation was prolonged, intense, cultivation of the area closest to these villages in a landscape with naturally poorly developed soils, resulting in soil impoverishment. This society practised a cyclical relocation of villages onto fresh soils when land exhaustion reached a critical level, in a pattern of shifting agriculture. In other words, this example serves rather to reinforce the principles underlying catchment analysis.

A second example concerns the Nuba of the Sudan, whose farming villages lie along very poorly resourced ridges, avoiding fertile valley land below (Hodder 1982c:127ff.). Essential to our full understanding of this settlement 'preference' is the fact that the valley land has become occupied by a different ethnic group which has driven the indigenous people into marginal hill locations for their livelihood. The ecological archaeologist, provided that his or her dating methods allow the inference that these two settlement systems are contemporary and complementary, will be less concerned with the question of why the hill culture does not occupy the plains, than with understanding how and why the marginal lands sustained settlement by a different cultural group. There is, none the less, a genuine point to learn from here, in that a given community may find itself forced to make a livelihood in a particular environment, rather than having the luxury of an empty landscape and total choice.

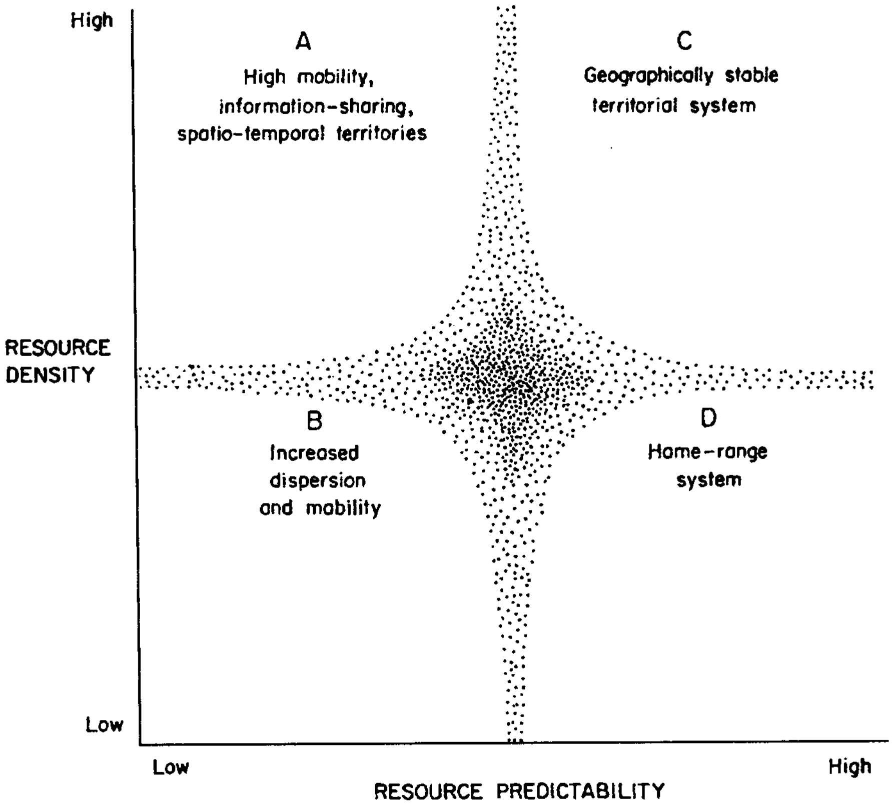
Military pressure from more powerful cultures is one factor in history; another, perhaps commoner, factor is the cyclical occupation of marginal lands resultant from pressurized population overspill out of more fertile heartland environments.

The lesson for catchment analysis is, however, a minor caveat: the researcher must extend the range of questions asked of a particular settlement location beyond the usual one of 'why did people choose this spot?', to include 'if this spot was a settlement focus, what are the advantages and limitations of its territory?' In a sense, both these questions are directed to the unchanged central aim of catchment analysis, which is to evaluate the way that—intentionally or otherwise—a given site location will be intimately related to the economic practices of that settlement's inhabitants. The way that microclimate, topography, soil types, and grazing potential are distributed within the territory, and how these factors vary with distance from the settlement, are critical considerations for the demographic history of the community and the economic options taken, regardless of whether the settlers chose to locate here or were forced to make a living from that spot.

A FLEXIBLE MODEL OF TERRITORY

Hunter-gatherer societies that survive today, or which survived until recently, exploit on average larger territories and have lower-density populations than either predominantly pastoral or predominantly arable communities. Yet there is a striking range of behaviours consistently associated with the density and predictability of hunter-gatherer resources, although recent research modifies environmental determinism by showing how communities culturally select their range of resources before adapting to the latter's parameters. A minority of hunter-gatherer groups lives in particularly prolific resource zones (for example, the north-west Pacific coast) where food is especially abundant, predictable, and spatially very concentrated: such unusual circumstances overlap with the resource potential available to communities practising herding and farming of small landscapes.

Dyson-Hudson and Smith (1978) argue from a wide range of such examples that the nature, scale, and importance of territory to a human group vary systematically with the properties of key resources available to and/or selected by the group as central to its economy (Fig. 13.1). Where resources are neither concentrated nor very predictable (Mode B), the human group will exhibit little or no systematic territorial behaviour. The group will be very mobile and exploit a very wide and annually or seasonally variable range of landscapes, heading opportunistically for the most favourable resource zones each season. Since the latter will shift across the countryside, characteristic relations with other human groups will be open and unaggressive. There are no 'hot spots' of high resource potential worth laying preferential claim to as a territorial focus, and shared access between groups to a wide area of low-density resources is a policy of most benefit to the individual group. Families may shift residence between groups to increase adaptiveness.



RELATIONSHIP BETWEEN RESOURCE DISTRIBUTION AND FORAGING STRATEGY.

	Resource Distribution	*Economic Defendability*	*Resource Utilization*	*Degree of Nomadism*
A.	**Unpredictable and Dense**	**Low**	**Info-sharing**	**High**
B.	**Unpredictable and Scarce**	**Low**	**Dispersion**	**Very high**
C.	**Predictable and Dense**	**High**	**Territoriality**	**Low**
D.	**Predictable and Scarce**	**Fairly low**	**Home ranges**	**Low-medium**

Figure 13.1 Model for the creation of human territoriality. Reproduced by permission of the American Anthropological Association from *American Anthropologist* 80:1, March 1978. Not for further reproduction.

In Mode A, the predictability of resources remains low but their occurrence is now localized into 'hot spots'. For the human groups concerned, this still requires a wide-ranging annual territory, and the precise location of key localized resources remains uncertain from season to season. It therefore continues to be infeasible to try and appropriate blocks of landscape as a preferential group territorial focus. On the other hand, key resources are focused into small areas, even though their position cannot be predicted. The required behaviour will be high mobility around a large landscape, and information-sharing between groups enabling a general concentration on 'hot spots' at certain times of the year.

Mode A already contains the seeds of a more sedentary and localized behaviour within the landscape. In Mode D, resources are found in low-density form but now with great predictability across the landscape. This still means that a human group needs potential access to a wide territory each year, but the requirement of inter-group shared access is obviated by the assurance that many distinct areas of each region have a reliable productivity. Under such circumstances, it is argued that each human group assumes preferential access to a particular district, its 'home-range', whilst foraging wider alongside other groups to complement and buffer over-dependence on the home-range. In the Australian Aborigine system, even the home-range can be used by other groups with the permission of the 'owners'; that is, if extremely severe years do not cause a critical reliance on the home-range.

Finally, Mode C represents the behaviour of human groups where resources are both highly predictable and very dense. Here cooperation and open access to the wider landscape are replaced by a systematic close tie between each group and a specific area; here resources are adequate for that group's flourishing and are sufficiently localized to sustain a behaviourally limited form of exploitation, perhaps from a single point of sedentary life central to the territory. Outsiders have little or no access to this narrow territory.

The sequence B-A-D-C is a trend of increasing behavioural focusing and territoriality. At one end of the spectrum, human groups can have fluid membership and no specific attachment to particular areas of landscape; at the other, the human group can become largely endogamous, with a fixed membership and economic behaviour highly localized on a territory largely or wholly claimed by the group for itself. In essence, we may expect the sequence broadly to mirror the behavioural implications of the increase in productivity achieved by the adoption of domestic plants and animals, and later by increases in economic productivity per acre occasioned by innovations such as the Secondary Products Revolution, animal traction and the plough (for both, see Sherratt 1981), developed bronze metallurgy and the spread of iron-working (Bintliff 1984, 1997). In the case of prehistoric Europe, from Palaeolithic to Mesolithic, then to Neolithic, Copper and Bronze Ages into the consecutive phases of the Iron Age, we would expect human behaviour on average to have become more territorial and more localized.

A second figure from anthropological case studies (Fig. 13.2) demonstrates how the entire range of minimal to maximal territorial behaviour may be found

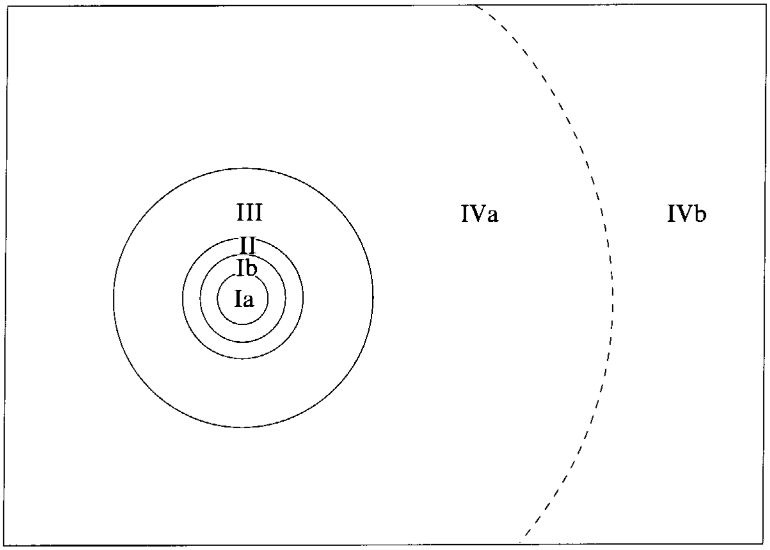


Figure 13.2 Concepts of radial territoriality in south-east Arabia. Ia: permanent cultivation (tree crops); Ib: permanent cultivation from less reliable base flow (alfalfa); II: seasonal crops; III: village grazing and sown land; IVa: mixed-herding nomads; IVb: camel-herding nomads. Source: Wilkinson 1983.

in a single historic landscape, in this case the traditional Middle East (Wilkinson 1983). In the centre of this district of south-east Arabia is a fertile oasis with perennial, abundant, irrigation water and highly intensive garden agriculture (Ia); its fields are privately owned and jealously guarded from outside access, whilst residence remains close to the resource and movement to subsistence activity minimal within the small zone concerned. Immediately concentric are other zones used by the sedentary village, but where water availability is less secure; in turn, permanent fodder crops, then seasonal crops (Ib and II) yield to village grazing (III). Formally delimited holdings and restricted family access are transformed into more communal, shared, access along this axis. Beyond this block of highly productive land use, significantly characterized by its exploiters as the 'sown' lands, lie the 'desert' lands, where water availability and average productivity drop to a low level and where extensive forms of land use are the rule, with flexible area use by year, season and month. Even here there is a distinction between the less arid and more vegetated sheep-goat zone (IVa) and the extremely arid camel-grazing zones (IVb), accompanied by a difference in the concept of grazing rights.

In summary, the total spectrum of land use here, conditioned primarily by the remarkable contrast within small distances in productive natural resources, creates a parallel spectrum of territorial behaviour, in which strictly private and spatially well-defined territory is modified by the other end of the behavioural spectrum to almost non-existent territorial behaviour as regards use of camel-grazing in the inner deserts. Notably, however, critical wells within the desert zone form miniature replicas of the oasis effect, as their rareness and predictability cause 'islands' of extreme territoriality to emerge in and immediately around them. We might consider the Arabian case to exemplify the broad trend from least-intensive forms of hunter-gatherer land use to most-intensive forms of commercial agriculture, and to represent to us the main lines of the development of territorial behaviour in world economic prehistory and the history of rural life.

HUMAN TERRITORIES: FROM STATIC TO DYNAMIC MODELS

A more consciously constructive critique of catchment analysis to that of Hodder, which will offer us a springboard for a thorough reworking of the approach, can be found in that masterly textbook of mature New/Processual Archaeology—Kent Flannery's (1976) *The Early Mesoamerican Village*. Central to Flannery's contribution to territorial analysis is his case study of the early maize-farming communities along the Atoyac Valley in the north-eastern district of the Oaxaca Valley (Fig. 13.3).

The first thing to note is that the settlement system along the valley can be understood dynamically, providing us with invaluable insights into changing attitudes to inter-site spacing and hence catchment boundaries. The earliest settlement is that of San José Mogote in the valley centre, significantly in one of the most fertile locations where the valley bottomlands are unusually broad. We cannot estimate its original catchment by internal evidence, in the absence of neighbours, but we might reasonably speculate that most of its subsistence activities will have lain within a classic 5-kilometre or 1-hour radius (T1). Some confirmation for this stems from the second phase of farming settlement in the valley, when two new hamlets (Sta. Marta Etla and T.Largas) are established upstream and downstream of Mogote, plausibly by colonization from the founder village. As Flannery shows, the three farming hamlets of this stage are so regularly spaced as to imply a 5-kilometre radius territory for each (T2).

In a third stage of settlement evolution, a further two hamlets are established in the valley, but this time they are positioned exactly intermediate to the existing three hamlets. Once again Flannery suggests that these represent population overflow from the existing hamlets, and illustrates how the implied territorial network has been transformed into a rather exact series of 2.5-kilometre radius catchments (approximately half-hour territories) (T3). There is in fact one final stage of new foundations, where very small foci appear within some of these territories, apparently close satellites of the main settlements. It is also significant that, whereas

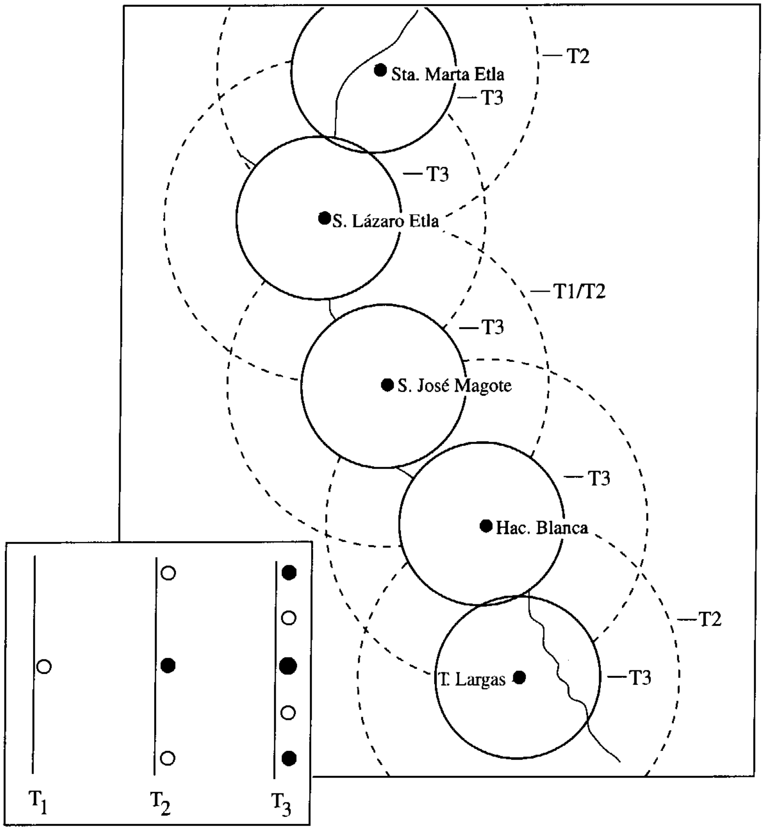


Figure 13.3 Early Formative villages along the Atoyac River in the north-eastern Valley of Oaxaca (Mexico); catchment circles with radii of 2.5 kilometres (solid line), 5 kilometres (dashed line). Inset: idealized model of settlement evolution along the Atoyac River during three temporal phases. Source: Flannery 1976.

Mogote exhibits a continual population rise until it represents the 'central place' for the valley, the other four main settlements remain as small hamlets for upwards of a thousand years, suggesting that their half-hour interval network approximates to a kind of long-term stability.

Flannery's thoughtful discussion demonstrates a dynamic development of territory size, so that we may conclude that the 5-kilometre farming radius may operate in certain settlement scenarios, such as pioneer farming 'infill' situations, but not others, with mature 'filled' farming landscapes stabilizing into 2.5-kilometre radius catchments. It also raises an unexpected but crucial difficulty: given that the Atoyac valley settlements are located to give prime access to the most important local resource—the fertile valley bottomland, for maize agriculture—how much territory is required to feed the estimated population of the five major settlements?

All but Mogote are argued to have been quite small hamlets of less than a hundred people, and their chief needs would have been met by a very small area of alluvial land indeed. Even Mogote at its peak was probably not straining the alluvial land's productivity within its 2.5-kilometre radius territory. It is therefore undeniable that the initial 5-kilometre radius and even the later stable 2.5-kilometre radius cannot arise from an area of land required by these settlements for intensive land use: they appear to have far more territory than they really need.

Flannery's solution is to shift discussion away from resource control towards social factors. When Mogote colonizes the valley with daughter settlements, the intervening distance is not economic but 'social'; the same must hold for the subsequent division of territory to provide discrete territories for the next group of daughter hamlets. Groups leaving older hamlets settle near their relatives, but maintain a greater separation in space than simple land use economics require, for reasons to do with their evolving social organization. Flannery does not offer any additional information about how these social factors operate, and it rather appears that this is a tentative suggestion to replace the seeming inadequacy of simple environmentalism. As we shall see later, social factors do indeed have a fundamental role to play in the establishment of village networks like that in the Atoyac valley, but there are more plausible ways to account for regularities in settlement spacing and associated territory size which remain within the realm of functional economic behaviour.

It is important to remind ourselves that case studies of settlement networks in many different parts of the world reveal a similar propensity for evolving community patterns to settle into regular spacings. In what follows, I shall narrow our focus onto pre-industrial mixed farming societies. Do we find that such systems repeat the ideal maxima of catchment analysis, or dynamic 'nested' patterns as in the Atoyac valley?

Dennell and Webley's (1975) neolithic Bulgarian *tell* villages show a tendency to crystallize into territories of some 3–4 kilometre radius, relatively stable over more than a millennium (inter-site distance is 5–6 kilometres, but the territories are asymmetric to the *tells*). In a very different area and time period—ninth-century AD Brittany—plentiful historic sources show an established village pattern (*plebes*) with a consistent inter-site distance indicating territorial radii of 3–4 kilometres (Davies 1988; Fig. 13.4); however, during high medieval and early modern times, parish numbers almost doubled, giving average radii of 2–3 kilometres. In early medieval Holland, settlement territories have been inferred with a 2.5-kilometre average radius (Heidinga 1987). In high medieval northern France, a typical village territory was 2.5 kilometres in radius (Pounds 1974:188), whilst contemporary English village parishes cluster into two groups: early 'heartland'/secondary pioneer

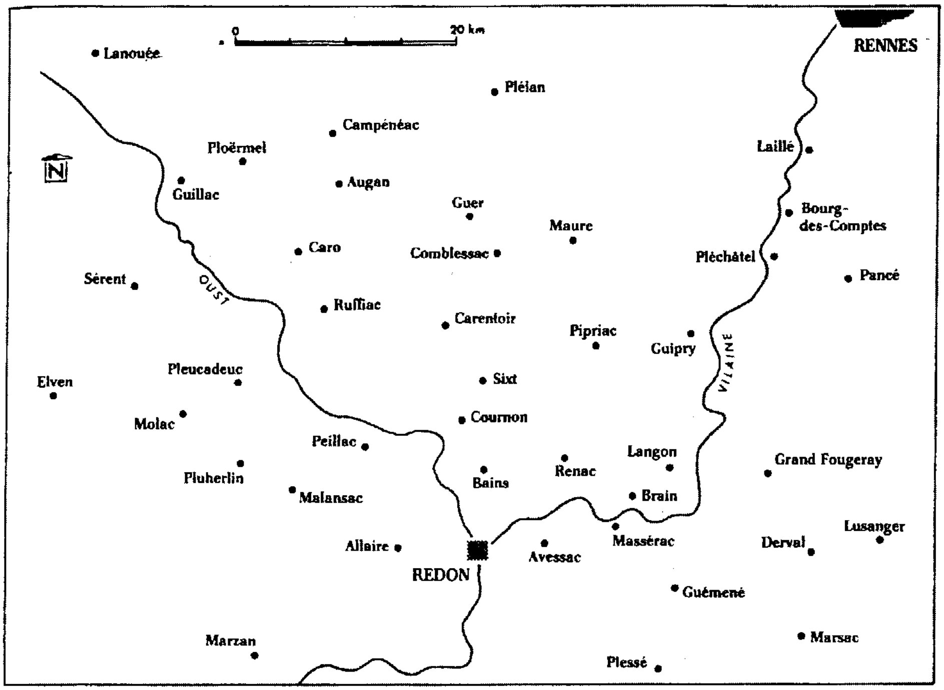


Figure 13.4 Ninth-century AD 'plebes' and 'plebiculae' (villages and hamlets) in Brittany. Source: Davies 1988.

woodland larger territories of 2–3 kilometre radius; and secondary infill/ upland smaller territories of 1–2 kilometre radius (Beresford and St Joseph 1979; Everitt 1986). Brian Roberts's detailed study of Warwickshire medieval village territories (1977) found a median of 2.5 kilometres to their boundaries.

In fact, settlement systems with radii of 2–3 kilometres, comparable with Flannery's inferred stable Mexican pattern, are hitherto the most frequently represented. Ellison and Harriss (1972), in their territorial analysis of southern English settlement systems from bronze age to early medieval times, found a radius of 2 kilometres most appropriate from empirical indications. In Classical Greece (Bintliff 1994), mature systems of villages and small towns in central Greece gravitate around a territory of 2.5-kilometre radius (Fig. 13.5), as does the remoter countryside of the hinterland of ancient Athens (Fig. 13.6); however, in the immediate environs of Athens, much smaller village territories of 1–2 kilometre radii appear.

It is clear from these archaeological and historical case studies that a number of what we might tentatively call 'settlement quanta' are becoming recognizable in farming territory dimensions—recurrent values, or better: ranges of values. When

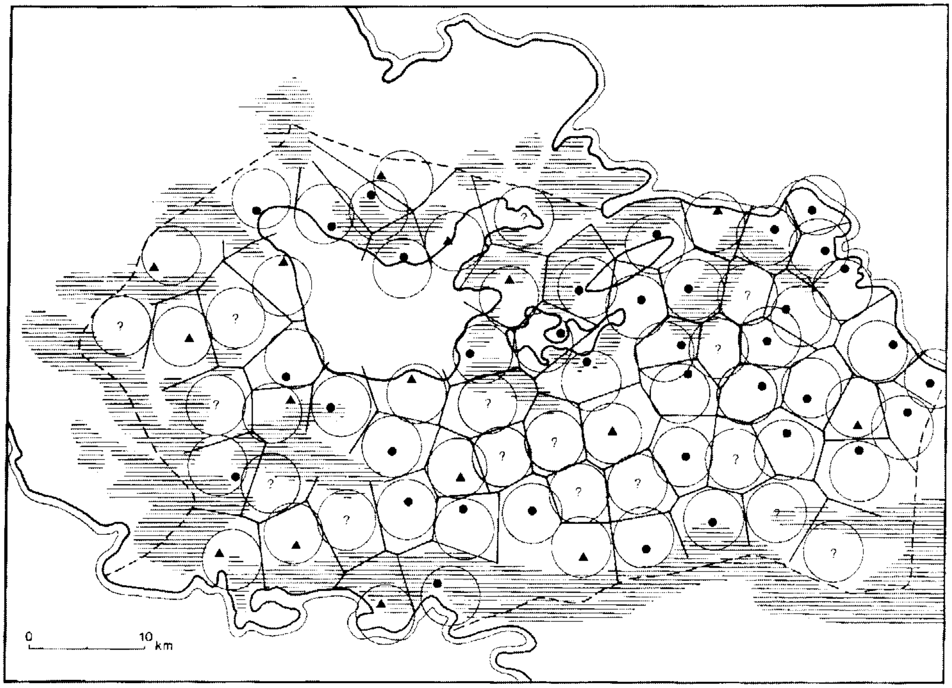


Figure 13.5 Known (solid symbols) and hypothesized (question-marks) nucleated settlement system in the classical era for the region of Boeotia, central Greece; cities are indicated by triangles, villages by circles. Best-fit circles of 2.5-kilometre radius have been fitted within village-city subsistence territories first defined through Thiessen polygons (the solid line cells). Shading represents infertile uplands. Source: J.Bintliff 1994.

information is detailed enough to allow us to follow the evolutionary dynamics of a settlement system, we sometimes observe the metamorphosis of a network from one set of values to another, usually smaller, set. It is not problematic to detect the underlying mechanisms at work, which are the same that we have observed in the Atoyac valley: as a landscape is populated by villages, large territories are established first, but over time the further multiplication of settlements occurs through infill between pioneer communities, an accommodation achieved through the progressive subdivision of land at the expense of existing territorial units.

This transformational series may be hypothesized to include quanta from a 5-kilometre radius, through 3–4 kilometres, to 2–3 kilometres, and finally to 1–2 kilometres, rarely to less than 1 kilometre. Flannery's Atoyac valley seems to move directly from 5 to 2.5 kilometres without an intervening stage, and finally gives rise to occasional tiny satellite hamlets nested within the 2.5-kilometre territory and with arguably less than 1-kilometre radius catchments. It is likely, however, that

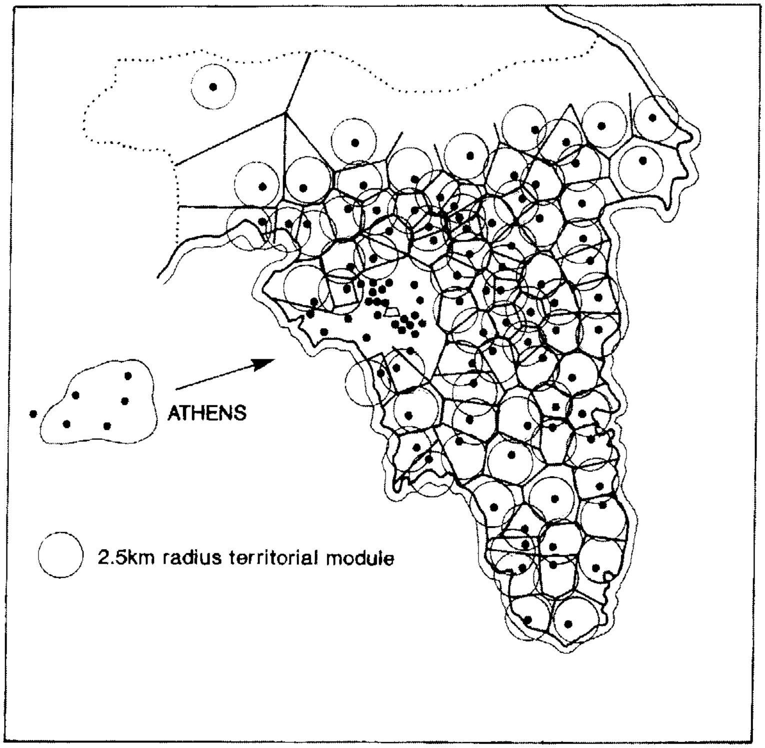


Figure 13.6 Known village communities in classical Attica (the territory of ancient Athens): territorial analysis through Thiessen polygons (the solid line cells) within which a best-fit module of 2.5-kilometre radius has been fitted, with the exception of the dense cluster of villages around Athens city itself. Source: J.Bintliff 1994.

Flannery has omitted to take account of the rather special characteristics of riverine settlement networks; to investigate this, we need to consider the geometry of territory.

THE GEOMETRY OF TERRITORY

The evolution of Atoyac valley settlement was constrained by the linear character of the river, since the prime locational attraction for its early farming villages was river alluvium for highly productive maize agriculture. As villages multiplied they expanded in axial, one-dimensional mode upstream and downstream. None the less, as Flannery reminds us, villagers in the valley were also regularly exploiting a wider range of resources in the adjacent piedmont zones and remoter upland areas on either side of the river. If the initial hamlet of Mogote and its first wave of two daughter settlements suggest a territory of 5-kilometre radius, this is largely taken up with such non-riverine landscape (cf. Fig. 13.3, stages T1 and T2). The restriction of settlement expansion to a riverine, one-dimensional, axis produces clear boundary restrictions along the river, with inter-site distances being reduced from 10 to 5 kilometres with the second wave of settlement infill (T2 to T3). Significantly, however, there continue to be no restrictions on the lateral extent of village territories (Fig. 13.7a), which will doubtless have remained at their full extent. In other words, approximately circular territories of 5-kilometre radius were converted into more narrow, rectangular, territories with a 2.5-kilometre radius upstream and downstream, and a 5-kilometre radius on either side of the river. Although Flannery represented the evolution of settlement as a process of halving the territorial radius, in fact this only operates on the one-dimensional river axis. On his interpretation, the actual subdivision of territory from a 5-kilometre catchment to one of 2.5 kilometres would be not a halving but a quartering of territory. In actuality, as can be seen through Thiessen-polygon analysis, when the three early hamlets increase to five, territories of approximately 5-kilometre radius decrease to oblong catchments some 2.5-kilometre radius on the one river axis and 5 kilometres on the other, resulting in a halving of territorial area, in predictable conformity to the regular interstitial location of one new hamlet between each pair of existing hamlets. If the Atoyac T3 territories had been exactly concentric rather than asymmetric, their radius would be around 3–4 kilometres.

It is generally advantageous to combine the overall concept of radial territories with empirical outlining of likely boundaries between neighbouring sites utilizing a technique such as Thiessen polygon analysis, so that asymmetrical territories can be identified at an early stage. Thiessen analysis is a simple method for suggesting plausible boundaries between territories of settlements considered originally to have been of comparable status, and operates as follows: connecting lines are drawn faintly between each contiguous settlement, then bisected, with strongly emphasized lines being drawn at right angles to the bisection points; these lines at right-angles to connecting lines are then extended until they bisect each other, thus creating polygonal cell walls around each settlement—the Thiessen Polygons. On the reasonable principle that a boundary between two communities of comparable status is more likely to be at a midpoint between these settlements than close to one particular community, these midpoint cell walls are taken as approximations to actual territorial divisions.

What axial settlement networks emphasize is the path of the priority resource zone and its properties, so that continued village colonization produces skewed territory shapes. This process was shown very clearly by Ellison and Harriss (1972) in their analysis of the well-known 'strip-parishes' of the southern English chalk downlands (Figs 13.7b and 13.7c), where early medieval settlements multiply along valley systems through continuous subdivision of valley land (early settlements white,

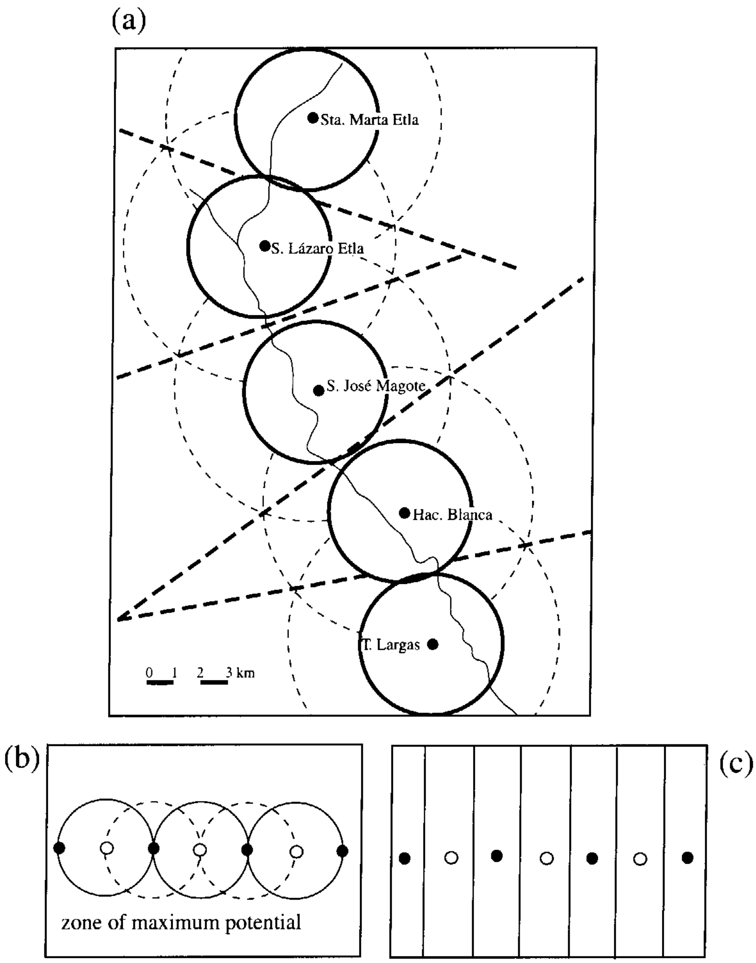


Figure 13.7 (a) Formative villages in the Atoyac valley, Mexico, with 2.5-kilometre radius territories modified by Theissen polygon analysis, (b) and (c) creation of strip territories through linear infill along a preferred resource band, (a) Source: Flannery 1976; (b) and (c) Source: Ellison and Harriss 1972.

secondary black), whilst retaining similar lengths of elongated territory stretching up onto plateau country to either side.

The other examples of territorial quanta for farming systems that we cited earlier do not belong to axial systems like the Atoyac valley, but to a much commoner form of settlement evolution in which desirable resources extend in all directions. These two-dimensional systems are typified by villages which multiply across the landscape

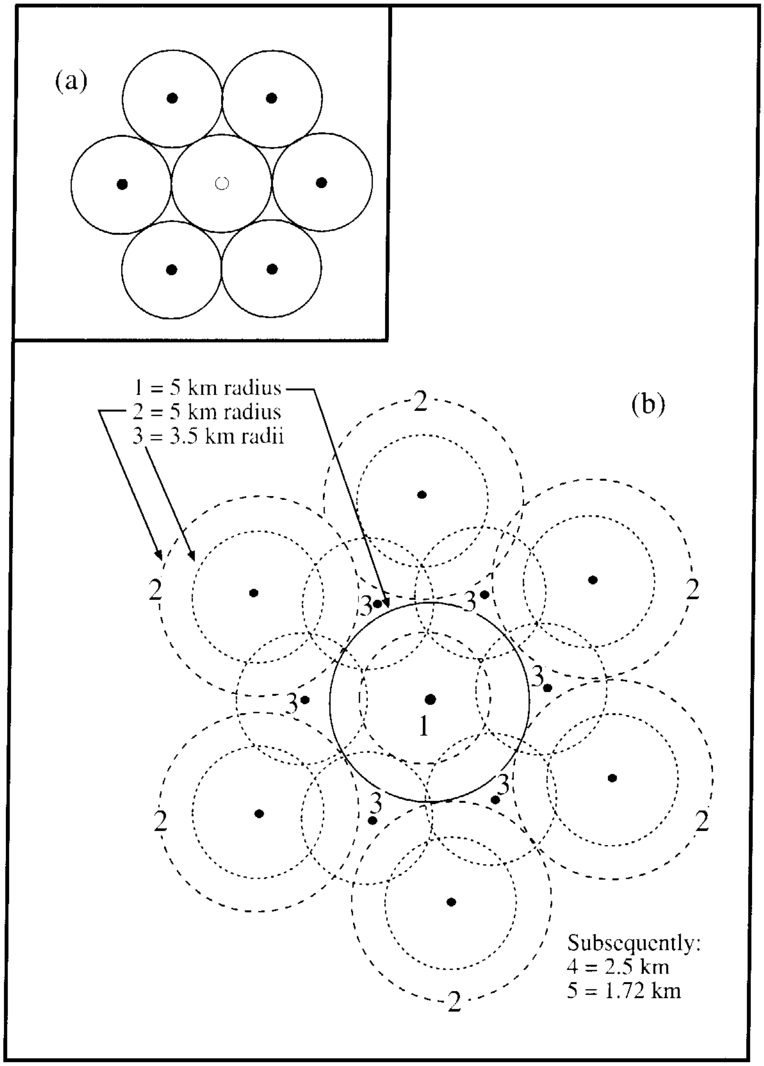


Figure 13.8 (a) Two-dimensional settlement expansion model (re-drawn from Ellison and Harriss 1972: fig. 24.16); (b) model of secondary expansion 2 from primary settlement 1 followed by tertiary interstitial infill 3. Source: J.Bintliff.

in all compass directions from primary colonies (Fig. 13.8a). If we rerun the dynamic spread of farming villages, this time allowing daughter colonies to spread in all directions from a single pioneer community before interstitial infill, the sequence might run as follows (Fig. 13.8b): pioneer village colonizes its surroundings (Phase 1); in an ideal scenario a single, 5-kilometre radius, origin community would eventually be surrounded by a complement of six secondary hamlets each with a 5-kilometre radius catchment (Phase 2); if a tertiary series of daughter villages was founded between all the existing six villages, the new radius for all hamlets becomes 3.5 kilometres (Phase 3); if a further series of daughter settlements infilled between the tertiary network, average catchment size for all settlements decreases to a 2.5-kilometre radius (Phase 4); a final subdivision of existing territories accommodates yet one more series of daughter settlements appearing between all previous hamlets, producing average catchment radii of 1.72 kilometres (Phase 5).

Three points are worth making in connection with this geometrical series of colonizing and infilling villages. First, although it might seem overly mathematical and 'inhuman' to reduce human settlement history to a game of landscape geometry, as if ancient farmers went out each time marking boundaries in fractions of modern kilometres, actually we are merely reducing to quantitative form a very simple operation: the equal division of an existing territory between an old village and new neighbours appearing between it and its former nearest neighbours. In effect, the territories of each stage of settlement are being subdivided by half to give land to interstitial colonies. This basic series of equal subdivision produces the observed series of decreasing catchment radii with each new generation of settlements, from 5 to 3.5 to 2.5 to 1.72 kilometre radii. Of course there is no reason to suppose that these exact figures were duplicated in the real process of dividing lands equally with daughter settlements, rather one might look for settlement networks peaking in the following ranges of quanta: *c.* 5, 3–4, 2–3 and 2–1 kilometres as plausible evidence for different stages in the maturity of agricultural settlement infill in particular landscapes.

Second, our discussion of settlement geometry dynamics underlines the importance of delineating the overall shape and symmetry, or asymmetry, of empirical territories, through a simple technique such as Thiessen polygon analysis, rather than taking a measure such as inter-site distance as a reliable guide to the average radius or radius-equivalent of a settlement's catchment. Villages may appear to cluster closely when they locate on a restricted resource which is clustered, but their individual territories may extend asymmetrically to greater distances as in the Atoyac valley, or the strip parishes of Saxon England. In contrast, in a landscape where resources vary little two-dimensionally or are found widely if discretely, settlement locations may be found to approximate closer to the geometric focus of circular territories, as in Classical Greece, ninth-century AD Brittany and neolithic Bulgaria.

Third, our proposed colonization model is strikingly comparable with that developed by Bylund from theoretical and empirical evidence for the early modern colonization process in northern Sweden (Bylund, 1960: fig. 4, Model F).

A final variation can be noted: if resources are 'isotropic' (equal in all directions), settlement territories will not only tend to recurrent size/radius/quanta and be evenly packed across the landscape, but the village or hamlet will tend to be exactly central to its territory. If, however, resources are distributed patchily across the landscape, and/or the settlement focus requires localized factors such as spring-water or a defensive position, the village may occupy a position asymmetric to its modular territory. Thus in Figures 13.5 and 13.6 the modular territories have been defined by Thiessen polygons and the module size detected through placing best-fit standard-radius circles within them. Providing that distances are limited to the furthest boundary (usually less than one hour), the friction of distance will allow such asymmetries as a trade-off against other locational considerations.

FLANNERY'S CARRYING CAPACITY CRITIQUE

Through our examination of Dynamic Catchments we have developed a new, flexible model of farming catchments 'nested' over time as the settlement system matures, population rises and existing territories have to be equably subdivided. In fact we can suggest that only two additional explanatory elements are needed to supplement the 'territory halving' process, in order to account for our entire sequence of nested catchments from 5 to 2–1 kilometre radii networks.

The first factor operates at the very beginning of farming settlement sequences, and relates to a putative outer, limiting, parameter of a 5-kilometre or 1-hour radius catchment. In Vita-Finzi and Higgs's first statement of Site Catchment Analysis this radius was considered as a recurrent constraint for farming sites. The figure originates essentially from observations in recent rural societies in various parts of the world where traditional technologies dominated, being indirectly derived from Chisholm's (1962) generalization that distance constraints become significant in a 2–4 kilometre radius from the farm and lead to little intensive agriculture beyond 5 kilometres. Interesting and promising though this statement is, it is perhaps surprising that empirical evidence *can* be found in archaeological and historical settlement systems for the effective operation of such a quantum in conditioning pioneer catchment boundaries. The initial infill of the Atoyac valley is such a case in point. It is also possible to simulate the creation of later systems with 3–4, 2–3 and 1–2 kilometre radius catchments through the simple operation of a settlement doubling/territory halving principle. According to whether resources are isotropically (relatively widely and equally) distributed, or clustered, these quanta of maturing settlement catchments may be recognized in a 'pure' form as symmetrical territories, sites in geometric focus, approximately circular shape, or 'skewed' form as asymmetric territories, sites decentred, territory shapes irregular. We can further characterize these two modes as 'quantum-radius' and 'quantum-radius equivalent' territories.

We noted earlier that both the first wave of 5-kilometre radius farming hamlets in the Atoyac valley, and the second wave of 3.5-kilometre radius-equivalent settlements, created catchments far in excess of their subsistence needs, with the possible single exception of the prime central-place village of Mogote, based on calculations of population derived from the surface area of these sites. On the face of it, this seems to undermine the initial thesis of Vita-Finzi and Higgs and their sources in human ecology, that catchment sizes are the product of the resource needs of a community and the least effort principle active in obtaining those resources. On this basis Flannery moved to consider 'social' explanations for catchment size.

The natural question to put is why, at a certain stage, offspring settlements begin to appear between existing communities and take territory from them? In the Atoyac case, for example, it is reasonable to consider most of the valley as barely exploited from the pioneer hamlet of Mogote, so that its initial pair of daughter settlements were free to append full 1-hour territories to the borders of their catchment. When the following pair of daughter hamlets was given off, however, it appears that remoter upstream and downstream locations were not available, so that these surplus populations had to be accommodated within the existing territories of older settlements. The same can be claimed for the addition of tiny satellite hamlets at an even later stage, located close to some members of the stable hamlet network.

Here Flannery's observations on carrying capacity of the landscape come into their own: we can now see that such a process of territorial subdivision was not actually problematic, as the 1-hour catchments were something of a luxury for the early hamlets, enclosing more resources than were essential to their comfortable survival. The primary 1-hour radius might be hypothesized to be a maximal resource zone easily buffering the community against shortages, yet compatible with the friction of distance. Indeed, we might suggest that the sequence from 1-hour radius through the other quanta to a 2–3 kilometre radius may proceed quite frequently without undue stress on the communities involved. What was at first obtained at least in part extensively could be produced intensively later, but within a smaller radius. At this point, however, further territorial subdivision could leave a nucleated village community with inadequate 'buffering' against bad harvests, crop pests, and other threats that often strike such societies. Hypothetically, we might see something of the order of a 1-kilometre radius territory as a critical radius, enclosing the necessary resources for farming communities to ensure survival in the long term. This lower limit constitutes our second factor in territorial dynamics.

The most frequently observed empirical quantum is a 2–3 kilometre radius settlement network. It is likely that this favoured range of catchment represents the ideal compromise between the need to move from the ideal 1-hour radius (essentially set by time-labour constraints) to allow for settlement infill within a landscape, and the need to avoid extreme diminution of territory and the threat of disaster from over-reliance on limited resources. A corollary of this train of thought is that settlement systems in the 3–4 and 2–3 kilometre quanta are probably reasonably stable, whilst those in the 1–2 kilometre range may be symptomatic of societies under resource and/or overpopulation stress.

In the above reflections I may have seemed to generalize rather grandly, on a world scale, and without regard to culture or period variations. It is of course necessary to avoid claiming 'laws' of settlement behaviour valid for any time or society, based on a relatively small series of case studies, even if they do surprisingly derive from contrasted cultural contexts and physical environments. So we should set out the scope and applicability of a revised, flexible territorial analysis, for which we have laid the foundations above.

I have tried to demonstrate that empirical research on pre-industrial farming settlements supports the existence of several quanta of territorial size. In some individual examples, settlement networks appear to gravitate from one quantum to the next, smaller, quantum. It can be suggested on theoretical grounds that such sequences are the result of a simple process of subdivision of landscape between parent and daughter communities. The value of these quanta might be set from two enclosing parameters—the 1-hour/5-kilometre radius walking-time constraint, and a critical radius of some 1 kilometre enclosing a survival resource zone, together with the dynamic process of geometric halving. Mature, stable, systems in the 2–3 kilometre range might occur with predictable frequency as a result of population growth, landscape infill, and catchment subdivision, constrained by the desire to control a territory with buffering capacity beyond the quanta of stress and bare survival.

Although it might be expected that in many regions and cultures the first development of farming villages, or subsequent recolonization phases following decline or abandonment, would follow an infill sequence beginning with individual sites adopting the time-conditioned 1-hour radius, it is quite conceivable that settlers spreading outwards from a mature settlement network which had already reached a 'stable' half-hour radius norm might carry that quantum with them. If settlement was large scale under conditions of considerable population pressure, it is also possible that even smaller territories might be established, unless the newly colonized area was reasonably extensive. Only with the painstaking reconstruction of stage-by-stage settlement dynamics shall we be able to identify which of these processes operated in a particular district. The averages quoted above for the size of different types of English medieval parishes may reflect the latter two models at work.

But could farming societies adopt very different forms of settlement, ignoring the pathways that these examples illustrate? We cannot deny this, and it would be against the spirit of the present exercise to claim universal laws. All that we can argue for is an understanding of how particular empirical networks may have arisen. A characteristic of our dynamic modelling is its 'ideal' form. We have tended to speculate in general terms about axial or two-dimensional landscapes, allowing those two to be uniform. In reality, all landscapes are more varied than this, and the precise point chosen for a village may be the result of a combination of locational factors, as already noted in connection with ancient Greek village/city-state territories. Thus the catchment could have been selected both in terms of the overall availability of preferred resources and the position of older settlements, yet within that catchment village location might be influenced by a prominent spring, a defensive hill, favourable winds, a river crossing, as well of course—as we have seen —by the shape of a critical resource. It may be helpful to see locational strategies as a kind of game played out in time and space, in which several factors, some competing, were demanding the attention of settlers at one and the same time. And let us not forget an earlier caveat, that in some societies the rules of that game were largely set to the disadvantage of settlers, when dominant groups displaced or marginalized subordinate communities into restricted environments. In extreme cases of the latter kind, locational decisions may have been made by others, imposing catchment constraints on communities; even so, the study of such territories will be highly revealing both of the pressures such landscapes could impose on village development, and the various ways marginal groups sought to adapt to their particular circumstances such as through the development of special economies, investment in resource enhancement through terracing, water control and so on.

SETTLEMENT SIZE AND SOCIAL SPACE

Two fundamental questions we now need to turn to are: why do farming people live so frequently in agglomerated settlements, typically 'the village'?, and why do villages and hamlets produce daughter settlements which infill the landscape around them?

No family can survive without frequent association with a wider human society: apart from the search for non-incestuous mates to perpetuate the population, human groups require in the longer term the mutual support of a number of families, to provide help in time of sickness, danger, or premature death, to assist in work tasks where several adults are advantageous if not essential, and also to provide a pool of practical lore about resources, technology, and life-skills. One oft-quoted figure suggests that a human group of some twenty-five individuals or more might be the scale of such a minimal support-group required as near-neighbours for a successful human community (Dodgshon 1987). In practice, observable villages are usually a good deal larger than this lower limit, though characteristically with populations typically in the hundreds rather than thousands.

Of course such a district-society need not live in a single camp or hamlet, but could occupy individual homes or clusters of homes in a dispersed network stretching across a small landscape. This kind of dispersed community is especially associated with landscapes where resources are patchy or land use is very extensive, and is common in predominantly pastoral economies. Space precludes a discussion of territoriality in dispersed agro-pastoral communities, where interesting modilocations to catchments occur, although still within a definable 'village territory'. On the other hand, it is more common for village-hamlet communities to live predominantly or essentially at a single nucleated location, at which point our nucleated community catchment quanta might be expected. However, whether the self-defining 'community' of hamlet or village is nucleated or dispersed, the extraordinary prevalence of this mode of society in mixed-farming societies around the world, with average membership well above the twenty-five or so minimum, requires explanation.

In 1972 the social anthropologist Anthony Forge published an analysis of community size in traditional rural Indonesia. Using a very large database, he proposed the following principles underlying regularities in the size and social organization of Melanesian settlements: (1) in communities up to some 150 members (or some thirty-five adult men), face-to-face relationships and direct close kinship were sufficient for coherent social structure; (2) communities larger than 150 and up to 300/ 400 members (35–85 adult men) consistently adopted sub-group organization such as clans, subclans and lineages to facilitate social cohesion, these sub-groups being manifested by hamlet strings or clusters making up the overall settlement (the latter sometimes stockaded); and (3) if communities developed beyond 300/400, they split into totally separate residential blocks with their own landholding zones and often stockades. By far the commonest settlement size was Type 2, with Type 3 argued to be a specific response to regular warfare (two or three Type 2 communities linked politically for mutual defence). Although these societies are described as 'egalitarian', they are actually characterized by typical 'Big Man' dominance structures—the dominance of a few males without hereditary power.

Forge suggested that Big Man systems favoured the emphasis on Type 2 villages: with less than thirty-five adult males (Type 1 settlements), individual Big Men could achieve prolonged influence, whilst with more than eighty-five men the number of players for dominance would be too large for any control over 'the power game' to be exercised. The optimum community of 150–350 had the right range of Big Men to sustain their existence in a stable structure without risk of individual tyranny. Since communities over 150 members require subdivision to place people into manageable categories, village structure had to be modified into distinct social, religious, and often residential groups. When communities reached numbers over 400 or so, they had to be composed of village pairings or triads. Archaeologically, we might view this series of social and political communities of increasing size using different terms from Forge: on the ground we would see Type 1 as small hamlets, Type 2 as a hamlet cluster or village, and Type 3 as separate but contiguous villages, each composed of hamlet clusters.

The physical anthropologist Robin Dunbar has also addressed the same question of quanta in the social groupings of traditional societies (Dunbar 1992, 1996). His approach has been radically different, focusing on an hypothesized connection between the complexity of the brain in primates and the size of their social groups, and in particular on the size of the neocortex area believed to be linked to socialization. Finding a demonstrable trend in primates, he extrapolated the ratio to predict from neocortex proportions the natural size of social groups whose interrelations were suited to the relative brain complexity of humans: the number was approximately 150. Put in very simple terms, Dunbar argued that human and primate social groups that operate on the primary principle of individual members memorizing each other's personal attributes and relations, are limited in size by the filing and sorting capacities of the relevant part of the brain. Assembling together a set of statistics for stable groupings of mobile or settled hunter-gatherers, and non-hierarchical traditional agricultural societies (localized clans and hamlets respectively), he found their average size to be 153. The simple explanation for recurrent limits on these human social groups that are not internally stratified is our inability to memorize upwards of 200 or so individuals in face-to-face contact, as well as updating their interrelations over time.

Dunbar's thesis is strikingly consistent with that of Forge, with the latter demonstrating that village communities that do manage to pass beyond the 200 or so population threshold achieve this through the creation of formal social subdivisions as well as residential segregation. The operation of social stress on communities rising beyond the 150–200 person level provides a very plausible explanation for the widely observed phenomenon of village fission in traditional farming societies studied by ethnographers. It can even be demonstrated that, in some societies, recognition of this process has become formalized into a cultural norm: amongst the ultra-traditionalist, primitive-Christian Hutterite communities of North America, for example, it is a fixed principle that when a village grows beyond 125 members it must split in two, on the explicit grounds that the social cohesion of the community is threatened above that level (Holzach 1979).

Thus there is a natural tendency for human residential groups to stabilize between twenty-five and 150–200 members, in the absence of strong mechanisms to counteract social division. We can group such strong mechanisms, allowing communities to grow to many hundreds or even thousands in size, into two basic types: horizontal mechanisms, where the society is subdivided into complementary social units such as clans, lineages, moieties; and vertical mechanisms, where the society is stratified in a hierarchy of authority.

Another parameter that is of central relevance to pre-industrial settlement systems is that of mating networks. Wobst (1974, 1976) has claimed that human groups need to operate marriage networks of at least 400–500 individuals to avoid the negative effects of an inbred gene pool on human health and fitness. The implication for the work of Forge and Dunbar is that, although the most natural social group for human cognition is below 150 members, other, equally natural, forces will require such groups to maintain exogamous relations with their neighbours.

In Melanesia, Forge showed that the village population norm of 150–350 or so individuals per community only found social coherence through the existence of internal subdivision into social and physical sub-groupings. Interestingly, he commented that these sub-groups have important social relations, not just with the other sub-groups constituting the immediate village community, but with groups of a similar order in other villages. Since the community will not be large enough for a Wobstian gene pool, clan/subclan networks of this kind would be essential to allow adequate mates to be found beyond the Type 2 village. With Forge's Type 3 communities, combining two or three Type 2 communities, total population will be above the mating network parameter, and one could consider whether the advantages of such political groups go beyond the considerations of defence paramount in Forge's analysis. Significantly though, the increasing separation in space that we see in Melanesia when crossing from Type 1 to 2 and then to Type 3 communities indicates the difficulty of sustaining a genuinely physically cohesive nucleated settlement of more than some 150 members.

SETTLEMENT FISSION AND THE EVOLUTION OF NETWORKS

This preceding discussion provides insights into the processes of settlement fission and landscape infill that we have already observed empirically in Formative Mesoamerica and Anglo-Saxon England. The fact that fission seems to occur well before population presses against available territory, at hamlet level, can be given a social explanation (just as Flannery had surmised), and we may expect to find the relevant hamlets to be characteristically less than two hundred inhabitants, but rarely smaller than twenty-five people (Dunbar's average is 150, but the range of empirical examples is 100–230). The corollary is that settlements which push well above the Forge/Dunbar face-to-face threshold can be expected to have adopted sub-groupings, whether through lineages, clans, or dominance hierarchies; possibly such categories may be spatially discrete within such larger settlements.

Before taking our discussion of these latter, larger, villages any further, it is worth testing the proposition of social group quanta on other empirical databases. One of the largest settlement inventories in pre-industrial times is the Domesday Book, in which William the Conqueror sought to tabulate the human, animal, and land resources available to him in recently conquered Anglo-Saxon England (Hill 1981; Fig. 13.9). A commonly accepted estimate gives 2–3 million people for Domesday England, a figure which doubled or trebled by the early thirteenth century. Current opinion would consider this AD 1086 record as that of a countryside composed of 'naturally arising' village communities whose population was typically well below the maximum capacity of the land to support.

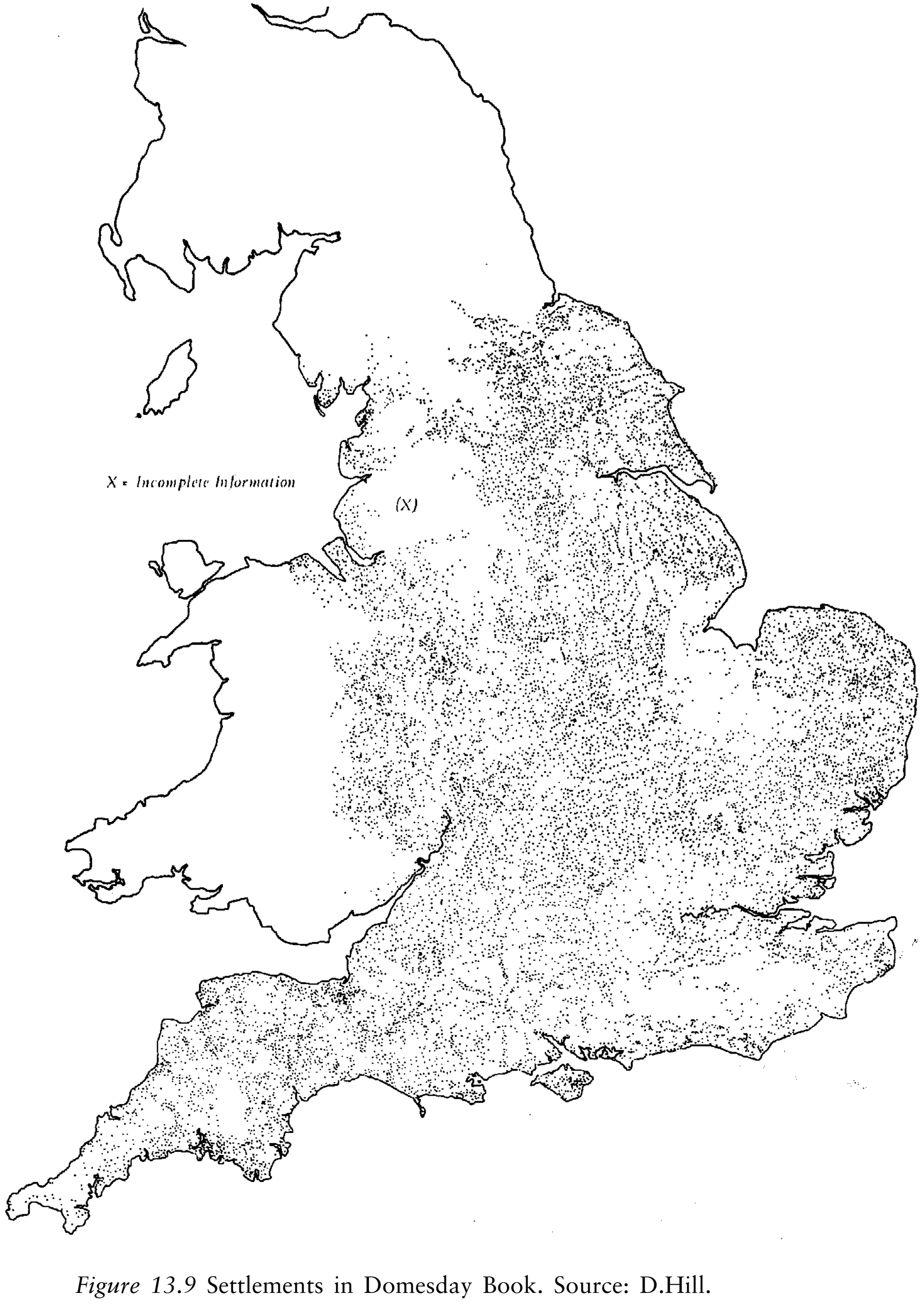


Figure 13.9 Settlements in Domesday Book. Source: D.Hill.

Rather surprisingly, although innumerable analyses have been made of the statistics available in Domesday Book, only one source to my knowledge interests itself in the size of listed 'vills' (Hallam 1981), despite the fact that there are some 13,400 villages inventoried. Although these 'vills' include both nucleated and dispersed communities, for our purposes the significant fact is that they exist as social groups within a defined territory, that is, they are 'village communities'. Hallam's comments on average village size are general but significant: eastern England—150 people; south-east England—150; east Midlands—115; south England—120; the Welsh Borderlands—54; Devon—88; Cornwall—82; Yorkshire—21. The most reasonable hypothesis to account for these data is that the consistent range of average village size, remarkably within that predicted theoretically above, is the product of the preferred maintenance of face-to-face communities at this stage in settlement growth and landscape infill. It is probable that surplus growth above 150 has been exported via fission to adjacent, underdeveloped or undeveloped sectors of the regional landscape. Intriguingly, this would suggest that the wider political context of later Anglo-Saxon society, strongly hierarchical and nascent-feudal *above* the level of the village community, is not the central factor in the colonization of the landscape and the mode of rural settlement. Early medieval settlement units in Holland have also been postulated to have held around a hundred individuals (Heidinga 1987:164).

From this basis we may search for additional settlement systems conforming to these norms. It may be expected that communities fissioning below the 150–200 person range will be especially typical for rural societies in which both internal social stratification and horizontal social segmentation are insignificant. It is most appropriate to approach cultural contexts believed likely to be characterized by relatively simple internal social structure, such as early farming communities. One example is the Neolithic of the Middle East, where farming villages appear on average to be composed of populations of 50–200 people (Redman 1978:143, 181, 188). For the neolithic *tell* societies of the Balkans, John Chapman (1989) has indicated village populations averaging 60–90 and rarely more than 120 people. Flannery's farming hamlet network in the Atoyac valley stabilizes at under a hundred people per hamlet, except for the original settlement of San José which predictably develops into a central place with putative social hierarchy. The Domesday example shows that even within Anglo-Saxon England, a society with a highly developed state structure and class divisions, the dominant form of settlement, the rural village (whether nucleated or dispersed around its defined territory), has a population dynamic appropriate to a relatively undifferentiated community. For more recent times, a well-documented study of the Greek Peloponnese around AD 1700 shows that the average population in a sample of over 1,400 villages is consistently under a hundred people (Sauerwein 1969).

Following Wobst's principle of the extended mating-network, such 'basic' village systems can be expected to practise exogamy or out-marriage in order to participate in a genetic pool removed from the obvious dangers of close-kin inbreeding. In fact a creative tension has now been created between the operation of the Forge/ Dunbar social fission model and the Wobst demographic pool model. Should we not consider the likelihood that one of the principal reasons why pioneer settlements grow to fission size and populate their *immediate* neighbourhoods is to provide an immediate reservoir of marriage partners? Does this requirement not also provide a motor for landscape colonization and infill, preventing pioneer settlements from stabilizing below the Forge/Dunbar threshold? Such considerations may help to explain some of the more paradoxical features of recorded village colonization processes, such as the early neolithic Linear Pottery culture of central Europe, where typically small communities of pioneer farmers spread the entire breadth of Europe at a rate inconsistent with land exhaustion.

FROM VILLAGE TO CITY-STATE: THE 'DORFSTAAT' MODEL

When the inhabitants of a village exchange marriage partners with neighbouring communities, such exchanges are frequently associated in the ethno-historic record with accompanying dowries of land, stock or other property. Let us envisage a scenario at a very advanced stage of landscape infill, when large, original, village territories have become subdivided into smaller units, and the inhabitants are using the entire bounded catchment to its full extent. A new form of demographic tension could arise, where villages compete over boundary lands and yet need to obtain marriage partners from the same adjacent settlements. Having to give arable land or pasture away to another village might seem to be compensated for through reciprocal land dowries being gained by a village, yet the usufruct or more usually rights over the products from land in another village territory, remote from one's home, are an inadequate substitute for family lands near the village that have now passed partly or wholly into the economy of non-villagers.

In real life, the tension between maintaining the integrity of village lands when population is high and the need to marry out if communities are below the genepool threshold, has resulted in a cross-cultural form of 'joking relationship' recorded by ethnographers working in traditional farming societies (for example, Tak 1990). Boys from other villages seeking to court and marry village girls risk ducking in the village fountain and other forms of rough-handling. Villages denigrate their neighbours through nicknames and stereotyping, exaggerating their own community's virtues and importance, in what has been dubbed in the Italian context *campanilismo* (after the symbolic competition between villages to erect bell-towers that put their neighbours to shame). Such recent behaviour represents a milder version of more aggressive competition for resources in earlier periods when state power was less all-embracing in rural areas of Europe. Thus in the Italian Apennines up until the eighteenth century, villages disputing valuable borderlands practised armed raids against each other.

It might be asked how far the tension between exogamy and territorial integrity is a conscious problem for traditional village societies living at high density in a totally infilled landscape. Susan Freeman, in her remarkable ethnography of the village of Valdemora in northern Spain (Freeman 1968, 1970), provides major insights into this question by contextualizing her small community within the wider cultural anthropology of traditional Spanish villages. The people of Valdemora occupy a small territory in the upland Sierra Morena, squeezed by neighbouring villages on all sides. With a population that historically never seems to have surpassed 200, it has always needed to practise exogamy. Yet the villagers explicitly point this out, bewailing the fact that Valdemora can never grow to become a true *pueblo*—the large village type which Freeman considers to have been dominant in wide swathes of Spain in recent centuries—where populations of 500 to 1,000 or more are largely endogamous and can keep village lands essentially within the community.

Clearly the achievement of a community size of 500 or more offers very special advantages to a village using its traditional territory to the full. Not only does the potential for a predominance of endogamy act to keep the village resources within the control of village members, but this centripetal force gives the village greater scope to manage the village territory as a communal asset, something which is very necessary when land use is intensive. If land is scarce, the community needs to have the power to reassign it to reflect the fluctuating size and needs of individual families, to systematize communal grazing, and other forms of benevolent interference in the economic life of the village. As we have seen, the growth of population to such a size puts village society well beyond the Forge/Dunbar range of face-to-face social relations, and predicates a transformation of political structure within the rural community.

Such a dramatic transformation in socio-economic structure can be documented in the historic development of European villages, and its outcome forms a central consideration in the ethnography of rural Western Europe. The 'corporate community' is a specific form of village organization in which wide-ranging powers over the disposal of land, animals, and labour are centralized in a village council. Membership of this council is customarily confined to adult male landowners, who often must possess a certain property qualification (a landholding in itself adequate for supporting a family). If we consider that, in many historic village communities, one half or more of the families had less than this scale of holding, and had to supplement their income through sharecropping, labouring, cottage industry and other means, and that in any case women and subadults are automatically excluded from the institution, then we can easily calculate how the numerical constraints required for a face-to-face society may be adapted to allow total community size to break through the 150–200 population limit. If the effective community of power, the village council, stays within the face-to-face range of 150 but represents, for example, only one half of the adult men, and each adult man represents a family of five (to take common averages for historic villages in Europe), the total village community can be as large as 1,500–2,000 people, and can easily solve most of its marriage-partner needs internally. The Forge/Dunbar threshold has been overcome through vertical stratification of power, but in itself the élite group of the corporate community is especially effective if it can remain on the scale of the face-to-face community. The rural anthropology of the west European countryside teaches us that such large, introspective, communities have a changed ethos from their small, relatively undifferentiated, ancestors: in Italy and Spain, for example, inhabitants of the characteristic medium-to-large villages or pueblos talk of themselves as 'villagers by day' when they are out in the fields, and 'townsfolk by night' when the inhabitants participate in the intense social and political life of their nucleated communities.

The famous historical geographer of the early decades of this century, Alfred Philippson, once wrote a seemingly innocuous and esoteric sentence for posterity to solve: why were there so many *poleis* (ancient city-states) in Thessaly, a region of north-central Greece (Philippson 1951:224)? The significance of this question stems from traditional conceptions about the origins of the ancient Greek city-state. It has usually been assumed that mountainous Greece, with its innumerable small plains separated by rocky massifs and the Aegean sea, gave rise by natural geography to isolated communities of a town-like character, emerging to statehood within their separate micro-environments. That thesis fails completely to explain the abundance of ancient poleis in the vast, open plains of Thessaly. In 1956 a pupil of Philippson, the equally renowned geographer of the Graeco-Roman world Ernst Kirsten, published a lengthy monograph on the history and geography of the Greek city-state, the underlying purpose of which was to provide the answer to Philippson's query. Kirsten's solution was simple, pragmatic, and even today the most convincing one. Rather than focus on the famous and unique historical properties of the Greek city-state, we should seek to understand it as a geographer would, as a form of settlement on a certain size scale and positioned in an associated landscape also of a certain scale. If we take this radical approach we see that the typical Greek polis is small, characteristically no more than a few thousand people, and its bounded territory or 'chora' is typically from 2–3 to 5–6 kilometres in radius. Clearly it is a special kind of village, a large village, and a politically very complex village, but none the less it is essentially a metamorphosis or politicization of the village, which Kirsten therefore termed the *Dorfstaat* or village-state model.

The ancient historian Eberhard Ruschenbusch (1985) has subsequently quantified the proposition: collating all the available information regarding the 700–800 city-states of the classical Aegean world, he found that 80 per cent have territories of a 5–6 kilometre radius or less, and 69 per cent have citizen male populations of 400 on average (perhaps 2,000–3,000 or so people in total). If the territory is as much as 5–6 kilometres in radius, and this is not a consequence of the inclusion of much uncultivable land, it will usually be because, during the transformation of the village to city-state, it has often given rise to, or absorbed, one or two small satellite hamlets. In central Greece and Attica, I have suggested that during the iron age recolonization of the landscape, interstitial settlement crystallized into a network of 2–3 kilometre and locally even 1–2 kilometre radius territories, creating what I have termed 'proto-poleis' or potential village-states (Bintliff 1994; Figs 13.5 and 13.6). In the Aegean as a whole, these were mostly absorbed over time into larger village-states.

Kirsten went on to distinguish a second kind of city-state, which either develops out of the Dorfstaat or is different in origin. These towns are much larger, with populations in the tens of thousands, and territories tens of kilometres in radius. On a scale comparable to medieval European towns, and supported by a network of lesser nucleated settlements within their territory (some of which were formerly autonomous Dorfstaat cities), such city-states are true towns for the geographer, and fit what Kirsten dubbed the *Stadtstaat* or town-state model. Obvious examples are Athens, Corinth, Argos, and Thebes.

What German scholars term the 'Normalpolis' of some two thousand or so inhabitants is generally associated in Archaic to classical Greece with a form of moderate democracy called the hoplite constitution. In this political structure, the dominant share of power in the 'village-state' belongs to a well-defined class of landholders, those of the 'hoplite' status or above (the aristocrats). In general, between a third and a half of the free farming population might possess sufficient land to achieve hoplite rank, the equivalent of an independent farmer with adequate resources for his family and the purchase and maintenance of the armour and weaponry for service in the citizen heavy-armed division (the essential defence force of the city-state).

The comparison between the Greek polis and the 'corporate community' of recent traditional rural Europe is striking, when we consider the village origin and character of the Greek city-state, the hoplite constitution, and the typical size range of the population and its territory. But it goes further, since the Greek polis jealously guarded its territory. Normally land could only be owned by citizens, citizen status was conditional on both land ownership and usually a certain size of estate, whilst Greek cities were totally male-orientated in inheritance rights. Thus it was possible and not unusual for females from other states to marry into the polis, but normally impossible for males to do so. The polis was also usually large enough to have in any case a high rate of endogamy. These widespread mechanisms ensured the territorial integrity of the hereditary male landowning community which constituted the essential core of the Greek city-state.

If Kirsten provided the central explanation of the high frequency and small scale of the typical ancient Greek city-state, we can now provide a mechanism to account for the 'politicization' of the village into the form of the miniature state: the 'corporate community' arises amongst a dense, mature, network of villages as a solution to social and gene-pool constraints in circumstances where communal land management is essential.

We are beginning to document the stages of development of this process of village-state formation in Greece, and the subsequent transformation of a small minority of these into town-states. In the Early Iron Age or Geometric period, population density is low, and the characteristic form of settlement is that of village or hamlet communities with a large territory, dispersed widely across the landscape. By the classical period, village fission has infilled the entire cultivable landscape with more closely packed and modular village territories, the average catchment being a 2–3 kilometre radius (Fig. 13.5). Many of these villages have been transformed into tiny states or poleis between Geometric and classical times, but increasingly the larger communities are absorbing surrounding smaller neighbours —villages or small poleis—into larger territories dominated by a medium-sized polis. During the fourth century BC in Boeotia, finally, the largest regional settlement, Thebes, which may have remained a small town throughout the Early Iron Age, achieves total dominance over all other poleis in the region as a Stadtstaat.

In the neighbouring Greek province of Attica (Fig. 13.6), this cumulative process must have occurred much earlier. By the time we get our first full picture of rural life in the region, the final Archaic era, as a result of the very detailed village distribution revealed to us through the political reforms of Kleisthenes in the late sixth century BC, the 139 listed village communities all belong to a single state—that of the city of Athens, already a true town of over 10,000 inhabitants. In the outer rural areas, however, the villages still retain a 'stable' territory of around 2.5-kilometre radius, whilst in the countryside around the precociously large true town of Athens the average territory has a 1.7-kilometre radius (strikingly similar to our ideal subdivision of 2.5-kilometre radius territories). The estimated populations of these small urban hinterland villages are surprisingly large, often nine hundred or so people, further indication of high demographic pressure, and it is unsurprising that from this time onwards Athens requires regular food imports to feed its population, as well as sending out frequent colonies ('cleruchies') and developing a far-flung empire.

The transformation from small, relatively egalitarian, hamlets into large villages with corporate community organization and a bias towards endogamy and a highly territorial approach to resources, may be a tendency which is latent in many evolving settlement systems of agriculturalists. I suspect this model could be helpful in explaining the rise and nature of the numerous, small city-states of the Levant in the Early to Middle Bronze Age, as well as the extraordinary profusion of hill-fort focused communities found throughout Europe in the Iron Age, whose distribution in space is comparable to early modern village-hamlet networks. Possibly it may help account for the rise in the Near East and Balkans, even in pre-pottery and early neolithic times, of unusually large and seemingly complex villages, such as Çatal Hüyük, Ain Ghazel or Knossos.

THE ORIGINS AND DEVELOPMENT OF THE MEDIEVAL VILLAGE COMMUNITY IN WESTERN EUROPE

It is widely agreed that the typical early medieval rural community in western Europe was very small, with plentiful resources. Population rise throughout the period AD 500–1000 occurred through settlement growth, fission and landscape infill. In more detailed regional databases, such as those we illustrated earlier for ninth-century Brittany or eleventh-century England, the countryside is already heavily settled, but there is still room for further, internal community growth. The on-average 3–4 kilometre radius territories of the Breton 'plebes' (Fig. 13.4) will be subdivided in medieval and post-medieval times to accommodate almost as many new parishes. Provisional calculations of ninth-century village populations suggest, though, that already the average community was well above the Forge/Dunbar face-to-face society and probably large enough for a predominance of endogamy. Predictably, there exists already at this date a highly organized village council (Davies 1988). In contrast in England some two centuries later, the Domesday Book reveals the dominance of villages and hamlets that lie within the parameters of a 'face-to-face' society. Instead of the doubling of village numbers, the English trajectory in the twelfth and thirteenth centuries is the doubling or trebling of average village populations, thus taking the typical village into the model already achieved in ninth-century Brittany. The eleventh-century population of England may have been in the order of 2.5 million, but according to Brian Roberts (pers. comm.) a figure of 7 million by 1300 is not unreasonable. On the ground, the ultimate product of these two different settlement transformations will end up looking very similar: large rural communities, usually well above the 100–200 person range and not infrequently at or above the 500 range, existing within catchments tending to two of our spatial geometry modes, the 'stable' 2–3 kilometre or 'pressurized' 1–2 kilometre radius.

Brittany is thus precocious in terms of village size, and the English pattern of slower growth beyond the 'face-to-face' scale seems to be more typical of western Europe as a whole, where the five centuries from *c.* AD 800 to 1300 have been broadly summarized as a fundamental *moyenne durée,* or an era of 'medium-term historical process', characterized by the transformation of the small rural settlement into a larger and more complex form—the Corporate Community. The reasons for political change are already familiar from our preceding discussion, but the activity of medieval village councils in adapting to a very high pressure of population on land manifested itself in a unique and very striking fashion, through a complete refashioning of the landscape over vast areas of western Europe (Fox 1981, 1992).

For centuries after the collapse of Roman rule, farming families in the typical hamlet or small village were able to open up holdings in any convenient part of its territory and graze their stock over the broad uncultivated zones. As village populations rose beyond the Forge/Dunbar threshold, fission allowed surplus population to infill neighbouring zones or more distant woodland and waste. Yet population growth continued, doubling or trebling average rural community size between early and late medieval times. Just as the social community had to adjust towards an internally stratified political management, so also the economic basis of the village could no longer exist on the basis of each family farming where it wanted and grazing at will; land and pasture were now too precious. The most obvious difficulty was to control grazing land so that animals were kept away from the key arable fields. The animals themselves were essential to the village economy for complementary products, fertilizing manure, and as a vital source of traction for ploughing and transport of rural production.

Pressure for radical restructuring of the village landscape came from parallel and related changes in levels of power above the individual village community. In the early medieval period in many regions of western Europe, clusters of hamlets or villages, often contiguous, were linked into a network of estates belonging to lords, royalty or the Church (Aston 1985; Blair and Sharpe 1992; Everitt 1986; Hooke 1988; Fig. 13.10). The estate centre tended to be one of the earliest villages, and predictably occupied one of the most fertile districts in each region. Subsequent colonization produced a group of smaller communities in less developed landscapes. Although these satellite hamlets might be expected to produce much of their own food, the estate owner stimulated their surplus production of complementary products for export to the estate centre; this might be barley, wood, animal products, and indeed the multiple estate might be run so that animals were moved around between different village territories to make optimal use of the abundant uncultivated lands.

In the later Middle Ages, however, this kind of economy gave way to a much more intensive and individual village-based approach. In a high proportion of cases in predominantly arable landscapes, each village became an individual estate of a particular landowner, and he or his bailiff resided within its catchment. Even where landowners retained many villages in their estate, they were now managed with greater emphasis on self-sufficiency in a broad range of crops and stock. The reasons for these general shifts in the medieval economy lie in a nexus of changes: growing populations were sustained by taking into cultivation an ever greater sector of the

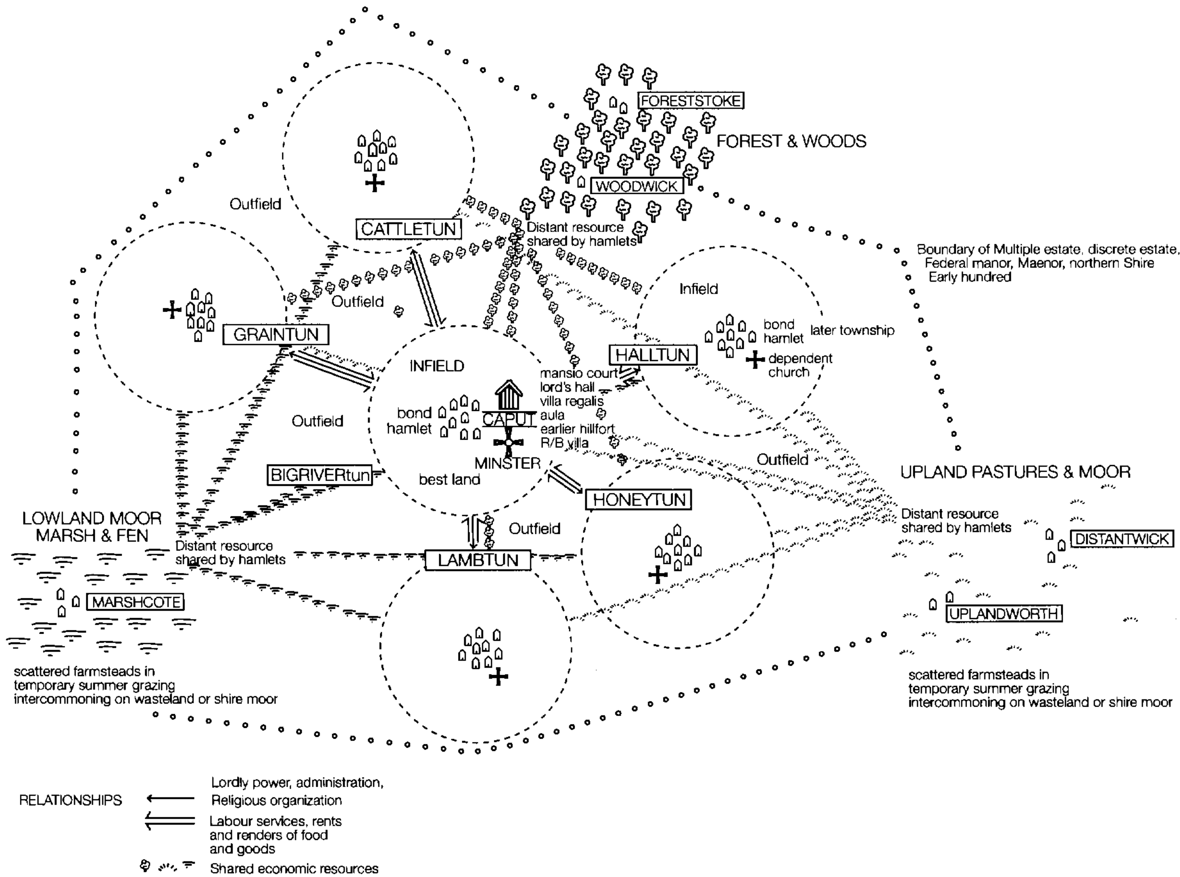


Figure 13.10 The relationships and arrangements within a theoretical multiple estate. Source: M.Aston.

village catchment, reducing land which could be devoted to specialist production such as woodland or pasture; social changes broke up large estates in which the Church and the king were often the original landowners, and a new class of local lords was required to pay higher taxes to the state.

These changes were mutually reinforcing and meant that the maximal production of local foodstuffs was required from a typical mixed farming community. With more and more village land converted into arable fields, the vital management of stock had to be reorganized to be as efficient as possible. Throughout western Europe, village councils imitated each other in carrying through a dramatic restructuring of the landscape (Fox 1981, 1992; Harvey 1989; Hooke 1988): in place of the patchwork of individual arable fields, fallow fields, private and communal grazing land, two and more commonly three giant land blocks were laid out across the parish, devoted respectively to cereals, fallow and pasture each year (Fig. 13.11: models B and C). All villagers were now obliged to conform to splitting their land and stock into these blocks, which rotated function each year or every few years. This was a revolutionary solution to the problems of keeping stock from the crops, of access for stock, and ensuring all the land was worked, and was certainly a central factor in the overall rise in productivity underpinning the remarkable population boom of the later medieval centuries.

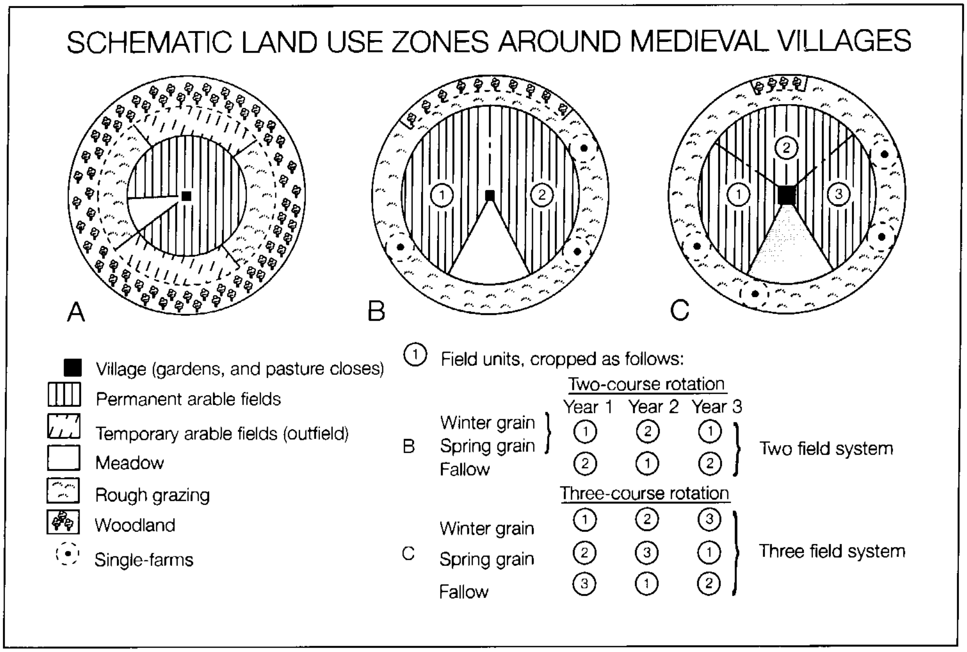


Figure 13.11 Schematic land use zones around medieval villages. Source: Roberts 1977.

Opinion is divided over the feasibility of sustaining such high rural populations, and it is certainly the case that from the late thirteenth century onwards, the trend was reversed, with widespread village abandonments and the conversion of large sectors of arable landscape into less intensive pasture economies. It was a central proposition of M.M.Postan that overexploitation of the land led to the breakdown of the medieval rural economy in western Europe (Postan 1975), to which can be added climatic deterioration in more westerly, northerly, and upland environments (Lamb 1977:449ff.). The Postan thesis still has strong adherents bringing new evidence to bear (Clark 1992). Less controversially, it might be claimed that the sheer density and size of villages, and the intensity of land use, taken with the partition of land that placed a very high proportion of village territories in the non-buffered 1–2 kilometre radius range, betray a rural economy that could not be sustained in the medium term.

The interdependence and mutual feedback between social and economic process have been strongly emphasized by Harold Fox in his theory of medieval village development in England (see also Bois 1992 for parallels in France). Population growth creates pressure on village resources as territories grow smaller. Larger villages require political reorganization, and this is also necessary to reorganize the village's internal resources more efficiently. Hence the rise of the corporate medieval village community is the product of social pressure and at the same time a response to land management pressure. The respective role of village communities or their feudal lords in encouraging village nucleation and radical land reorganization is disputed. Probably both encouraged a natural adaptive process with cross-cultural resonances. In the absence of powerful feudal lords and strong overarching state structures, these repetitive processes might otherwise have led to innumerable small, competing, polities such as in ancient Greece. Indeed I would suggest that the rise of hundreds of small city-states claiming variable degrees of autonomy in early medieval north-central Italy represents exactly such a contemporary outcome, achieved predictably in regions of weak feudal power and remote and relatively ineffective state power (Waley 1988).

CONCLUSION

In this chapter I have suggested that, behind the enormous variety of habitats settled by human communities past and present, and in the context of widely divergent social and political systems, it has been proved possible to isolate a limited set of factors and processes which have had an extraordinary influence on the size, spacing, and socio-economic organization of rural communities. I have argued that none of these factors is unavoidable in settlement history, and in none the less seeking to account for their remarkable prevalence I would prefer to banish any trace of determinism through an appeal to the new science of complexity (Lewin 1993).

Within this grouping of theories, semi-autonomous variables clustered into interactive ensembles are probabilistically likely to be drawn into stable configurations of complex behaviour. In the terminology of chaos-complexity theory, our recurrent factors are the so-called 'strange attractors' or gravity-forces that continually pull the development paths of human settlement history into their sphere of operation.

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This chapter has benefited from the advice and criticism of Geoff Bailey, Bob Layton, and Brian Roberts.

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Susan Tax Freeman's wonderful Spanish village study (1970) from the ethnographic present is admirably complemented by Wendy Davies's remarkably rich portrayal of early medieval villages in Brittany (1988). Harold Fox's exciting model for the evolution of English medieval villages into corporate communities as human ecology (1992), sadly remains unpublished, but the groundwork can be found in an earlier publication (1981). Robin Dunbar has recently produced a volume on his stimulating theories for human social evolution (1996). I have tried to bring together the concept of the corporate community, human ecology, and rural settlement geography in my extended paper on the ancient Greek city-state (Bintliff 1994), which was initially inspired by the neglected and obscurely published masterpiece of Kirsten (1956).

14

FOOD AND FARMING

Graeme Barker and Annie Grant

INTRODUCTION

The purpose of this chapter is to review the evidence of archaeology for the prehistory and history of food, and for the changing relationship between food (and the associated products of food production) and human culture. The *Shorter Oxford English Dictionary* defines food as 'what one takes into the system to maintain life and growth, and to produce waste' (*SOED* 1973:782), the latter part of the definition nicely presaging the necessary relationship between inputs and outputs in the acquisition of food that is an important theme for this chapter. Humans share their need for food with the rest of the animal kingdom, but the techniques we have evolved to obtain our food set us completely apart, in sustaining extraordinary densities of population and threatening the sustainability of the environment in ways unmatched by other species. Furthermore, animals eat food to stay alive, but for all humans, even in the most demanding environments, eating is inextricably related to culture, and is the primary context of most social relations (Goody 1982).

We must also remember that humans—farmers especially—do not exploit plants and animals simply for their food and drink. A critical aspect of agriculture is the production of food for livestock—hay and fodder crops—to maintain stock through the seasons when grazing is poor, to improve stock health for breeding, and so on; and many hunter-gatherers in the past have also sought to improve grazing conditions for the game they exploited. Plants, terrestrial mammals, sea mammals, birds and fish produce a wide variety of oils for lighting and fuel. Straw and dung are both important sources of fuel for many societies. Humans have clothed themselves entirely with plant and animal products until the advent of artificial fibres. Plant products, bone, antler, horn and leather, augmented with stone and metal, have had much the same role in tool and ornament making before plastics.

Plants have always been the main source of medicines, potions and drugs until the development of the modern pharmaceutical industry.

Humans have occupied the globe for several million years, and for most of that time they have obtained their food by various combinations of gathering, collecting, scavenging and hunting (Chapters 19 and 20). The production of food on a systematic basis has a much shorter history (Chapter 21), its beginnings generally equated in time with the transition to the modern climatic era, the Holocene, some 12,000 years ago, though in many parts of the world the transition to food production was thousands of years later, and a very few societies have remained hunter-gatherers to the present day. For the *SOED*, farming is 'the business of cultivating land and raising stock' (1973:727), and is equated with agriculture: 'the science and art of cultivating the soil, including the gathering in of the crops and the rearing of live stock' (1973:39–40). The mixture of art, science and business in these definitions is a useful introduction to an important distinction used in this chapter. In discussing the acquisition of food in the past we are sometimes dealing with 'subsistence', in the sense of what people lived on, but often also with 'economy', in the sense of the management and mobilization of resources—the creation of food and related products surplus to the immediate requirements of the human group, and the use of that surplus for non-subsistence purposes such as feeding non-producers in a community, or for barter, payment of tax or tribute, or sale in a market (Barker and Gamble 1985).

Like all the thematic discussions in this section of the *Encyclopedia,* therefore, this chapter has an impossibly wide remit in time and space, and we have only been able to select what seem to us key themes, and illustrate them with case studies from a wide variety of regions, periods and societies. The acquisition of food may seem one of the most mundane activities that we can study in the archaeological record, relatively amenable to archaeological investigation. The exploitation of plants and animals for food by past humans, however, whilst certainly reflecting adaptations to the constraints and opportunities of particular environments, was also associated in intimate and complex ways with human culture—with technological skill, demographic pressures, economic structures, the aspirations of particular social groups, perceptions of risk and opportunity, and ritual life.

SOURCES AND METHODS

Documents

We are concerned in this book first and foremost with archaeological evidence, but of course archaeologists interested in food and farming can, for the historic periods of the past, learn a great deal from a wide variety of written sources. From the earliest civilizations of Mesopotamia, Egypt and the Aegean to the modern era, states have created huge archives of official records documenting their involvement in the management of food production and distribution, in trade of agricultural products, in market prices, and taxation systems. At the other extreme are what we can glean from individuals' life experiences as shown in personal diaries and the like, such as the jottings by serving Roman soldiers on wooden writing tables at the Vindolanda fort on Hadrian's Wall. In between is a huge mass of written material of potential use—official inscriptions on public monuments, private inscriptions on buildings and tombs, agricultural treatises, poems and so on.

Of course there are many instances where documentary evidence gives us a mine of information about aspects of food and farming that we could never glean from archaeology. A good example is the wealth of written records left by the ancient Egyptians on the use of plants in medicine (Reeves 1992). We learn that fir resin was used as an antiseptic and for embalming, aloe for catarrh, cinnamon for ulcerated gums, incense for sweetening air and as a fumigator, fleabane for driving fleas out of a house, henna to treat hair loss, root of pomegranate to dislodge roundworm, beer for boils (rubbed on, not drunk!) and, as a remedy for crying children, a paste of *spn* seeds (probably poppy) mixed with fly dung from the walls, strained and drunk for four days.

Like archaeological data, the references to food and farming in the huge variety of written material left by past societies cannot be taken simplistically as 'telling us how it was'. Literacy has rarely been widespread, so the majority of people within the historic period did not create history in the sense of writing it. Then there is the mix of fact and fiction in so many ancient sources that makes reading somebody like the fifth-century BC Greek historian Herodotus such a delight. To this we must add the agenda of the writer: the Celts living on the fringe of the Roman world, for example, were variously portrayed by Roman authors as bloodthirsty barbarians deserving to be conquered, or Noble Savages living in peace and harmony as models for the innocence Rome had lost—descriptions that tell us more about Roman politics than iron age societies. There are numerous other examples of descriptions of the lifeways of peoples beyond the frontier, whether Arabs through the eyes of Crusaders, indigenous Americans in the nineteenth century through the eyes of contemporary white politicians and soldiers, or the Indian peoples of the Amazonian rain forest in the modern era. The Roman agronomists such as Cato, Pliny and Varro are invaluable sources for learning about Roman farming in Italy, so long as we remember that much of their writing consists of exhortations on 'best practice' rather than literal descriptions of what most Roman farmers might actually have done (White 1970).

Iconography

One of the defining features of our species is the making of art, and the representation of experience through iconography (Mithen 1996). Most of the great art systems of prehistoric Europe—upper palaeolithic cave art, the Levantine mesolithic rock shelter paintings of the Iberian peninsula, the Scandinavian and alpine rock carvings of later prehistory, the artefact decoration of the Celtic Iron Age — include representations of activities associated with subsistence, whilst from societies such as ancient Egypt there are enchanting models of agricultural and domestic scenes (Stead 1994). The designs pecked into the surfaces of glacial boulders in the Val Camonica in northern Italy, for example, generally regarded as mainly bronze age (second millennium BC) in date, include scenes of people hunting deer with dogs, of ploughing with a crook ard pulled by a pair of what are assumed to be cattle or oxen, and villages of small wooden houses surrounded by small rectangular fields (Anati 1976). Potentially such material is an exceptionally rich source of information, as long as we do not try to divide it into things we think we can recognize as scenes of everyday life, on the one hand, and evidence of 'ritual' on the other. Of course prehistoric artists drew on their experiences in the world they inhabited, but we cannot select out what we think we can understand, as mirror images of everyday life: everything that we know of art systems produced by people such as Kalahari San and Australian Aborigines today, for example, emphasizes the powerful and complex links between the production of motifs and ritual behaviour, with designs often being made after dreams and trances, sometimes drug-induced (Lewis-Williams 1983). Even in the case of art systems produced by 'more accessible' peoples such as the Romans, modern scholarship emphasizes the complexity of meanings and messages encoded in apparently straightforward images of, say, agricultural or hunting scenes in the mosaic floor of a villa (Scott 1997).

Artefacts

For most historic periods of archaeology the function of many artefacts associated with hunting, farming, food preparation and eating can usually be discerned given the other sources of information on technology available, such as written records and the variety of iconographic material, like the carvings in some English churches of different craftsmen, or illustrations in illuminated manuscripts and early books showing hunting, pastoral and agricultural scenes (Langdon 1988; White 1984). Prehistorians can learn from the same sources, and also from the ethnographic record of contemporary or recent non-industrial societies, and it is from typological comparisons with the latter sources in particular that most of the common functional descriptions used by archaeologists for prehistoric artefacts—axe, knife, scraper, strainer, sickle, harpoon, mortar, and so on—are derived.

However, in most instances we can only infer the function of an artefact, not know it, and there are good reasons to emphasize the need for considerable caution in the straightforward interpretation of function on the basis of typological similarities, and even more so when artefact types are being used to identify systems of subsistence. Artefacts of similar shape and size can be used for entirely different purposes. Grinders and sickles have sometimes been regarded as useful indicators of early farming, yet grinders can be used for grinding cultivated seeds, or wild seeds, or substances such as ochre for body painting, and sickles can be used for harvesting cultivated plants, or wild plants, or fodder for animals, or thatch for housing. The geometric flint microliths of the European Mesolithic are assumed to have been armatures for arrows, and most of them presumably were, given the discovery of wooden arrowshafts with microliths attached in resin as points and barbs, but in a famous discussion of mesolithic subsistence David Clarke (1976) pointed to one ethnographic example of identical microliths being mounted upright in a wooden board and used for shredding vegetable foods. An added complication is that the same artefacts might well be used for different purposes during their lifetime, and ethnographic studies suggest that many an artefact in prehistory passed between functional and ceremonial uses—several times, perhaps—through its 'biography', with different meanings to different people at different times (Hodder 1982).

Despite these problems, there is much we can learn from the artefactual record about food and farming. When preservation conditions are good, the material that survives can be so specific that it is difficult to deny reasonable interpretations of function. The prehistoric 'lake villages' of the alpine region in Europe are a good example of a waterlogged archaeological context which has yielded a remarkable array of artefacts where functions associated with a wide range of hunting, fishing, and agricultural activities can be postulated with reasonable confidence (Fig. 14.1). A rich variety of wooden, or wooden-based, agricultural, gathering and food-processing equipment has survived from waterlogged prehistoric, Roman, and medieval sites in Europe, as have desiccated artefacts from the arid regions of the world, from the Peruvian desert to Tutankhamun's tomb in Egypt. Artefacts of organic materials associated with food and farming found in the excavations of the waterlogged deposits of Viking Dublin included: wooden churns, shovels and spades; ropes and tethers of tree roots and withies; hurdles of coppiced wattles; wooden spindles, bone whorls, weavers' swords of wood, weaving tablets of antler, horn and bone, a wide variety of bone needles, and hundreds of examples of cloth and spools of thread; a huge variety of leather goods; and even mosses collected as lavatory paper (Wallace and O'Floinn 1988).

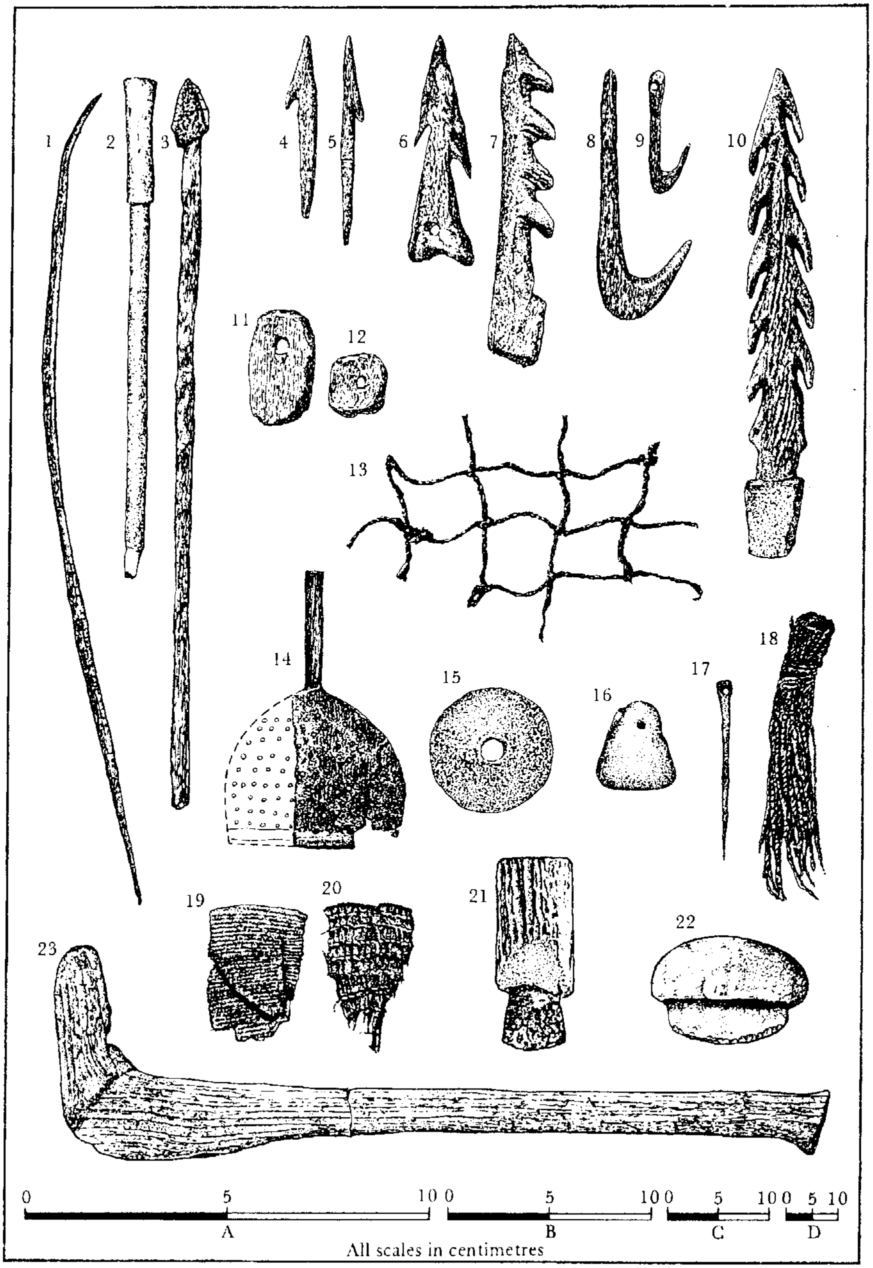


Figure 14.1 Artefacts associated with hunting, fishing, and farming activities from waterlogged prehistoric sites in Switzerland. 1. wooden bow; 2. wooden fowling arrow; 3. wooden arrow with flint point; 4, 5. bone harpoons; 6, 7. antler harpoons; 8, 9. bone fish hooks; 10. antler harpoon; 11, 12. wooden floats; 13. fish net; 14. wooden carving board for flax; 15. bone spindle whorl; 16. clay loom weight; 17. bone needle; 18. skein of thread; 19, 20. textile fragments; 21. stone axe in antler sleeve; 22. flint knife or scraper in wooden sleeve; 23. wooden handle for axe or adze. All at scale B except 13 (A), 14 and 23 (C) and 1 (D). Source: G.Barker 1985.

Also, some artefacts are so specific that their general purpose seems not in doubt. In this category we can include hand cultivation tools such as shovels, spades, and hoes, wooden ards (primitive ploughs that cut a furrow but did not turn the sod) and ploughs, metal ploughshares, metal sickles and scythes, horse-riding equipment such as saddles, bits, bridles and horseshoes, and transport items such as sledges, carts, carriages, and chariots, skis and snow-shoes (Clark 1952). Bronze age 'Canaanite jars' from the Ulu Burun wreck off southern Turkey contained pistacia resin, the essential ingredient of incense, and had dockets attached to some of them identifying their contents with the Egyptian word for incense, *sntr* (Mills and White 1989).

Archaeological science can also aid us considerably in the interpretation of artefacts (Chapter 9). In one common approach, microscopic traces of use-wear damage on the cutting edges of prehistoric flint artefacts are compared with use-wear patterns on the edges of replicated tools used separately for, say, chopping bone, cutting meat, scraping leather, and cutting up plant foods (Donahue 1988; Keeley 1980). Microscopic traces of the food or other organic materials with which the artefact has been in contact may also sometimes be identifiable by chemical analysis: in the case of Palaeoindian stone tools, for example, it has indicated their use for plant collection and processing (Briuer 1976). Gas chromatography and mass spectometry have been used to identify the presence of oil and wine in classical amphorae (Condanin *et al.* 1976; Rottländer and Hartke 1982). Potsherd residues are one of the main indicators of plant domestication and use in tropical areas where macroscopic plant remains survive very poorly (Hill and Evans 1989). Residue analysis of earthenware bottles in the frozen tombs of Pazyryk on the Russian steppes indicates that they were probably filled with a version of the traditional drink of the steppe nomads, koumiss (Rudenko 1970). Isotopic analysis of organic matter encrusted on potsherds from sites in the Peruvian Andes showed that the pots had contained tubers such as potatoes, and even indicated that the potatoes had been boiled and mashed (Hastorf and DeNiro 1985).

Settlements, structures and fields

The earlier archaeological literature was full of inferences about people being either hunters or farmers, or at least either nomads or settled people, on the basis of the settlement traces found, on the assumption that hunters always move around the landscape leaving few traces, whereas agriculturalists always stay in one place and build permanent dwellings. Inevitably, better understanding of the ethnographic record has demonstrated that archaeologists need to assume that most settlement forms *per se* cannot be taken as simple indicators of subsistence behaviour, or even of degrees of mobility or sedentism.

As with artefacts, individual structures revealed by excavation may well be open to alternative interpretations as to function. The classic examples are 'four-posters', the square settings of four post-holes cut into the subsoil on many British iron age sites—what structure was built on top of four posts? The most reasonable interpretation is that the four post-holes are all that is left of above-ground granaries, but ethnographic analogies have been cited of 'four-posters' variously supporting dwellings, hayricks, chicken coops, pigsties, racks for smoking and drying meat, lookout towers, and scaffolds for exposing corpses. However, much can be learned from the structural evidence of some settlements when the evidence is very specific. In many past societies, farmers lived under the same roof as their livestock, and from a variety of prehistoric and early historic settlements excavated in temperate Europe, from the first *Linearbandkeramik* farmers to the Vikings, we can see from floor plans how the dwellings were divided into space for people and space for cattle, the latter further divided into stalls for individual beasts (Hvass 1993; Whittle 1993; Fig. 14.2). In English deserted medieval villages, we can recognize distinct types of accommodation for humans, livestock and equipment in the 'toft' or farmyard, though sometimes the livestock and equipment were housed separately and sometimes incorporated within the main residential building depending on factors such as status, topography and regional custom (Astill 1988a).

We can also learn much about the function of structures from archaeological science. A detailed analysis of food refuse in and around two late neolithic waterlogged sites in the Jura mountains in France has revealed a great deal about the function of the different buildings (Arbogast *et al.* 1995). Similar survival of organic remains at waterlogged bronze age farms in the Netherlands has enabled the recognition of houses, barns, byres, and hayricks—the latter consisting of a single post-hole at the centre of a circular gully, with numerous remains of the house mice and field voles that made their homes at the bottom of the haystacks (Ijzereef 1981). There are comparable examples of Roman-period, Viking and later medieval farms in Scandinavia and northern Germany. At the other extreme, good survival conditions in the Libyan desert allowed the recognition of many aspects of Roman-period farms: the dwellings, storage buildings, press buildings for producing olive oil, water storage cisterns, and even the stalling areas for the flocks, as the sheep and goat dung survived in the arid climate (Barker *et al.* 1996).

In many regions there is also a rich archaeology for the agricultural landscape beyond the farm or village. Throughout north-west Europe, for example, there are extensive traces of fossil 'field systems' of prehistoric, Roman and medieval date, surviving especially in upland and pasture areas as the low banks of earth or stones that formed the field boundaries. Dartmoor in south-west England is a good example of an upland region where the study of such evidence has given us excellent information about

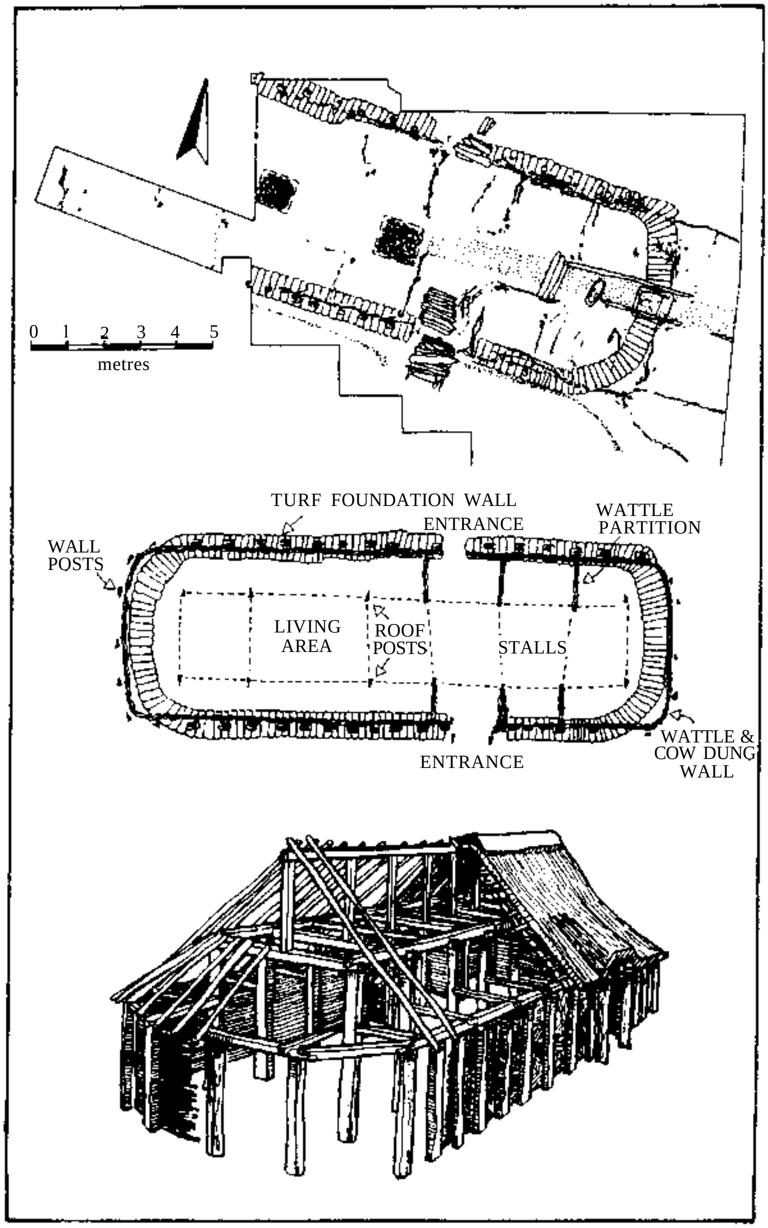


Figure 14.2 A reconstruction of the Tofting farmhouse in northern Germany. Source: G.Barker.

agricultural organization from prehistoric to medieval times, in terms of both the functioning of agricultural systems and the social context in which they operated, from individual farms to community landscapes (Fleming 1988; Fleming and Ralph 1982).

In addition to field boundaries, traces of ancient ploughing within them survive in many parts of Britain and Ireland now used for pasture or rough grazing; they take the form of long narrow banks separated by shallow depressions, variously termed 'ridge and furrow', 'rig (or rigg) and furrow' or 'lazy beds' (Astill 1988b). Rather comparable field systems were created by Palaeoindian farmers in the American Midwest using hoes made of large mammal scapulas (Gallagher *et al.* 1987). In the Mediterranean region, air photography has revealed extensive systems of Roman land division in the lowland zone, the 'centuriation' well known from the classical authors, where square fields of standard size were laid out on a single axis across the landscape (Chouquier *et al.* 1987). Studies have also begun of the chronology and functioning of ancient terrace systems in the Mediterranean uplands (Moody and Grove 1990; Wagstaff 1992), as in the semi-arid regions of North America (Sandor *et al.* 1990). By contrast, field-system archaeology in arid regions such as North Africa, the Middle East and the American Southwest is extremely well developed, the focus here generally being on the functioning of such systems in terms of capturing and diverting seasonal floodwaters, as is discussed later (see pp. 576–8).

Palaeoecological indicators

Many of the indicators of past environments discussed in Chapter 6 are also important for the information they can provide about the effect of human activities on past landscapes.

Soil science, for example, can be an important indicator of human settlement and agricultural activities such as grazing and manuring, because such activities can affect the physical and chemical properties of sediments (Courty *et al.* 1990; Limbrey 1975). These techniques can be invaluable at a variety of scales, from providing insights into the function of individual buildings and fields, and the agricultural activities implied by the creation of buried soils or palaeosols (Fieller *et al.* 1985), to regional geomorphological studies of Holocene valley alluviation, a phenomenon which is variously explained in terms of either climatic change, or activities such as cultivation and pastoralism, or combinations of the two (van Andel *et al.* 1985; Bell and Boardman 1992; Lewin *et al.* 1995).

Pollen analysis, or palynology, has been of critical importance once the possibilities were realized of interpreting pollen diagrams as signatures not only of ecological change in response to climatic change but also of human activities affecting vegetation, though there is the need to refine techniques for distinguishing such 'human impacts' from clearings caused by natural events such as forest fires and freak storms (Edwards 1989).

Many pollen-bearing deposits also contain phytoliths, minute particles of silica from plant cells, and they have also been found surviving within potsherds and on the surfaces of artefacts and teeth. Like pollen, phytolith assemblages can be invaluable indicators of both plant assemblages in the past and of human activities affecting those assemblages (Pearsall 1989; Piperno 1985). Moreover, being specific to different parts of the plant, phytoliths can also be useful for differentiating between wild and domestic plants, and in some instances may provide evidence of the conditions in which plants were grown (Rosen 1994). Land molluscs have also been used like pollen and phytoliths as indicators of agricultural activities. Snails are adapted to different ecologies, such as wet and dry soils, grassland and woodland, so changes in snail populations through time can be used like changes in pollen spectra, as in the classic study of snail assemblages underneath the neolithic barrow of South Street near Avebury in southern England, interpreted as evidence for woodland clearance by neolithic farmers prior to the construction of the barrow (Evans 1971).

Human remains

Simon Hillson in Chapter 7 describes the rich variety of information about diet, health and disease that can be gleaned from the application of archaeological science to human skeletal remains. When survival conditions are good, as in many waterlogged and desiccated environments, the evidence may even include the stomach contents of bodies (Brothwell 1986; Glob 1971) and faecal material (Callen 1969; Hillman 1986; Holden 1994; Reinhardt and Bryant 1992; Sobolik 1990), providing us with extraordinary snapshots of single meals, with information on condiments, nutrition, pharmacology, and food processing and preparation, as well as insights into health and disease from parasite levels (A.K.G.Jones 1992). Coprolites can be a remarkable mine of information—they may contain macrobotanical, microbotanical, macrofaunal and microfaunal remains (bone, hair, shell, undigested plant remains, pollen, phytoliths, fungal spores, parasite eggs and so on) —but their study is not for the faint-hearted: techniques include not only visual identification and chemical studies but even odour analysis (Moore *et al.* 1984) and experimental studies on modern material (Osborne 1983)!

More commonly we have to glean insights into diet from skeletal remains: from tooth wear and decay, and from the changes to bone chemistry caused by long-term reliance on plants, meat and/or fish that may be revealed by isotopic analyses of bone collagen. In Portugal, for example, isotopic analyses document a change from a predominantly meat diet amongst mesolithic people to a neolithic agricultural diet higher in plant foods, coinciding with evidence for a decrease in tooth wear and in the incidence of caries as a result of the dietary shift (Lubell *et al.* 1994).

There are comparable studies of dietary shifts accompanying agriculture in North America, in many cases associated with health decline (Cohen and Armelagos 1984; Katzenberg 1992). In ancient Egypt, plaque-related diseases and tooth wear both increased with urbanization as the amount of meat decreased in the average diet, and enamel hypoplasia increased in children's teeth because of vitamin deficiencies at weaning (Hillson 1979).

Plant remains

Macrobotanical plant remains survive on archaeological sites in a number of ways: as impressions in fired clay, such as pots, ovens, and hearths; as waterlogged, desiccated, or mineralized remains, preserved respectively by anaerobic conditions, aridity, and by calcium phosphate replacement (commonly in latrine deposits); and—especially—as carbonized or charred remains, burnt either in a major conflagration or accidentally during processing (some cereal crops in antiquity had to be roasted to remove their husks). Occasionally large samples of plant remains are found in storage pits, pottery vessels, ovens and the like, but more commonly they are extracted from bulk soil samples by one of a series of painstaking processes: dry sieving in the case of desiccated remains, wet sieving for mineralized seeds, and water flotation for carbonized seeds.

Macrobotanical remains are often informative about past environments, and they may also provide indications of seasonal activities by the communities which harvested them; they also of course inform on diet. However, beginning with pioneering work by Robin Dennell (1972) on samples of carbonized plant remains from neolithic *tell* villages in Bulgaria, the focus of much research in archaeobotany has been on refining our understanding of the formation processes that create different kinds of plant samples, and their significance in terms of cultivation and processing systems (Greig 1989; Hastorf and Popper 1989; G.E.M.Jones 1992; Jones 1985; van der Veen 1992a). In support of this there has been a great deal of ethnoarchaeological research amongst traditional farming communities in countries such as Greece and Turkey to try to define the 'archaeobotanical signatures' (such as different mixes of seeds, chaff, and weeds) created by different cropping regimes and processing systems (Hillman 1981; Jones 1984; Fig. 14.3).

A key focus of much archaeobotanical research has been and remains on the origins and spread of crop farming in different regions of the world (Harris 1996; Harris and Hillman 1989; Ucko and Dimbleby 1969; see Chapter 21), but the increasing sophistication of archaeobotanical methodologies in terms of contextual analysis has also enabled archaeobotanists studying the cereal-based agricultural systems of Europe and the Near East to reconstruct not only diet and subsistence but also cultivation regimes, scales of agricultural production, and economic

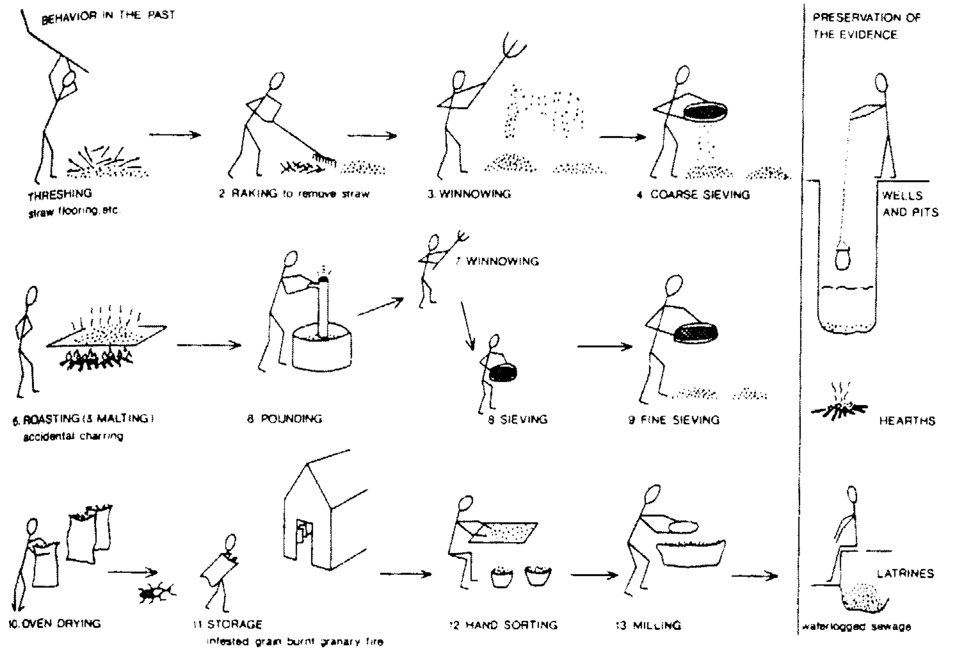


Figure 14.3 Cereal crop processing: ethnoarchaeologicial studies of these activities in traditional farming communities help archaeobotanists to recognize such acitivities in archaeological samples. Drawn by Annick Boothe, from *Archaeology: Theories, Methods and Practice* by Colin Renfrew and Paul Bahn, published by Thames and Hudson Ltd, London, 2nd edn, 1996. After Greig 1983.

processes such as specialization in production, the exchange of foodstuffs, and intensification (Jones *et al.* 1995; Jones 1985; Murphy 1983; van der Veen 1992a).

Animal bones

The study of animal bones from archaeological excavations began in the nineteenth century—for example, with identifications of the bone fragments found in palaeolithic caves in France and in the 'lake villages' of the alpine countries. These early studies tended to be by veterinarians, who were primarily interested in the morphology of the species represented and, in the case of bones from Pleistocene sites, on the information they provided about the contemporary glacial or interglacial environment. This information remains of interest, but in recent decades the focus of this branch of study, archaeozoology, has shifted to what animal bones can tell us about the people who exploited the animals.

As in the case of human remains, unusually wet or dry survival conditions may yield entire bodies with their stomach contents, skin, faecal matter and so on, but on most archaeological sites the evidence consists of bones: either articulated skeletons (or parts of skeletons) of animals that had died of disease or been buried for ritual purposes, or fragments of butchered bone discarded as food refuse (Davis 1986). The latter may include fish and birds as well as mammals. Microfauna (rodents, frogs, and so on) are generally analysed, like insect remains, primarily for their information on local environments (of which they can be sensitive indicators), though coprolite studies (for example from Palaeoindian sites in the south-west United States) show that some past societies subsisting in hostile environments had to include bugs and beetles in their diet as well as larger animals.

The information commonly recorded in an archaeozoological analysis includes the identification of the species represented and their relative frequency, the parts of the skeleton present, the age of the animals at death (calculated from long bone fusion and tooth eruption and wear: Wilson *et al.* 1982), evidence for sex (either morphological, or from measurements), for butchery techniques in the form of cut, chop or saw marks, and for disease and injuries, whether healed or fatal (Davis 1986; Grayson 1984; Klein and Cruz-Uribe 1984; Payne 1972). Measurements of groups of bones are also used variously as indicators of domestication, environmental change, and changes in husbandry techniques.

As in the case of archaeobotany, there has been a great deal of research by archaeozoologists on developing methodologies for recognizing the many 'taphonomic' biases that have affected the material under study in its long journey from being part of a living herd of animals to becoming a pile of fragments in the laboratory (Lyman 1994). Whilst these biasing factors are still imperfectly understood, archaeozoologists have been increasingly successful in demonstrating that their materials can provide a remarkable range of information about ancient societies: on the exploitation of animals for subsistence purposes, whether by scavenging, hunting, or herding, or combinations of these activities; on stock-keeping for different husbandry goals, whether for meat and/or for the 'secondary products' of live animals such as milk, wool, and traction; on stock management for the purposes of producing a surplus of animals on the hoof or of animal products, for gifts, exchange, trade, or tribute; and on the role of animals in human ritual. Animal remains may also be indicative of the season of occupation of a site, on the evidence of migratory fish and birds, deer antler, and jaw bones of young animals if the season of birth can be judged (for example: Brinkhuizen and Clason 1986; Grigson and Clutton-Brock 1983; Legge and Rowley-Conwy 1988).

Molluscs

Molluscs provided a useful, sometimes critical, source of meat for past societies, and the chemical composition and robustness of their shells mean that the latter often survive on archaeological sites. Many hunter-gatherer societies in the recent past, for example in South America, Australia and southern Africa, have collected shellfish, many food-producing societies have used shellfish as a welcome addition to the diet, and shellfish have often been a critical resource for many coastal communities (Bailey and Parkington 1988; Grigson and Clutton-Brock 1983). Techniques have been developed for using the species ecology, shell shape and shell chemistry of marine shellfish for reconstructing the environment of the midden in terms of coastal ecology and levels of salinity, whilst the season of collection may also be adduced from species demography, growth lines, and oxygen isotope analysis (Bailey *et al.* 1983; Claessen 1993; Killingley 1981).

Attempts have also been made to calculate the dietary value of a shell midden for the community that created it, usually by estimating the quantity of shells, converting that figure into meat weights, and then trying to compare this information with similar calculations for the other sources of plant and animal food used by the community (Koike 1986). Such studies face enormous problems, given the difficulties of estimating the total population of a midden, the heavily seasonal use often made of shellfish, the numerous uses of shellfish in addition to that of human food (for fishbait, for example, or for items for tool manufacture and trade), the common practice of drying shellfish for later eating, and unknown cooking practices. In general, archaeologists have tended to downplay the value of shellfish as a food source given the amount of time and effort needed to collect them —you need to collect over 50,000 oysters or over 150,000 cockles, for example, to get the calorific value of one red deer (Bailey 1978) —but for many communities shellfish may have been a critical starvation food. Also, ethnographic studies of some Australian aboriginal communities indicate that shellfish collecting was valued by the women as 'quality time' to enjoy each other's company and that of their children.

Ancient DNA

The principles of ancient DNA studies described in Chapter 7 in respect of human remains apply equally to studies of plants and animals. This is a new area of research of great potential, though with formidable methodological difficulties. At the time of writing, for example, there are a number of research projects on ancient DNA underway in Britain funded by the Natural Environment Research Council, grouped within what is termed the Ancient Biomolecules Initiative. Many of these projects are addressing themes relevant to this chapter and to Chapter 21, such as the domestication and early breeding history of cattle in Europe and Africa, horse in Siberia and eastern Europe, llama and alpaca in South America, sorghum in Africa and wheat in Greece (Eglington 1996). In virtually all cases the recovery of ancient DNA is proving so piecemeal that, whilst the occurrences are providing intriguing hints about domestication and husbandry history, most of the useful information from these projects has been coming from studies of DNA in modern populations—but the situation is likely to change in the near future as we move from the present experimental phase of laboratory techniques.

Experimental archaeology and ethnoarchaeology

Archaeologists can only explain the past in terms of observations of the present, particularly for the periods before writing, but we obviously cannot make the same one-to-one linkage between, say, modern hunter-gatherers and prehistoric hunter-gatherers that the geographer can make between the behaviour of modern and ancient rivers. Hence experimental archaeology and ethnoarchaeology both play vital roles in helping us move from observations of systematic patterning in archaeological data to more robust explanations of such patterning.

Experimental work has already been mentioned in the context of artefact analysis, and in terms of farming prehistory sites such as the Butser Iron Age Farm in Hampshire, southern England, have also been useful for understanding the possible efficiency of prehistoric farming methods, and storage pits, and the kinds of structures built where only ground plans have survived from excavations (Reynolds 1979). These kind of experiments sometimes tell us how things could not possibly have been done, rather than the opposite, but they still give salutary lessons. One important proviso is that we cannot recreate ancient animals and people: thus modern Dexter cattle are as small as iron age cattle were in Britain, but putting a twentieth-century English academic, two Dexter cattle, and a replica of a prehistoric plough together (as was done in a famous experiment at Butser) clearly does not give us an exact guide to the efficiency or otherwise of iron age ploughing techniques and iron age farmers!

Ethnoarchaeology is the study of contemporary communities with the specific purpose of understanding the relationship between their behaviour and the kind of archaeological signatures created by it (Gould 1980). The work by archaeobotanists on crop processing activities has already been mentioned, and ethnoarchaeological research has been just as fundamental for archaeozoologists in understanding the taphonomic processes that affect faunal samples (for example: Binford 1978, 1984; Brain 1981). Beyond these studies, however, ethnoarchaeology has also helped promote an awareness of how the creation of archaeological residues such as bone and seed samples can be structured by social relations as much as by subsistence needs and economic goals (Hodder 1982).

SCALES OF PRODUCTION

As mentioned at the beginning of this chapter, the acquisition of food and of associated animal and plant products can operate at a variety of scales. First and foremost are the most basic requirements of subsistence, to obtain sufficient food to maintain human life. If the system can be intensified in some way so as to obtain a surplus, whether of live animals, or of plant and animal foods, or of plant and animal non-food products, then it has the capacity to support one or more of a variety of economic goals. More food means that more people within the community can be fed, including non-food-producers such as craft specialists, priests, and élite groups. Within communities and between communities, people can compete for resources, with the winners taxing the losers. Social obligations can be met with gifts. There are the means for trading with neighbouring communities for scarce resources. The ability to intensify subsistence systems to create surplus food and food products that sustain new social and economic relations has been a cornerstone of human prehistory and history.

Yet at the same time, the other theme running through agricultural history is the difficulty most subsistence farmers face in intensifying production. In medieval Europe, for example, cereal yields were invariably low, animals small and unproductive compared with today, and technologies primitive, resulting in a vicious circle of low-input/low-output farming: 'the evil of small harvests due to insufficient manuring, the lack of manure being in turn the result of small agricultural production, making it impossible to keep more cattle… How narrow were the boundaries that restricted the practice of farming. The opportunities in ancient farming were very limited' (Slicher van Bath 1963:10, 23). The same was true of the peasant farmer in Roman times: without proper fodder, the problems of maintaining a team of plough cattle through the summer drought could leave the oxen so weak that one of the Roman agronomists recommended the Italian farmer to feed grain to his oxen before the ploughing season to build their strength up, starving his own family in the process (White 1970). Even in today's global market, much of the developing world is still characterized by agricultural communities operating at the most marginal levels of subsistence.

So how and why have many human communities managed to intensify their food-production systems so successfully and so spectacularly from the earliest agriculture 10,000 years ago to the agro-businesses of the modern industrialized nations? In the case of European agricultural history, Grigg (1982) discusses the contrasting evidence for the influence of four major stimuli in the intensification of agricultural systems: changes in climate and environment; the invention and adoption of new technologies, such as more efficient ploughs and harvesting tools; the pressure of rising populations; and social change. There is the same theorizing regarding agricultural intensification in prehistory too (Barker 1985). Most of these theories have also characterized the debate over how and why agriculture was invented in the first place, and in time adopted by most of the world's population (see Chapter 21).

In recent years one important theme in the debate on the social context of intensification has been the emphasis on how farmers, like hunters, need to deal with risks, hazards and uncertainties in their decision-making (Halstead and Jones 1989). Strategies need to be in place for dealing with the expected unpredictabilities of fluctuating harvests. These may include practical mechanisms such as storing food, diversifying the food supply, or subdividing fields, but they can also include social mechanisms of mutual obligation as in the case with many subsistence farmers today, where a family can help out its neighbour one year in the knowledge that it might need the same thing the next; in many societies, too, valuable equipment is owned communally and shared. Thus few subsistence farmers in fact operate as independent economic units, and systems of 'social storage' amongst past subsistence farmers, whilst developed as a mutual self-help system, must have had the potential to allow particular individuals or communities to gain advantage over others through the acquisition and control, rather than sharing, of resources (Halstead and O'Shea 1989).

Although we can discern many instances of significant agricultural intensification in the archaeological record, it is extremely difficult to identify causation with much confidence. In prehistoric Europe, for example, there are many examples of agricultural intensification, but in virtually all cases these are associated with significant changes in other aspects of the cultural system: new technologies for tillage or harvesting, for example; or more complex societies than hitherto; or larger populations than hitherto; extensions in the settled area; or combinations of any of the above. Did the adoption of the new technology allow more land to be cultivated, or the same land more productively, with more food allowing populations to rise? Did the rise in population force the adoption of a new, more productive, but more labour-intensive, technology or agricultural system? Did technological change and agricultural intensification facilitate social stratification? Was the rise of élites in pre-state and state societies the context in which new technologies were adopted— and controlled by them—to create more surpluses? Add to this the undoubted effects of significant climatic change, which we can generally discern, and the unknown but probably significant effects of the small-scale fluctuations in sequences of good and bad harvests which we generally cannot, and we are invariably faced with sequences of agricultural intensification where the chickens and eggs of causation are impossible to separate.

It is also important to emphasize that agricultural change, like the transition to farming that preceded it, need not be, and certainly was not in the past, unilinear, an inexorable process of increasing intensification. It must be expected that archaeology will increasingly reveal examples of subsistence 'de-tensification' as well as of intensification as its database grows more detailed, though such fluctuations are only gradually being detected (e.g. van der Veen 1992a).

The following sections sketch in the variety of hunting, agricultural and pastoral systems we can discern in the archaeological record, before we turn to the social archaeology of food and farming.

HUNTING SYSTEMS

There has been an enormous amount of debate regarding the subsistence behaviour of the early hominids, but microscopic studies of their teeth and isotopic analyses of their bones suggest that they had a predominantly vegetarian diet. It is now thought that they probably foraged in sexually discrete groups, eating as they went —no home bases, no hunting, no food-sharing as once thought (Chapters 19 and 20). They probably scavenged, though, taking meat from carcasses killed by lions, leopards and hyenas, activities in time greatly aided by primitive hand-tools. The critical factor in the effective colonization of the northern latitudes was the ability to use hunting as a means of coping effectively with the shorter days and harsher winters than further south (Dennell and Roebroeks 1996). It is quite likely that these early humans practised 'confrontational scavenging', allowing other carnivores to kill large animals and then chasing them away to get at the meat themselves, but the nature and location of the butchery marks on bones of rhinoceros, horse, bison and giant deer at Boxgrove indicate that the carcasses were more or less intact when butchery started, making it likely that the people were hunting these large animals (Roberts 1996). Another technique seems to have been to stampede animals into swamps or over cliffs (Scott 1980).

Most middle palaeolithic sites in Europe consist of caves containing evidence for flint knapping and carcass butchery associated with fire, but true hearths or campsites are very rare (Stringer and Gamble 1993). In a detailed case study of two caves in central Italy, Mary Stiner (1991, 1994) found that one of these caves, Grotta Guattari, had mainly heads and hooves of animals such as red deer and fallow deer, whereas the other cave a few kilometres away, Grotta Sant' Agostino, had most parts of their bodies represented. The Grotta Guattari was also used by hyenas, whose scavenging activities left very similar faunal samples to those left by the Neanderthals. The implication is that Neanderthal bands roamed the landscape practising a mixture of hunting and scavenging, one possibility being that they divided these activities between males and females. They then transported the meat back to convenient locations such as caves for defrosting by fire and (as far as we can tell) immediate consumption. Skeletal studies show how hard life was for them, with hunting as likely to end in a bruising close-quarter wrestling match as in a clean kill at a distance (Stringer and Gamble 1993). All was not mayhem, however: some Neanderthal faunal samples suggest 'controlled, focussed, and selective hunting strategies' (Gaudzinski 1996:37) like those of the Upper Palaeolithic (see also, for example, Patou-Mathis 1994).

The last 40,000 years of the Pleistocene were characterized in the northern latitudes by some of the most hostile glacial conditions ever endured by humans, yet this was the period when fully modern humans were able to spread from Eurasia to North America and Australia. The period also witnessed extraordinary transformations in technology and subsistence, and probably also in cognitive skills (Dennell 1983; Mithen 1996; and see Chapters 18 and 20). In Europe, there is consistent evidence that upper palaeolithic hunters specialized in hunting migratory herbivores such as reindeer and horse in the north and red deer and steppe ass in the south. It used to be argued that the reindeer hunters followed the herds over hundreds of kilometres throughout the annual migrations, more or less to the exclusion of other game (Sturdy 1975), but the consensus now is that most of the hunting bands were probably more like the Nunamiut caribou hunters of Alaska who specialize in intercepting the deer at key ambush locations during their seasonal migrations, augmenting this meat with other food sources at other times of the year (Binford 1978; Weniger 1987). In France, detailed studies of cave faunas indicate that different bands of upper palaeolithic hunters camped at different points along the migration routes, killing the deer at different seasons (Boyle 1996; Fontana 1995). At Canecaude in the Aude basin, reindeer made up almost 90 per cent of the animals killed, though the wide variety of other species (cattle, horse, chamois, red deer, ibex, pig and small game such as hare) implies a range of hunting skills from spearing at a distance (using spear-throwers) to trapping (Fontana 1995). Red deer and steppe horse hunting in the Mediterranean seems to have been as strongly seasonal as reindeer hunting north of the alps (Donahue 1988). Such specialized hunters would have had to have developed effective strategies for dealing with fluctuations in prey numbers, and Mithen (1990) argues that palaeolithic cave art probably had such a function: images not just of different species of animals and birds (and of different types such as old, young, male, female, healthy, sick) but also of their tracks, hoofprints and dung, and of the terrain where they were most likely to be found, suggest that the caves must have acted in part as invaluable repositories of hunting lore, for example when hunters needed to vary between cooperative game drives and individual stalking.

In some parts of the world highly specialized systems of hunting remained effective methods of subsistence after the end of glacial conditions—the bison hunters of the North American plains are a good example (Speth 1983) —but more commonly diversified systems of hunting, fishing and gathering developed. In Europe the postglacial climatic warming created a landscape of forests, lakes and rivers teeming with wild life, and mesolithic subsistence systems adapted accordingly. The classic site remains Star Carr in northern England excavated in the late 1940s and early 1950s by Grahame Clark, where *c.* 7500 BC a platform of birch branches and brushwood was constructed at the edge of a lake; bones of a variety of animals were dumped around it such as elk, cattle, pig and roe deer, but especially red deer (Clark 1954). The site has been interpreted variously as a winter base camp (Clark 1972), an all-year-round ambush location (Andresen *et al.* 1981) and most recently (on the basis of a taphonomic study of red deer body parts and roe deer tooth eruption) as a summer hunting camp (Legge and Rowley-Conwy 1988). Presumably Star Carr represents one, possible brief, moment for a community that practised a cycle of hunting, fishing and gathering within an annual territory that probably extended from the coast to inland hills. The shell middens of the tiny island of Oronsay off the Scottish mainland are another example of a 'seasonal snapshot' —in this case of a community who probably moved between the mainland and the adjacent islands (Mellars 1988). In southern Scandinavia, in contrast, we are fortunate in having a series of well-excavated sites with excellent conditions of organic survival both on the coast and inland, and elegant models of seasonal cycles of hunting, fishing, and gathering have been proposed as a result (Bang-Andersen 1996; Larsson 1978, 1983; Zvelebil and Rowley-Conwy 1986; Fig. 14.4).

In general we know far less about mesolithic plant gathering than hunting, fishing, fowling and shellfish collection (Clarke 1976), but Zvelebil (1994) argues convincingly that a wide variety of berries, nuts, leaves and roots was collected, involving not only the use of a number of hand-tools but also perhaps even protective tending and weeding—a form of horticulture, in effect. These findings also accord with the growing palynological evidence that mesolithic hunters were burning and clearing forest to encourage secondary growth, thus improving feeding conditions for animals such as red deer (Caseldine and Hatton 1993; Simmons and Innes 1987; Simmons *et al.* 1989). By *c.* 5000 BC integrated systems of hunting, fishing and gathering (and horticulture?) sustained highly complex and more-or-less sedentary mesolithic communities in a number of regions of Europe, particularly coastal regions with plentiful terrestrial and marine foods (Rowley-Conwy 1983; Zvelebil and Rowley-Conwy 1986).

Comparable systems of hunting, fishing and gathering developed during the Holocene in many regions of the world, especially where marine and terrestrial resources were abundant (Bailey and Parkington 1988). In Japan, as in Europe, these systems proved resilient enough to sustain highly complex societies much like the Ainu of more recent times, who were stratified into nobles, commoners and slaves, the nobles undertaking the prestige hunting of dangerous game, and lower class groups specializing more in fishing (Akawaza and Aikens 1986; Watanabe 1972).

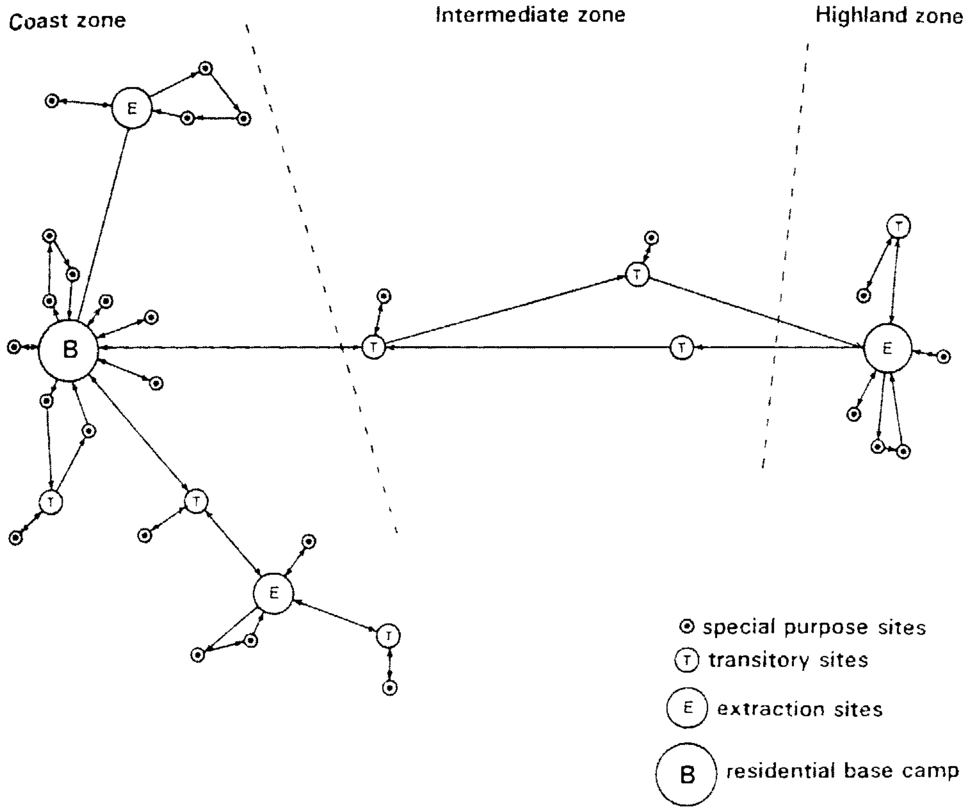


Figure 14.4 A model of mesolithic seasonality and territoriality in southern Norway. Source: Bang-Andersen 1996.

The Ganges valley in India and the eastern seaboard of North America are other examples of regions where rich resources sustained more-or-less sedentary and stratified societies (Chattopadhyaya 1996; Sanger 1996). Similar arguments to those put forward in Europe for forest management by postglacial hunter-gatherers have been proposed for the tropical forests of South America (Linares 1976) and Asia (Groube 1989).

Wild foods have remained a critical resource for many farmers from the earliest history of agriculture, and remain so for most agricultural societies outside the industrial world. In prehistoric Europe, many societies relied more on foraging than farming for hundreds and in some cases thousands of years after they first began to use domestic plants and animals (Barker 1985), and the same is true of many other regions of the world (Hall 1987; Harris and Hillman 1989 *passim;* Stark and

Vorhies 1978; Tankersley and Isaac 1990; Zvelebil 1986). In the case of complex societies relying on agriculture for their sustenance, the pursuit of wild foods has commonly taken two forms: to provide a supplement for people subsisting on a monotonous diet of plant staples; and as a leisure pursuit for the wealthy, one of the ways of demonstrating their 'otherness' from the rest of the population: the iconography of all the ancient civilizations is invariably full of images of the chase. In medieval England, considerable investments were put into creating and protecting suitable habitats for game—deer-parks, dovecotes, 'pillow-mounds' (warrens constructed for rabbits), fishponds and so on—and in legislating to circumscribe ordinary people's access to wild resources (Grant 1988).

AGRICULTURAL SYSTEMS

Temperate

It is not the purpose of this chapter to debate the arguments surrounding the change from hunting to farming, but certainly in most of temperate Europe given the kind of evidence described above it seems increasingly difficult to maintain the thesis of a simple dichotomy between mesolithic hunting and neolithic farming that has been one of the central tenets of prehistoric archaeology for well over a century (Barker 1985; Zvelebil 1986, 1996). In many parts of temperate Europe, early neolithic subsistence is now seen as having more in common with late mesolithic subsistence than with the agricultural systems that developed later in the Neolithic (Thomas 1996). In Britain, for example, stable isotope studies of skeletons indicate an early neolithic diet dominated by meat and leafy vegetables, with cereal foods of little importance—grain may have been grown on a very limited scale largely for ritual purposes (Evershed *et al.* 1991; Richards 1996); one recent suggestion (based on pot residues) is that much of it may in fact have been for brewing rather than eating (Dineley 1996).

What is clear is that the agricultural systems that developed in temperate Europe using the exotic domesticates from the Mediterranean and the Near East were, from the outset, well adapted to the cooler, wetter and more forested environments (Bogucki 1988): thus cattle were generally more important than sheep; the ceramic sieves of the first *Linearbandkeramik* farmers (Bogucki 1984) suggest that milk may have been extracted for human use from a very early stage in cattle and sheep husbandry; and spring sowing may also have been developed. Some of the most remarkable insights into the nature of early temperate farming come from the alpine 'lake villages' (mostly in fact small farmsteads) because of the extraordinary survival of organic materials. At Thayngen Weier in Switzerland, for example, cattle byres were recognized from the presence not only of cattle dung and bedding straw but also insect remains including the puparia of the common house fly, which liked to overwinter in warm cow houses; structures with deposits rich in macrobotanical remains of ivy, ash, twigs, clematis, and elm shoots, and with very high frequencies of pollen of fodder plants such as ivy, were identified as the barns containing the winter leaf fodder for the cattle (Guyan 1966). As noted earlier, the tradition of humans sharing their houses with their cattle has endured in many parts of temperate Europe for most of the prehistory and history of farming (Hvass 1993; Whittle 1993; Fig. 14.2).

Although many elements of the 'Secondary Products Revolution' (Sherratt 1981, 1983) were probably a feature of temperate European farming from the beginning (Chapman 1982), the exploitation of animal secondary products (the products of the live animal such as milk, wool, and traction power) probably did not develop on a systematic basis until the third and second millennia BC, coinciding with increasing social complexity (Chapter 22). Bogucki (1993) argues that there may have been a causal relationship: in providing meat, milk and wool, sheep and goats were ideal as 'insurance', as a 'walking larder', whereas cattle would have been an expensive luxury for meat given their slower growth rates—they needed some four years to get to optimum body weight—so the development of dairying made them more useful, but it was traction that really made them come into their own. Traction enabled farmers to raise production by cultivating more land (though switching from hand-tools to ploughs probably meant that yields per hectare fell) and transporting bulk goods (crops, fodder, fuel wood) from remote locations to the residential base. Cattle would have increased in value as assets worth accumulating through barter, bridewealth, gift exchange and raiding, facilitating the development of social stratification as winners (whether families or individuals) moved upwards and losers moved downwards into dependency relationships.

Associated with these social developments were transformations in the agricultural landscape. In the earlier neolithic systems of subsistence, land ownership seems often to have been communally based, with ancestral rights reinforced and legitimated through the siting of burial monuments. By the second millennium BC, however, there is increasing evidence for people demarcating their land with formalized boundaries—banks, fences, hedges, and ditches (Fleming 1988; Taylor 1996). Much has been learnt of the organization and functioning of the farms at the centre of such landscapes from modern extensive excavations of waterlogged settlements and their surrounding pens, paddocks and drove-roads (Ijzereef 1981; Pryor *et al.* 1985).

By the first millennium BC we can discern complex agricultural economies operating at the regional scale in the highly stratified competitive world of the pre-Roman Iron Age. In central-southern England, for example, contextual studies of large samples of botanical and faunal remains from different kinds of settlement indicate that grain and animals on the hoof were bartered between communities and exchanged within client relationships (Grant 1984; Jones 1985). Rising populations coincide with widespread evidence for agricultural intensification in the centuries preceding the

Roman conquest: both field systems and pollen diagrams indicate an expansion of the agricultural area, improved ploughs allowed the cultivation of heavier soils, and different crop mixes were developed to take advantage of these (Jones 1986; van der Veen 1992a). In Holland there is the first clear evidence for sod manuring of sandy soils (*plaggen* culture) at this time, though it may have begun earlier (Groenman-van Waateringe 1978). With Romanization there is increasing evidence for specialization in agricultural production for urban markets, but the core of the system remained cereal farming on the lowlands to feed the urban population, with cattle-keeping critical for ploughing and manuring the arable land (Grant 1989; King 1989). One interesting result of Romanization, though, was the development of viticulture in north-west Europe, remarkable evidence for which has been found recently in the excavation of a Roman farm in Northamptonshire in the English Midlands, where the vineyard survived as a series of parallel ditches containing post-holes, depressions made by the root balls of plants, and plentiful vine pollen found in the trench fills—the excavator calculated that the 6 kilometres of trenches represented 4,000 vines, or 15,000 bottles of wine (Meadows 1996).

In northern Europe outside the Empire, agricultural systems remained much like those of the pre-Roman Iron Age, though there is some evidence for the production of grain and animals (and even furs in the far north) for the Roman markets (Randsborg 1985; Zvelebil 1985). Gennep, a migration period (fourth/fifth century AD) centre in the Dutch Meuse area, is a good example of a well-preserved settlement with farmhouses, barns, granaries, ovens and wells, an élite stronghold whose inhabitants controlled local trade routes, received cereals, cattle and pigs as tribute, and spent most of their time raising horses, hunting, and drinking (Heidinga 1994). In Scandinavia at this time the number of cattle byres on farms and the size of their surrounding fields suggest similar landscapes of inequality, with cattle a standard of value and a means of payment (Nasman 1996). Soil analyses indicate that the fields were cultivated in single course rotations without fallow, so requiring much manure, but excavations of key sites such as Vorbasse (Hvass 1993) and of well-preserved field systems (Widgren 1983, 1990) indicate that, during the course of the first millennium AD, there were developments in efficiency: infield land was fenced off as manured arable fields and meadows for winter fodder, and separated from summer pasture on the surrounding outland.

One of the most elegant studies of the long-term development of an agricultural landscape in the temperate zone, in many ways typical in its trends, has been the investigation of the Ystad region in southern Sweden by an interdisciplinary team of ecologists, archaeologists, and human geographers (Berglund 1991; Fig. 14.5). Agricultural settlement began in the Neolithic, when crops such as emmer, einkorn and naked barley were introduced, though there were many similarities with preceding mesolithic subsistence in terms of forest management and seasonal territoriality. Phase 2 marked the development of permanent agriculture in the Bronze Age, characterized

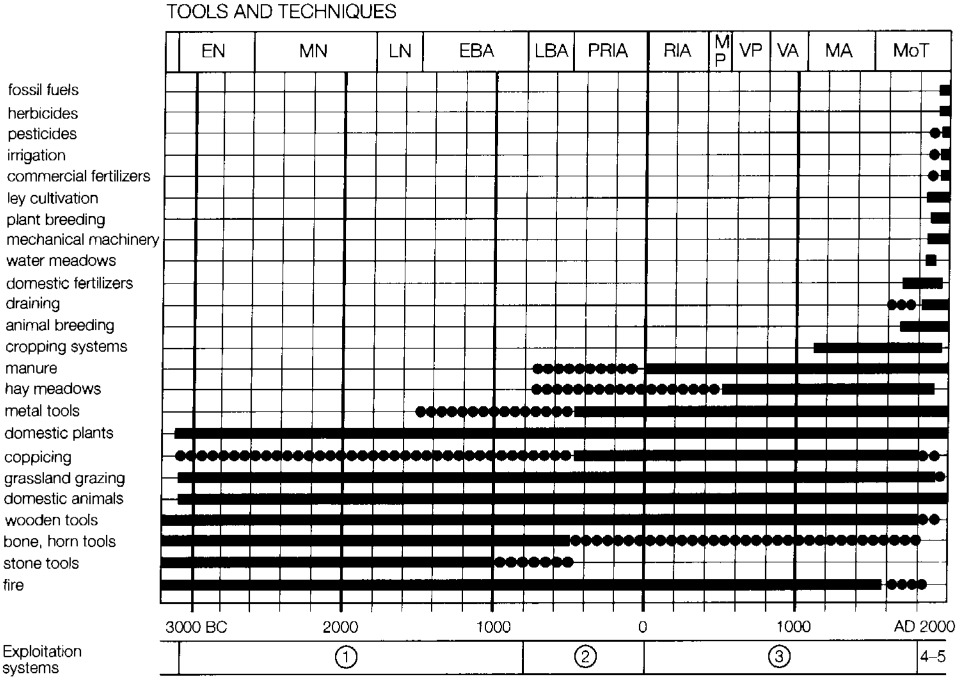


Figure 14.5 The development of agricultural systems in the Ystad area, southern Sweden. For explanation of the five exploitation systems, see text. EN—early neolithic; MN— middle neolithic; LN—late neolithic; EBA—early bronze age; LBA—late bronze age; PRIA —pre-Roman iron age; RIA—Roman iron age; MP—migration period; VP—Vendel period; VA—Viking age; MA—Middle Ages; MoT—modern time. Source: Berglund 1991.

by cattle longhouses, fodder collection, and the manuring of fixed fields. Phase 3, beginning in the first millennium AD, was characterized by the development of infield—outfield systems, with one-course tillage (of hulled barley and rye especially) of manured fields, and coppice—pastures beyond. Feudal landscapes were in place by the tenth century, becoming increasingly segregated in the ensuing centuries, but the agricultural system remained essentially unchanged until the early eighteenth century (Phase 4), when the permanent arable was improved by external nutrients and yields increased by three-field tillage. The late nineteenth and twentieth centuries (Phase 5) have been marked by the extraordinary transformations to the landscape caused by the development of capitalistic industrial farming, with its crop rotation systems, the use of under-draining and marling, and mechanization.

Mediterranean

Until the introduction of modern mechanized systems, farming in the semi-arid landscapes of the Mediterranean was characterized by extensive cereal farming, the fields being prepared for sowing by light ploughs pulled by oxen, cattle or horses; by a reliance on the small stock best adapted to coping with the paucity of summer feed, sheep and goats, with much use made also of the donkey for transport; and by the integration of cereal and animal husbandry with the cultivation of vines, olives and other tree crops such as figs. Until recently it was common in many regions to see the intermingling of these crops in systems of 'polyculture' —alternate rows of olive trees and vines, with small patches of cereals and legumes grown in between, especially on terraced hillslopes. The other feature of traditional Mediterranean land use has been transhumant systems of grazing, in which large numbers of livestock (especially sheep and goats) were driven on the hoof each year between widely separated winter upland and summer lowland pastures. Archaeology now shows that many aspects of this 'traditional' Mediterranean farming have in fact only developed very slowly (Barker 1995; Halstead 1987a, 1987b).

Agriculture seems to begin rather suddenly in the eastern Mediterranean about 7000 BC, the settlement of Knossos on the island of Crete remaining the single most convincing example of the traditional colonization model. In the central and western Mediterranean, however, there now seems to have been a very long period of several thousand years during which mesolithic populations made some use of domesticates but relied predominantly on hunting, fishing, and gathering, the latter including the harvesting of morphologically wild cereals and legumes (Barker 1985; Rowley-Conwy 1995). Lewthwaite (1986) suggests that the domesticates may have spread westwards as part of exchange systems of prestige goods between indigenous hunting populations, agriculture only finally becoming established throughout the Mediterranean basin as the mainstay of subsistence by about the fourth millennium BC.

Early farming here was practised in a predominantly forested landscape, often by springs and in other areas of natural moistness. The diet of these societies was probably dominated by plant foods, both gathered and cultivated (the latter with simple hand-tools), the livestock being kept on only a small scale, quite possibly for social as much as for subsistence reasons (Halstead 1981, 1987b, 1996a). By the fourth millennium BC, as agriculture spread throughout the region, there are indications of the beginnings of traditional dryland cereal farming, integrated with systems of sheep/goat husbandry in which the animals were kept both for their meat and their milk. Halstead (1992a) suggests that livestock exchange amongst these societies, in exchange for surplus arable produce, is likely to have been an important element in the process of wealth differentiation and social ranking that is increasingly visible at this time. In the third millennium BC the evidence for social stratification is even clearer, and it coincides with the first clear evidence for the development of viticulture, presumably for the production of wine as an élite drink —the evidence is strongest in the Aegean Early Bronze Age, where it was also associated with olive cultivation and terrace cultivation (Renfrew 1972), but there are indications of viticulture amongst the contemporary societies of the central and western Mediterranean too (Barker 1995; Chapman 1990).

The second millennium BC in the Aegean was the period of the Minoan-Mycenaean civilization. The remarkable tablet archives suggest that palaces such as Knossos and Pylos owned huge estates in their territories and extracted surplus foodstuffs and other agricultural products such as wool from their subservient populations, giving food rations back in return—mainly bread and oil, the traditional poverty diet of the Mediterranean peasant. One of the more striking features of the tablets is that a palace such as Pylos owned flocks of sheep in the tens of thousands, but probably only a dozen plough oxen—they are named individually in fact. Halstead (1992b) suggests that the palace élites farmed their estates extensively, the land being ploughed by their oxen and their flocks probably being managed in systems of transhumance, whereas the peasants were farming small plots intensively and keeping small flocks of sheep and goats, the entire system being meshed together in flows of goods and services to and from the palaces—the system of surplus banking termed 'social storage' by Halstead. In Spain at this time the control of the plough teams may also have been a key feature of élite power (Gilman 1981). In the Italian peninsula, pollen evidence shows that the mountain forests were now being opened up (whether by climate change or human action or both is not clear), and there is also good archaeological evidence for the expansion of settlement into the highest mountains, presumably for summer shepherding (Barker 1995) (one bronze age settlement on the Maiella mountain is on the site of a modern ski resort, for example).

Many aspects of Mediterranean farming, therefore, were in place by the end of the second millennium BC, but it was not until classical times that the Mediterranean landscape as we know it today really took shape. In the images on painted Greek vases and Etruscan tombs, as well as from the surviving artefacts and models, we can see virtually the full range of agricultural equipment and activities of the present-day Mediterranean farmer prior to mechanization. Archaeobotanical evidence indicates that the development of the Etruscan city-states in central Italy was accompanied by an expansion in the number of cereal and legume species cultivated alongside olives, vines and figs, a frieze in one of the Etruscan tombs at Tarquinia showing mixed crops in rows suggesting that the advantages of polyculture were now deliberately sought. *Cuniculi,* underground channels, were cut to divert water through hillsides onto irrigated fields. A recently excavated Etruscan farmstead (Fig. 14.6) had evidence in its structures and artefacts for wine-making and cheese-making, and the excavators calculated that, if ancient Etruscans drank more or less

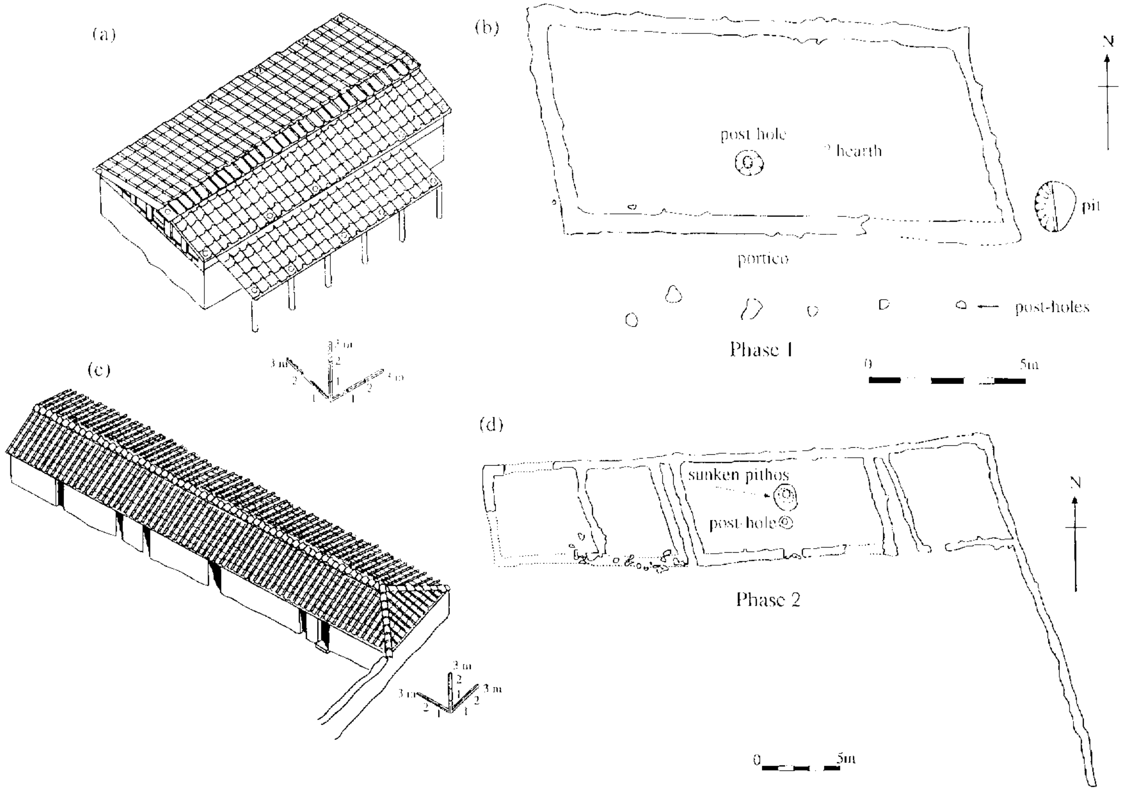


Figure 14.6 Podere Tartuchino, an Etruscan farm. Source: Barker and Rasmussen 1997.

the same as modern Italian farmers (a total unquantifiable it has to be admitted!), the family would have been producing a surplus of wine more than three times their own needs (Perkins and Attolini 1992). The faunal samples from Etruscan towns indicate the intensification of animal husbandry in the countryside to supply the growing urban populations with meat and secondary products, and specialized butchery systems can be identified; but trace element and dentition studies of Etruscan skeletons reveal a steady decrease in animal and vegetable products in the diet, and the dominance of cereal foods (Barker and Rasmussen 1998). Similar trends in farming and diet accompanied urbanization in Greece (Foxhall 1997; Garnsey 1988, 1992). For most ordinary people in these early Mediterranean states, the main opportunities to taste fresh meat were probably the religious festivals, a situation in many respects unchanged until recent times.

Although one of the most striking features of the Roman landscape is the evidence of land allotment or centuriation as revealed by air photography (Chouquier *et al.* 1987), probably the most important development was the growth of the large estate at the expense of the small farm. The trend had begun in classical Greece— half of Attica, the territory of Athens (so often portrayed as a democracy of peasant citizens) may have been owned by less than 10 per cent of the population (Foxhall 1992) —but it accelerated dramatically with the expansion of Rome, as the wealthy élites of first Italy and then the provinces invested their ever-increasing riches in slave-staffed estates specializing in production for the marketplace. The trend is clear not only in the written sources but also in the ploughsoil evidence of numerous archaeological surveys (Alcock 1994; Barker and Lloyd 1991; Carreté *et al.* 1995; van Andel and Runnels 1987). Large-scale excavations of the villas at the centre of these estates such as Settefinestre in Italy have revealed in extraordinary detail how close was the organization of such establishments to the ideal described by the Roman agronomist Varro: the *pars urbana* or living space for the noble family, and the *pars rustica,* with its facilities for processing and storing agricultural products, together with the accommodation for the slaves (Carandini 1985). The piles of broken wine amphorae outside Rome's port of Ostia and the cargoes of numerous shipwrecks around the Mediterranean are further eloquent testimony to the success of such estates in supplying the burgeoning urban markets of the Empire. Large-scale long-distance transhumance was another component of estate farming (Whittaker 1988). The evidence for high rural populations and large-scale agricultural practices coincides in many regions with geomorphological evidence for significantly accelerated rates of erosion (Lewin *et al.* 1995).

With the collapse of the western Roman empire there was generally a considerable decline in population, and it was not until the tenth century or so that the pattern was established of nucleated village settlement so typical of the Mediterranean landscape today. In the Biferno valley in central-southern Italy a programme of archaeological survey and excavation documented a series of cycles of expansion and contraction in village settlement over the past thousand years, the expansion phases generally coinciding with geomorphological evidence for accelerated erosion as land was taken back into cultivation or used more intensively (Barker 1995). There is similar evidence from Greece (van Andel and Runnels 1987) and Spain (Fédéroff 1998). The most striking feature of all these studies, however, is that the damage pales into insignificance compared with the effects of mechanization and agri-business in the past few decades.

Arid

Deserts are the most hostile environments for human subsistence, particularly so for farmers, because of the scarcity of perennial water supplies, the paucity, irregularity and geographically localized nature of rainfall, and the effects of these factors on plant growth. The !Kung San of the Kalahari desert and the Australian Aborigines are well-known examples of peoples who have developed effective ways of living in deserts by combining the hunting of small mammals with collecting a very wide range of edible plants, tubers, snails and grubs within carefully organized systems of seasonal scheduling and mobility (Gould 1980; Lee 1979). The other way of living in arid environments is pastoralism (discussed on pp. 584–7), whereby people rely on the animals they herd to convert the desert vegetation into humanly accessible protein, systems which invariably require seasonal mobility in search of pasture. However, archaeology also provides evidence for human societies which have succeeded in living in arid environments as more-or-less sedentary farmers, practising forms of subsistence that involved a significant element of crop cultivation, invariably based on the careful management of water. Techniques included digging canals to divert water from river valleys onto adjacent arid lands; cutting underground conduits to reach aquifers; and, especially, 'floodwater farming', the construction of diversion walls and checkdams to capture the floodwaters that flow down hillslopes after rainstorms. The term 'floodwater farming' was first used by Bryan (1929) to describe the traditional systems of farming practised by the indigenous peoples of Arizona, and archaeological evidence for floodwater farming proves the antiquity of such systems, not only in this region (Fish and Fish 1994) but also in North Africa, the Middle East and Arabia (Gilbertson 1986; Gilbertson and Hunt 1996). One of the best-known studies of the archaeology of floodwater farming was in the Negev desert of Israel, where the systems were reconstructed by the investigators and shown to function efficiently (Evenari *et al.* 1971).

It is important to remember that today's deserts have not always been so. In the Sahara region, for example, the transition to the Holocene 12,000 years ago brought sufficient rainfall to create a lush vegetation of woodland, shrubs, and grasses around rivers and lakes, and grassland on the intervening plateaux, allowing populations of hunter-fisher-gatherers to expand westwards right across the interior of North Africa from the Nile valley (Barich 1987; Wendorf and Schild 1980). These people then changed to pastoralism as the present-day climate and environment of the Sahara gradually developed from the sixth millennium BC onwards (Muzzolini 1993). Although these pastoralists probably grew cereals on a small scale, the first evidence for systematic cultivation in the Saharan oases is only in the late second and early first millennia BC (van der Veen 1992b). In the Fezzan region of southern Libya, it was based on the construction of *foggaras:* subterranean channels connected by vertical shafts, cut into the hillsides to collect water from underground aquifers and channel it down to the fields on the oases floors— similar structures, termed *qanats,* have also been a feature of arid-zone farming in parts of the Middle East. Significantly, this dramatic intensification in investment was in the context of the development of sedentary stratified societies in fortified settlements, who emerge a few centuries later into history (in the writings of the Greek historian Herodotus) as the Garamantes tribe.

As Wittfogel (1957) originally argued, many early states were situated in semi-arid lands and were supported by irrigation agriculture, and certainly in the Middle East, air photography has been used with remarkable effect to document the development of canal-building and irrigation farming between the Tigris and Euphrates rivers that formed the basis of successive civilizations from the Sumerians onwards (Adams 1981), and the diversion canals and floodwater catchments that sustained substantial settlements on the arid steppes further north (Wilkinson 1993). Field survey here suggests that fallowing and manuring were well understood as moisture conservation measures (Wilkinson 1990). There have been comparable studies of the irrigation systems of the early states of Peru and Mesoamerica (Blanton *et al.* 1981; Coe 1974; Farrington 1980). However, in the arid zone proper, perhaps the most striking feature of land use history in many regions has been the alternation between periods of intensive high-input/high-output sedentary agriculture sustaining high populations and phases of low-input/low-output subsistence pastoralism with lower-density populations. The former, moreover, have invariably been associated with social intensification, and often also with political change in the adjacent core regions of primary settlement. Two examples illustrate this.

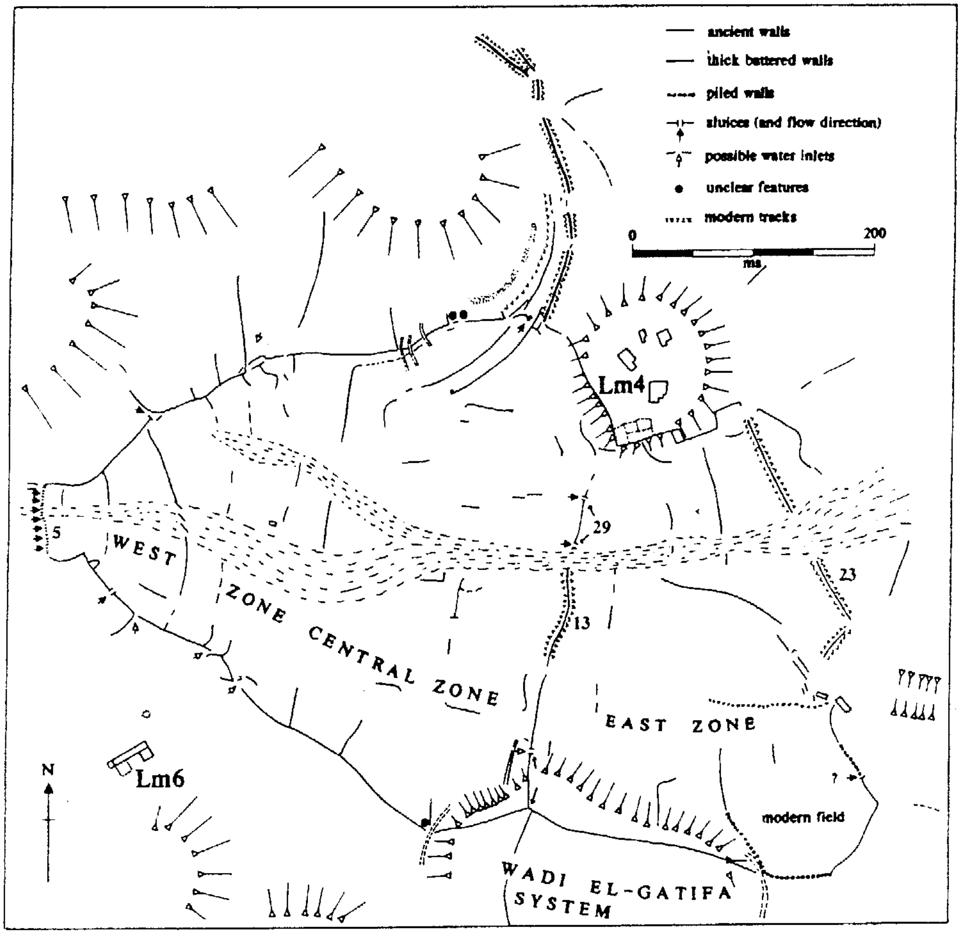
In the Wadi Faynan in southern Jordan, for example (Barker *et al.* 1997), the agricultural sequence begins with an early neolithic (eighth millennium BC) village, situated at the head of the wadi by a perennial spring—the location is typical of many early farming settlements in the region such as Jericho and Beidha, presumably selected so that crops could be grown without irrigation in the damp soil by the spring (Sherratt 1980). By the fifth millennium BC, when the environment was significantly wetter than today, people were growing crops on soils that were naturally irrigated by floodwaters, but the first evidence for floodwater farming in the form of simple drystone diversion walls and terraces coincides with the emergence of stratified societies in the Bronze Age. This is also the case in the Negev nearby (Levy 1995a), where similar structural evidence for floodwater farming is further supported by phytolith evidence (Rosen 1994). The development of the iron age states in the first millennium BC was the context for the construction of an extensive and elaborate field system in the Wadi Faynan: floodwaters issuing from side wadis were trapped by drystone barrages, and diverted through sluices and baffles down onto terraced fields. The system was further expanded at the time of the Nabataean kingdom, and reached its climax during the centuries of Roman occupation, when it was used to feed a large population of slaves working in neighbouring copper mines. Erosion and wadi-downcutting gradually rendered the system unworkable by the end of the Roman period, and the region has been used since then for pastoralism.

The second example comes from Tripolitania in north-west Libya, from the pre-desert region between the well-watered coastal zone and the Sahara (Barker *et al.* 1996). The region was occupied by transhumant pastoralist populations until the Romans took control in the first century AD, at which point the local Libyan élites organized their followers (quite possibly by coercion) into sedentary farms producing foodstuffs for the markets provided by the coastal towns and the oases forts —potsherds with graffiti scratched on them *(ostraca)* at the Bu Njem fort, for example, describe the arrival at the fort of farmers from the surrounding area bringing fresh food and olive oil (Marichal 1992). Hundreds of villa farms were built in the pre-desert, their facilities including elaborate olive presses capable of producing a surplus of oil substantially beyond the needs of the community, surrounded by field systems where the floodwaters from the surrounding hills were concentrated (Fig. 14.7). Animal husbandry was reduced in importance because the main grazing areas for the stock were now enclosed for cultivating what seems, on the archaeobotanical evidence, to have been a remarkable range of crops: cereals (barley, wheat), pulses (lentil, pea), oil plants (olive, safflower, linseed, castor), Mediterranean fruits (grape, fig, pomegranate, almond, peach), African fruits (date, water melon) and herbs (van der Veen *et al.* 1996). In the southern parts of the pre-desert the communities seem to have reverted back to pastoralism after a couple of centuries, but in the better-watered northern wadis sedentary farming outlasted the collapse of the Roman markets and survives in places today.

Tropical

Though often envisaged as a kind of Garden of Eden, tropical rain forests are difficult to exploit by foraging alone (Bailey and Headland 1991), and the archaeological evidence in fact indicates that, from their earliest occupation, they were exploited by well-adapted foraging technologies that presaged horticulture. One feature of many tropical rain forests are toxic plants that, if treated, are very valuable—they are often abundant, available for long periods, and storable—and a variety of tools had to be developed to deal with these: stone knives to crack nuts, stone grinders to crush kernels, baskets to leach out toxicity. Burnt endocarps of the toxic fruit *Pangium edule* have been found in the Niah cave in Borneo in levels probably as early as 40,000 BP (Bellwood 1990) and Groube (1989) suggests that waisted axes in New Guinea indicate that strategies were developed to change rain forest plant ecosystems from the earliest periods of occupation as early as 40,000 years ago, creating disturbed patches of forest to encourage economically important plants to thrive. Rain forest organic residues have now been identified on the edges of stone tools from Yombon, New Britain, *c.* 35,000 years ago (Pavlides and Gosden 1994). In South America, well-developed foraging technologies were practised by 11,200 years ago at Caverna da Pedra Pintada, Brazil (Roosevelt *et al.* 1996). In Australia, the tropical rain forests of the north-east were exploited for foraging by about 5,000 years ago, and by about 2,500 years ago this had developed to include the intensive exploitation of toxic nuts, using a distinctive technology (Cosgrove 1996).

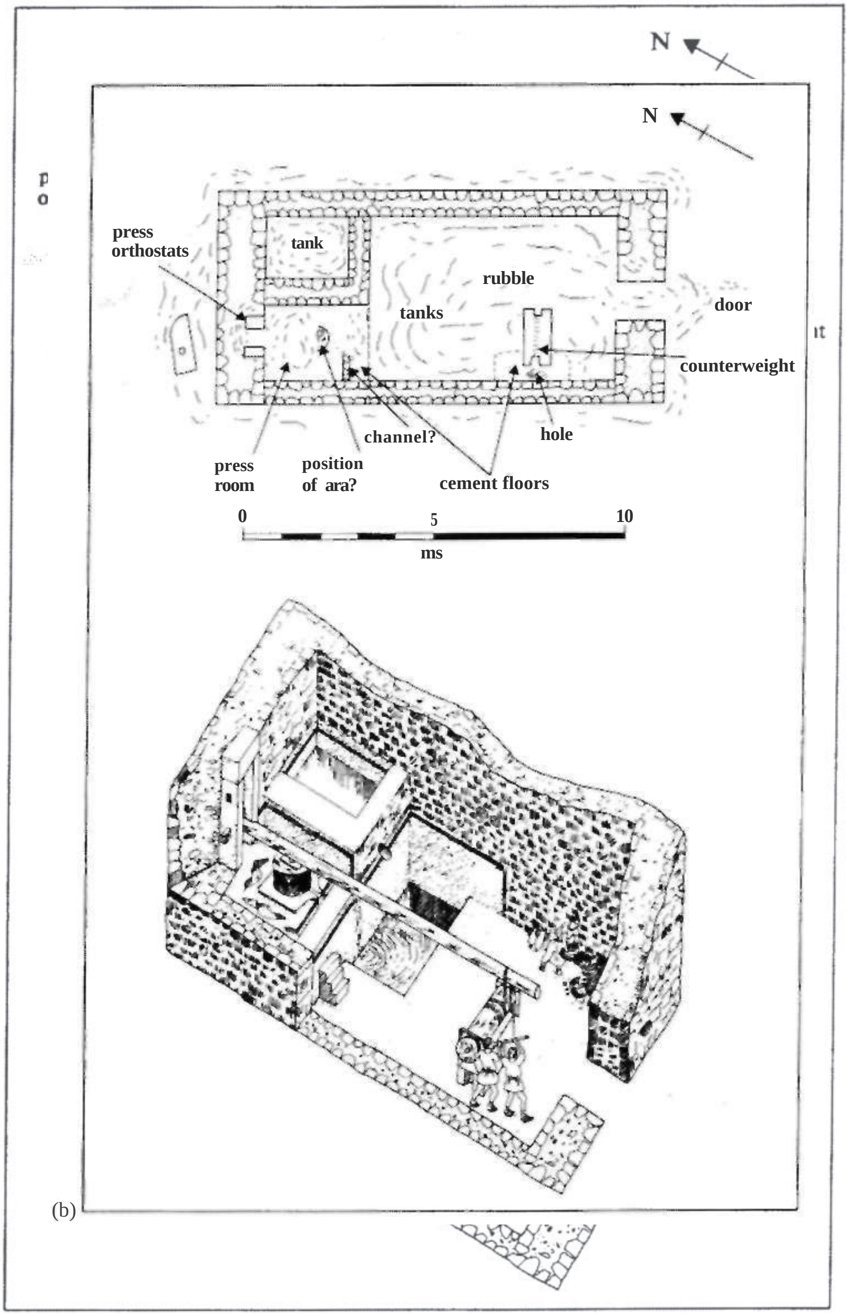
The conventional wisdom has been that neolithic farmers colonized south-east Asia, spreading southwards from the Chinese mainland to Indonesia between about 6,000 and 4,000 years ago (Farrington 1990; Spriggs 1989). The process has been linked with the appearance of particular pottery styles such as Lapita ware, and with theories of language spread based on linguistic studies of the present-day languages of the region, rather like Renfrew's model of the colonization of Europe by neolithic farmers speaking an original Indo-European language (Renfrew 1987). As with the latter case, the situation now appears to be much more complicated. The most remarkable evidence remains the discovery of swamp drainage systems in the highlands of Papua New Guinea at the Pleistocene/Holocene boundary, probably for taro cultivation (Bayliss-Smith and Golson 1992; Golson 1990). Gosden (1992) documents the evidence for two-way transfers across the region as a whole, of Melanesian plants for south-east Asian animals. Developing from the 'forest management' mentioned earlier, there seems to have been a long process of experimentation from the late Pleistocene through the Holocene which involved extending the natural range of plants and animals and altering the ecologies in which they could be husbanded. The simple spread southeastwards of taro and yam, the basis of Pacific agriculture, is now doubted, and some food plants and animals certainly spread the other way; the cuscus *Phalanger orientalis* may have been taken to Timor by early foragers, and the wallaby *Thylogale brunii* may have been moved by people through the islands of the Bismark archipelago; and wild and tame pigs may have been exploited in extensive systems of management long before domestic pigs were husbanded intensively.



(a)

Figure 14.7 (a) A Roman-period farm and its system of floodwater farming in the Tripolitanian pre-desert, Libya, and (b—opposite) plan and reconstruction of a Roman-period olive press in the same region. Source: Barker *et al.* 1996.

The study of farming systems in tropical environments is greatly hampered by the poor survival conditions of organic remains, especially of the root and tuber crops that are the major staples of these regions (Hather 1992). In the islands north of New Guinea pollen and charcoal have both been used successfully to document the development first of small-scale swidden agriculture and then its replacement by an 'agroforest' of breadfruits, taro, coconuts and yams (Athens *et al.* 1996). The critical source of information has been phytoliths recovered from sediments, artefact surfaces and pottery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fillers (Pearsall 1989; Pearsall and Trimble 1984), and the combination of pollen and phytolith analysis has been used successfully in the New World tropics to document the gradual development of swidden farming after millennia of forest disturbance and manipulation, augmented in some regions by systems of intensive farming in the last 2–3,000 years (Pearsall 1996; Voorhies 1996). In recent years, too, these methodologies have been greatly strengthened by the realization that the soft tissues (parenchymatous) of root and tuber crops can be recognized in carbonized form by scanning electron microscopes—presumably they were overlooked or misidentified in the past as wood charcoal: remains of sweet potato, for example, have been found in Mangaia, one of the Cook Islands, from contexts dating to around AD 1000, clear evidence for its transferral from South America to Polynesia by this time (Hather and Kirch 1991).

In addition to botanical and faunal remains, the archaeological record of tropical farming includes field evidence for agricultural practice, beginning with the water disposal channels (over 750 metres long) cut in the Kuk Swamp of New Guinea 6,000 years ago (Hope and Golson 1995). A variety of irrigation systems sustained significant populations and complex social structures in central and South America, such as the Maya in Belize (Kirke 1980), and prehispanic chiefdoms in Colombia (Parsons and Denevan 1974) and Venezuela (Spencer and Redmond 1992). Some of the most remarkable relict landscapes are the buried paddy fields of Japan, where more than two hundred sites have now been excavated, their principal use for wet rice cultivation (for crops like taro and millet can also be grown in irrigated fields) confirmed by phytolith analysis (Barnes 1990) and even the discovery of the root holes of rice seedlings (Imamura 1996; Fig. 14.8).

Rice seems to have been cultivated first in the Yangtze valley of central China, between 9,000 and 6,000 years ago. Wild rice grew naturally in the coastal swamps and inland marshes of east and south-east Asia, and, for reasons that are not yet clear, by about 3,000 years ago many sedentary coastal and lacustrine communities were incorporating rice cultivation within their existing systems of hunting, fishing and gathering (Higham 1996). Rice grains, husks and phytoliths recovered from sediments and pottery fillers document the rapid spread of rice throughout the islands of south-east Asia (Glover and Higham 1996). Though the spread of rice has traditionally been correlated with the spread of farmers, in fact often it does not seem to have been an important crop until a few centuries ago, many people living by a combination of foraging and forest cultivation and taking their carbohydrates from plants such as the sago trees that grow wild in the forest—in Borneo, for example, rice cultivation sustained the coastal trading states of the medieval period, but most people in the interior have only turned to rice cultivation in living memory. Whilst the evidence for the history of tropical agriculture remains very fragmentary, the clear impression provided by the data is that there was no simple transition from hunting/gathering to farming, that systems of forest management were developed from very early in the history of their occupation and that the 'agroforest' has provided the principal means of sustenance for many people until the most recent past.

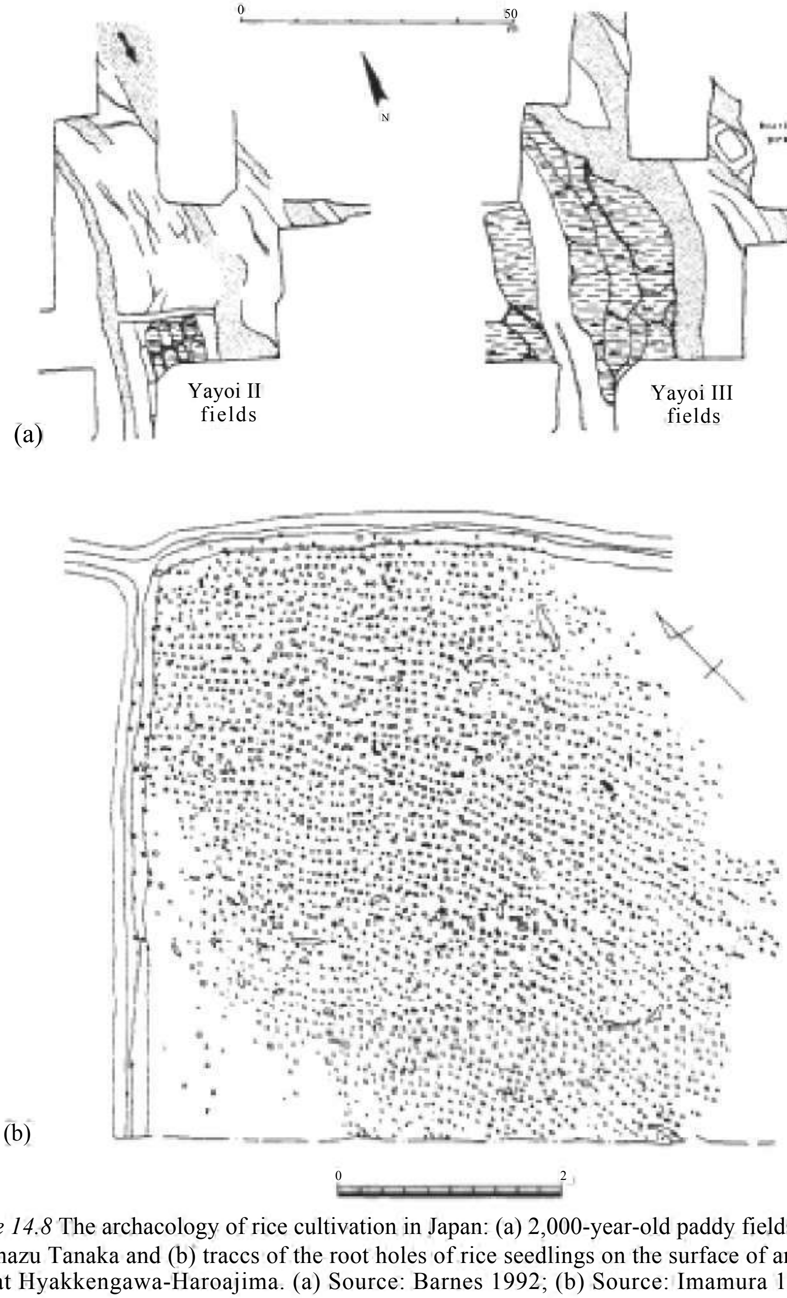

Figure 14.8 The archacology of rice cultivation in Japan: (a) 2,000-year-old paddy fields excavated at Tamazu Tanaka and (b) traccs of the root holes of rice seedlings on the surface of an excavated field at Hyakkengawa-Haroajima. (a) Source: Barnes 1992; (b) Source: Imamura 1996.

PASTORALISM

There are many definitions of pastoralism, as with the related concepts of nomadism and transhumance, but for the purposes of this discussion we mean simply forms of subsistence based predominantly on the management of animals. Pastoralism was regarded by Victorian archaeologists as a primitive form of husbandry, an intermediate step in the ladder of progress between hunting and farming (Westropp 1872), but anthropological studies of present-day pastoralists demonstrate both the complexity of pastoralism and also how pastoralist societies invariably operate in symbiotic relationships with agricultural societies (Dahl and Hjort 1976; Khazanov 1984; Spooner 1973). The latter point is certainly confirmed by historical studies of pastoralist societies (Braudel 1972; Whittaker 1988; Zeder 1994).

The study of pastoralism in antiquity presents archaeologists with considerable methodological problems. Pastoralists today are invariably characterized by mobility, moving on foot or mounted (at least until the advent of trucks) as they shift their animals between areas of grazing from season to season, so commonly they use rather ephemeral shelters for themselves and their animals, and do not carry round with them large quantities of material culture with later archaeologists in mind. One result has been that archaeologists have too often had to have recourse to postulating the presence of pastoralists on the basis of negative evidence: in the arid regions of the Near East, for example, periods without settlements but with burial cairns have been interpreted as periods of pastoralism, in this case part-supported by biblical references to desert nomads (Bar-Yosef and Khazanov 1992; Finkelstein 1995), and rather similar arguments used to be put forward to explain periods of European prehistory where burial monuments were the most visible component of the archaeological record (Fleming 1971; Gimbutas 1965). In the context of these debates, pastoralist societies have been studied by ethnoarchaeologists in terms of the kind of 'archaeological signatures' created by their use of territory, structures, artefacts, animals and plants (Barker and Grant 1991; Bar-Yosef and Khazanov 1992; Chang and Koster 1986; Cribb 1991; Gifford-Gonzalez 1984). Whilst our understanding remains limited, there are now increasing examples of archaeological studies where pastoralist societies can be recognized with some confidence.

There has been much debate amongst archaeologists about the antiquity of Mediterranean pastoralism, particularly of the specialized forms of long-distance transhumance still practised today (though fast disappearing) and recorded by Roman and medieval writers, whereby huge numbers of livestock, especially sheep and goats, were driven between lowland winter and summer upland pastures (Maggi *et al.* 1991). Arguments used to be presented for the existence of long-distance transhumance in various periods of Greek, Italian, southern French, and Iberian prehistory, but the consensus now is that, whilst it may have been a component of Minoan-Mycenaean estate farming, it was otherwise not a feature of Mediterranean prehistory, developing only with the emergence of the classical states (Barker 1989; Forbes 1995; Halstead 1996b).

The archaeological record of the arid zones on the fringe of the Tigris—Euphrates states of Mesopotamia has commonly been interpreted as cycles of land use oscillating between sedentary agriculture (the systems of floodwater farming discussed earlier) and pastoralism. In the Negev desert of Israel, for example, the Chalcolithic and Early Bronze II/III periods are usually characterized as socially complex and sedentary, and the Early Bronze I and IV periods as phases of 'reversal' or 'decline' to pastoralism explained variously in terms of climatic shifts, humanly adduced degradation, internal social change and external political influence (Levy 1995b). The models are certainly over-simplified: the presence of pigs in some of the 'pastoral' periods suggests that we are looking at shifts in a balance between mixed farming and semi-sedentary pastoralism or 'agro-pastoralism' (Grigson 1995), and specialized pastoralist communities may in fact have been a feature of Chalcolithic, Nabataean and Roman/Byzantine societies (Levy 1992). In the latter period, detailed fieldwork is beginning to identify at least three categories of pastoral sites in the Negev: large camps with numerous living structures; small camps with fewer structures; and ephemeral or tent sites consisting of stone lines, cleared areas, fire pits and ceramic scatters (Rosen 1992; Fig. 14.9). Bedouin-style camel pastoralism seems to have begun in the Arabian desert in the second millennium BC in the context of developing trade systems linking New Kingdom Egypt, the Levantine city-states and the Babylonian empire (Zarins 1989).

In North Africa, Saharan rock art is thought to reflect the changing ideologies of Saharan societies during the transition from hunting to herding between *c.* 6000 and 2000 BC, as well as acting as mechanisms for the exchange of information about the landscape they inhabited. In the Libyan study referred to earlier (Barker *et al.* 1996), tent footings and hut foundations with Roman pottery suggest that transhumant pastoralists continued to inhabit the pre-desert even though the main wadis were taken into cultivation by the kind of estates mapped in Figure 14.7. Camels were used by the pre-desert farmers for ploughing and as pack animals, and camel pastoralism in the desert seems also to have developed in the Roman period, perhaps partly in response to the opportunities provided by trans-Saharan trade (though the late Roman authors concentrate more on the considerable threat posed by these nomads to the coastal cities and farms).

Early agriculture in subequatorial Africa was a mixture of crop cultivation and small-scale stock-keeping, settlement concentrating in general on forested waterside locations (Sutton 1996), but as agriculture expanded to more open environments during the first millennium AD, animal husbandry increased in importance. Cattle-keeping in particular was a critical component of the *zimbabwe* state societies that developed in the early second millennium AD (Barker 1988). The élites controlled

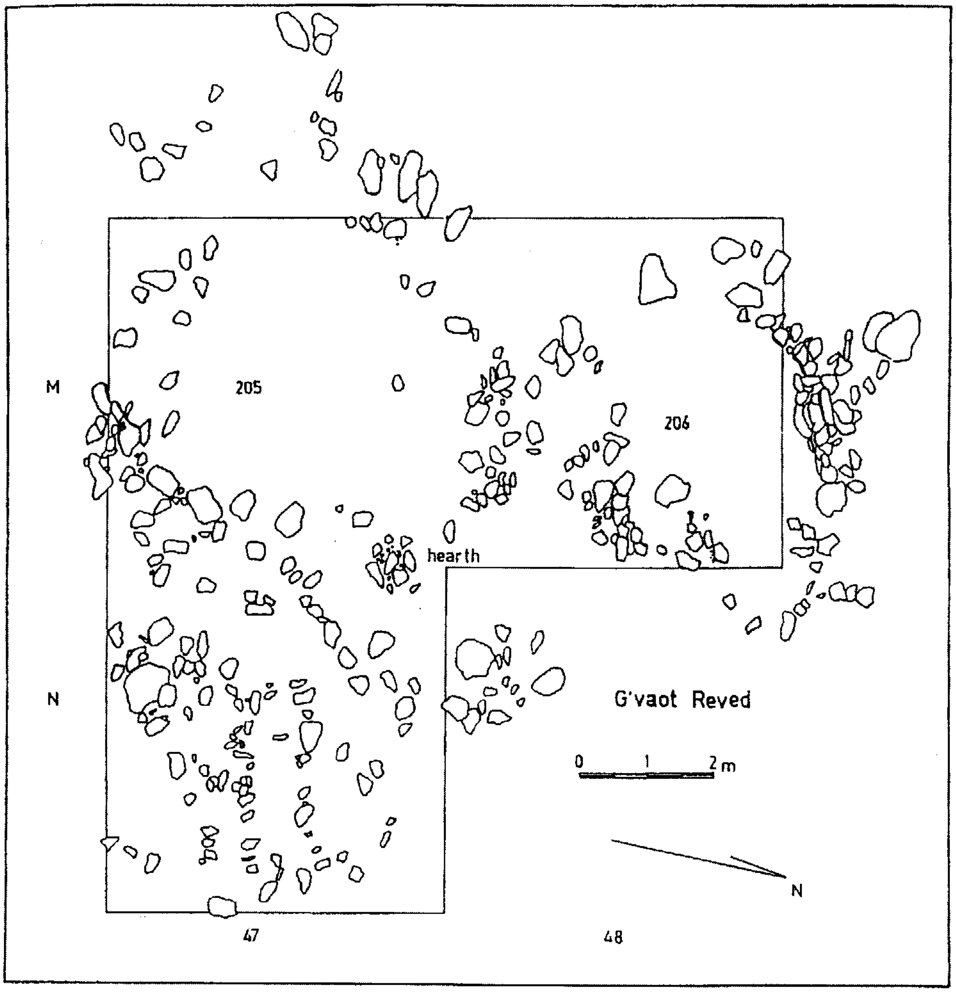

Figure 14.9 Plan of a first-millennium AD tent camp from Giv'ot Reved in the Negev desert, Israel. Source: Rosen 1992. © University Museum Publications.

large herds of cattle which were probably moved on a seasonal basis between the high veld in summer and the low veld in winter to keep them free of tsetse fly (Garlake 1978). These states were linked in trading relationships not only with the Arab and Portuguese trading settlements on the coast but also with complex pastoralist societies to the west on the fringe of the Kalahari desert, where élite groups living in regional centres were supported by tribute from subordinate cattleherders—the camps of the latter have been plotted by air photography because their dung deposits are covered now by grasses tolerant of high levels of phosphates and nitrates (Denbow 1984).

The horse, hunted in late glacial times, is thought to have died out in most of Europe in the Holocene, surviving on the Russian steppes and being eventually domesticated there. On the evidence of microwear on premolar teeth, horses at Dereivka in the Ukraine were being bridled by *c.* 4000 BC (Anthony *et al.* 1991), though the faunal analysis suggests they were the critical meat source for the community (Levine 1990; Olsen 1996). Although the horse was probably first domesticated on the steppes as a meat source, its critical role elsewhere was for riding and pulling carts, its widespread adoption invariably associated with the emergence of élites and other indicators of social intensification (Sherratt 1981). The first historically known horse-riding nomads of the Eurasian steppes are the Cimmerians and Scythians, recorded from the early first millennium BC, but the hundreds of high-status graves dating to the third millennium BC containing wagons or carts and horses are commonly taken as evidence for the emergence of similar pastoralist societies at this time. From western Europe to China, the wagon was replaced by the chariot during the first millennium BC, and then abandoned in favour of cavalry warfare (Piggott 1992).

As with the horse on the Eurasian steppes, it seems likely that the camelids of South America were initially domesticated as a meat source but were then valued more as they are today—the llama principally as a beast of burden, though also important for wool, dung (as fuel and fertilizer) and in ritual, and the alpaca as a wool-producer (Browman 1989). Specialized camelid pastoralism is practised today in locations largely unsuited to agriculture such as the high grasslands of Peru, whereas in most regions their husbandry is complementary to agriculture. The latter situation seems also to have been the case in antiquity (McGreevy 1989).

FOOD AND CULTURE

In a famous analysis of the meaning of cooking for human societies, the structural anthropologist Lévi-Strauss (1965) defined what he termed an underlying 'culinary triangle' of opposing relationships between raw, cooked and rotten food, cooked food being transformed by culture and rotted food being transformed by nature. He went on to argue that the principal modes of cooking form another structured set, transforming raw food (in his terms, meat) by the addition or subtraction of air, water and culture (the cooking apparatus). Thus roasting was a process by which meat was brought into direct contact with fire without the mediation of any cultural apparatus, air, or water, and the process was only partial—roast meat is only partly cooked (at least when properly cooked in France!). By contrast, boiling was a process which reduced raw food to a decomposed state similar to natural rotting, but through the mediation of both water and culture (the pot). Smoking was a process of slow but complete cooking mediated by air but not by culture. The scheme became evermore complicated as he tried to place grilling, steaming and frying into the triangle, and as Edmund Leach commented in his analysis of Lévi-Strauss's arguments, 'at this point some English readers might begin to suspect that the whole argument was an elaborate academic joke' (Leach 1970:31). However, his principal point was that, whereas animals just eat food, what is and is not food for humans, and what food is eaten by humans on what occasion, is largely determined by their social conventions (Goody 1982).

From his fieldwork amongst the Nuba of Sudan, for example, Ian Hodder (1982) argued that two neighbouring tribes, the Moro and the Mesakin, whilst practising similar systems of subsistence, in fact created rather different faunal samples in and around their settlements because of contrasting social relations, gender roles and ideological systems. In the compounds of the Moro, for example, were found only the jaws and skulls of pigs, whereas in those of the Mesakin there were jaws and skulls of pigs, goats, and cattle. The Moro hid the bones in the roofs of granaries, the Mesakin displayed them openly in front of the granaries. Pigs were critical for Moro marriage dues, cattle feasting was important for Mesakin burial ceremonies. There were strict concepts of purity and cleanliness, and complex social behaviours associated with a fear of ritual pollution of cattle and cattle milk, interpreted by Hodder as a symbolic expression of the fear felt by men of pollution by women. The implications for archaeozoologists, he concluded, were very clear:

> archaeologists studying the economy through bones appear to assume that their evidence of relative proportions of animals, butchering practices, age distributions, herd control and so on are somehow free of all symbolic content: theirs is supposed to be a practical, rational, scientific world. But meat-eating, the division of the carcass and the dispersal of the bones must always have had a symbolic content behind which there is a conceptual order. Beyond the functioning of 'the economy' is a conceptual scheme and meaning.
> (Hodder 1982:116)

It is debatable whether the implications of the Nuba study are quite so iconoclastic for archaeological studies of food and farming as Hodder argues: the fact that the subsistence systems of the two societies are fundamentally the same, and would appear so to archaeologists if they had access to the full suite of subsistence data from the two societies, is rather encouraging for archaeologists attempting to reconstruct long-term patterns of hunting and farming from such data. Nevertheless, the Nuba study is an important reminder of the central role that plants and especially animals play in human social relations as well as in subsistence, and it is clear that environmental archaeology has enormous potential to contribute to studies of past societies through investigations of the cultural values of food (e.g. Chaix *et al.* 1995; Manning and Serpell 1994; Meniel 1988; Ryan and Crabtree 1995).

Although fire is commonly found in the caves occupied by Neanderthals, microscopic studies of tooth wear and damage suggest that Neanderthals, like their predecessors, ate their food more or less raw, gripping a lump of meat between their teeth and then either tearing and yanking bite-sized chunks from the bone, or hacking them off by sawing away in front of their faces with a flint flake (Stringer and Gamble 1993). The same marks on children's teeth conjure up a nice image of Neanderthals teaching their toddlers their table manners: 'use your Stanley knife properly, dear'! In contrast, upper palaeolithic societies were certainly practising meat drying, smoking and storage, and stone-lined hearths also indicate that cooking was now the norm. Given the increasing evidence in their material culture for status differentiation amongst many late glacial and early Holocene huntergatherers, it is quite possible that food was another indicator of status (Bender 1979). Hayden (1992) has in fact argued that, if competitive feasting began to supplant food-sharing amongst such societies living in resource-rich areas, the need for food to meet increasing social demands might have been a factor in persuading them to commit to agriculture.

Clear evidence for the links between food and culture can be discerned amongst later agricultural societies. In later neolithic Britain, for example, the analysis of faunal samples in henge monuments such as Durrington Walls suggests 'a highly organized system of animal management in which pigs were specifically bred for feasting purposes and were slaughtered in large numbers', probably in ritual activities involving the entire community (Thomas 1984:206). With the emergence of élite groups, the link between food and status seems inherent in the production of alcoholic drinks such as wine, mead and beer; both the Sumerians and Egyptians associated brewing and wine-making with particular deities, and the occurrence of beer residues in beakers in ritual contexts in Britain suggests that here too these activities also had a strongly magical aspect (Dineley 1996; Vencl 1994). Wine was a critical indicator of status in Greece and Rome, where the élites of both societies indulged in the long eating and drinking bouts of the *symposion* (Murray and Tecusan 1995). Another indicator of status has often been sugar: in ancient Egypt, for example, the lifestyles of the élite are differentiated from the poor in the amount of tooth decay caused by their sugar-rich diet (Hillson 1979).

There are many examples of societies for whom animals on the hoof, cattle in particular, were a critical resource for exchange and alliance formation, for bridewealth and other social obligations within the community, and for distribution for status—and thus the primary target for inter-communal warfare. Examples include the 'hillfort societies' of the British Iron Age (Grant 1984) and the German tribes on the fringe of the Roman empire (Roymans 1996). The early medieval communities of Ireland recorded by the Early Christian sagas were very similar, as were those of Scandinavia, where the Old Nordic word for goods and property was *fae,* 'horned animal' (Nasman 1996). In the case of the *zimbabwes* states of central-southern Africa, too, faunal analysis indicates that prime young cattle were brought to the chiefly enclosures for consumption, the provision of their meat for the court or capital being an important aspect of élite power (Reid 1996). At the Manekweni *zimbabwe,* the middens by the chief's hut and by those of the court were dominated by the bones of prime young beef, whereas the middens on the edge of the enclosure where the lower-status people lived had poorer cuts from older animals, and a variety of game (Barker 1978).

King (1984) argues that eating beef was also an important indicator of status (in this case the acquisition of Roman culture) in the towns and villas of Roman Britain, a habit he suggests was imported by soldiers who had previously served on the German *limes*. In Roman Italy, on the other hand, pork was generally the highest status meat, the subject of innumerable recipes in the Roman literature, and pigs dominate the faunal samples of towns like Capua, Naples, Pompeii, Ostia and Rome. At the Settefinestre villa the faunal sample indicates a clear separation in the quality of food eaten by the senatorial family and the slaves who worked the estate, the food refuse of the former consisting of prime cuts of young animals including many burnt fragments, presumably from roasting, whereas the latter consisted of poorer cuts, from older animals, probably boiled as a broth (King 1985).

Another indicator of status in food is the consumption of exotic items not available to the general populace. The aristocratic diet at Settefinestre typically included venison and game birds, and the faunal samples from medieval castles in England commonly include substantial frequencies of deer, game birds and waterfowl (Grant 1988).

The archaeology of gender has scarcely been investigated by environmental archaeology, but one of the most exciting examples of the potential of the archaeology of food to inform on gender relations is Hastorf's study of Andean chiefdoms (Hastorf 1991), described in Chapter 22. The integration of archaeozoology, archaeobotany and isotopic analyses of skeletons indicates that male and female diet was at first very similar, but gender relations then changed significantly with the incorporation of these societies into the Inca state: the women worked harder, producing maize for male beer-drinking at public and political occasions, men also ate more meat within the same political arena, and women were increasingly restricted to domestic activities.

The symbolic association of modern humans with the animals they hunted is evident from palaeolithic art (Mithen 1996), and probably from the famous red deer head-dress at Star Carr (Clark 1954). The dog seems to have been the animal first tamed by humans, and it is significant that from the beginnings of this companionship there are examples in both European and American hunter-gatherer societies of dogs being buried in graves with humans, as well as sharing in their daily life and food (Clutton-Brock and Noe-Nygaard 1990). Later dog burials presumably symbolize the social and ideological role of hunting for the élites of many agricultural societies (Hamilakis 1996). The powerful symbolism of cattle for agricultural societies is evident from the 'bull shrines' at the neolithic settlement of Çatal Hüyûk and the 'heads and hooves' graves in English neolithic tombs to the 'pastoral ideologies' in which were embedded the social relations of the German tribes beyond the *limes* (Roymans 1996:55) and those of the Great Zimbabwe élites (Reid 1996). There is as long a tradition of animal sacrifices amongst the pastoralists of the Eurasian steppes, from the Bronze Age even to the nineteenth century, when a European traveller witnessed the sacrifice of 100 horses and 1,000 sheep at the burial of a Kirghiz prince—a first-millennium AD grave at Lake Baikal has recently been reported in which a prince lay side by side with his horse, the latter having been sacrificed and part-eaten at the funeral meal and the animal then recreated around its skeleton by stuffing the hide (Crubézy *et al.* 1996).

Faced with the evidence of 'ritual deposits' such as this, and 'normal' settlement evidence, it is all too easy for archaeologists to do as Hodder warned, separating the evidence into domestic and ideological spheres. This may be a feature of our own largely secular world, but cannot have been so in the past—the medieval peasant lived with Christianity in field and farm as well as in church, and activities as mundane as breeding rabbits are now seen as imbued with symbolic meaning (Stocker and Stocker 1996). Ideology and domestic life were inextricably enmeshed in neolithic and bronze age societies in Europe (Garwood *et al.* 1991), and comfortable assumptions about the nature of British iron age society are also having to be discarded (Grant 1984; Hill 1995). The study of pit-fills at sites such as Danebury and Winklebury has revealed 'special deposits' amidst the rubbish such as complete animal and human carcasses, and parts of carcasses, both probably the result of sacrifice (Fig. 14.10), along with what seem to be ritual settings of mundane rubbish such as potsherds and broken quern-stones. Wild animals and plants seem to have played an insignificant part of the diet of these people, yet wild animals are frequently found in ritual deposits. The structuring of the evidence suggests linkages and taboos in human-animal relationships every bit as complicated as those of the Moro and the Mesakin today. There are increasing indications of similar ideologies underpinning Romano-British society (Grant 1991; Scott 1991), in striking contrast with the traditional models emphasizing the modernity of that world. Such studies make it very clear that archaeologists will only be able to understand the history of food in human societies, and the complexity of the hunting and agricultural systems developed for its acquisition, if we learn to bridge the disciplinary gaps and integrate the goals and methodologies of archaeological science with those of social archaeology.

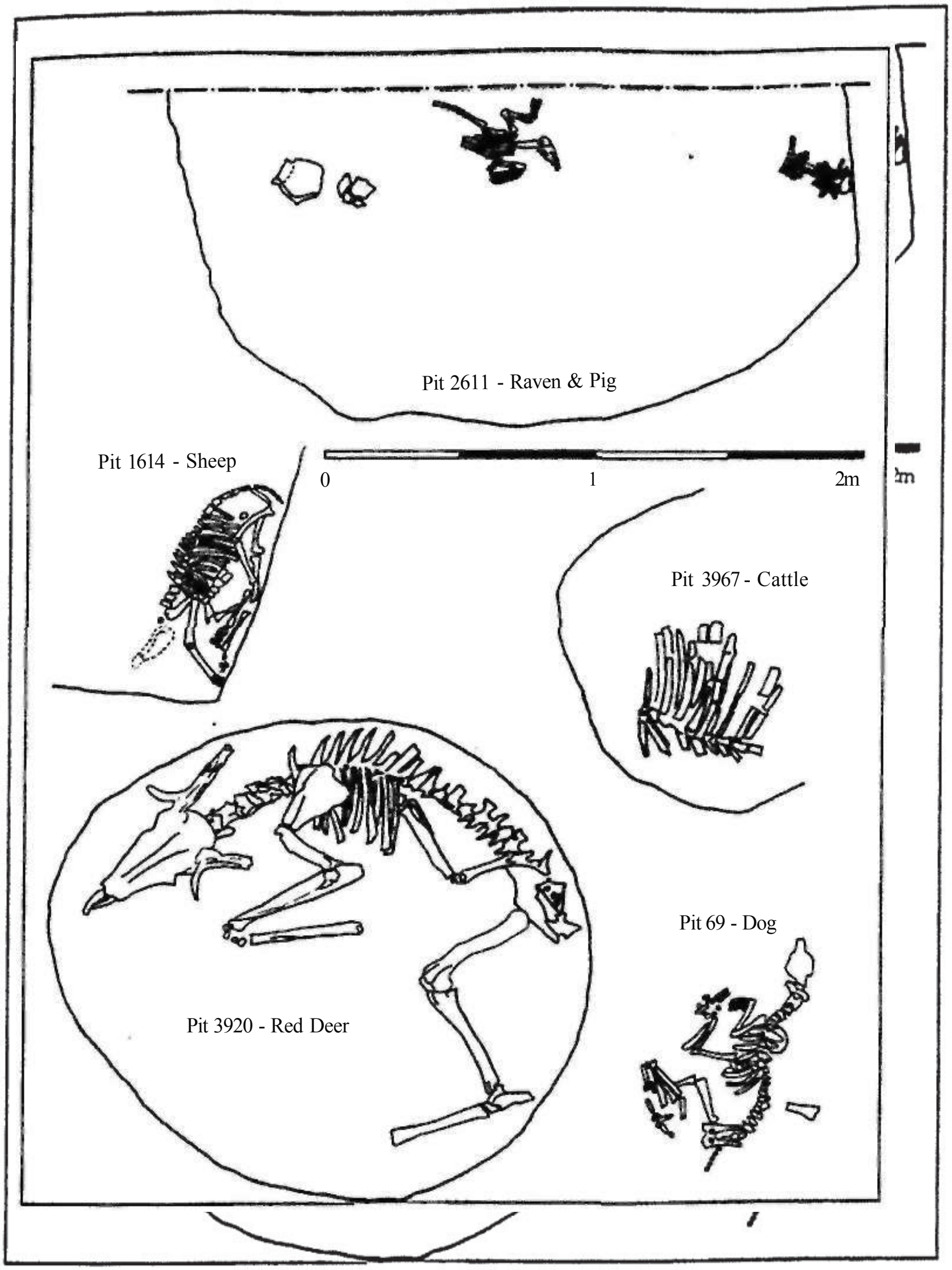

Figure 14.10 Deposits of articulated animal bones— 'special deposits' —in pits at the iron age settlement of Winklebury in southern England. Source: J.D.Hill.

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15

PRODUCTION AND EXCHANGE IN PREHISTORY

Timothy Earle

INTRODUCTION

The economic basis of human society is undeniably important. To understand the operation and evolution of past societies, investigations of production and exchange have become a central concern to archaeologists. This chapter summarizes the ways that production and exchange are studied by prehistorians and the theoretical significance of economies for understanding past human societies.

Our understanding of social process emphasizes three perspectives on production and exchange. The first perspective views the ways a human society extracts, processes, and distributes the necessities for human existence. An ecological approach, which studies a society's subsistence economy, has been the research agenda for the processual archaeologists of North America (Binford 1964; Flannery 1968a) and Europe (Bailey 1983; Higgs 1972). Local specialization and exchange have been viewed as means of adaptation. The second perspective studies how the political economy functions to finance the institutions of chiefdoms and states and to support the stratification on which these societies rest. Means of finance include the mobilization and distribution of staples and wealth (D'Altroy and Earle 1985). Approaches within social archaeology have looked at prestige goods exchange (Earle 1982b; Friedman and Rowlands 1977), peer-polity interaction (Renfrew and Cherry 1986), and centre-periphery relations (Algaze 1989; Rowlands *et al.* 1987). The third perspective studies how a society's relationships and categories become objectified ('real' if you will) through the economic process. As seen in the writings of the post-processualists (Bradley and Edmonds 1993; Hodder 1982a, 1984), the production and distribution of material goods are part of a broad social process in which individuals actively construct systems of meaning and relationships. From each of these perspectives, production and exchange are basic to the function and operation of human societies. These three approaches are in no sense mutually exclusive; rather, they express complementary uses of the economy in everyday life, political manoeuvring, and rituals of past societies.

RESEARCH TRENDS

Studies of production and exchange mirror the broader history of the discipline of archaeology (Chapter 2). Key intellectual and methodological themes of economic anthropology and geography show their strong influences within our investigations of past societies (Earle 1985a; Earle and Preucel 1987; Torrence 1986; Willey and Sabloff 1974). Although a full discussion of this history could form a separate chapter, I shall summarize some of the trends as a background.

Traditional archaeology frequently explains cultures as collections of traits deriving from migration, diffusion, and 'influence'. Exchange is a vehicle for cultural interchange. Attempts to look at these relationships systematically include such work as Stjernquist (1967) and Curtin (1984). A critical juncture for archaeology was the substantivist critique within economic anthropology and the subsequent formalist-substantivist debate (LeClair and Schneider 1968; Polanyi *et al.* 1957; for archaeology, see Earle 1985a). In his analysis of the ancient economies of the Middle East and Africa, Polanyi (*et al.* 1957, Polanyi 1968) noted that economies were embedded in the broader socio-political organization, such that economic forms varied greatly cross-culturally. Substantivism suggested that, through the study of economy for which archaeology has ample methods, researchers can investigate the social organization of extinct societies. Polanyi's typology of economic relationships (reciprocity, redistribution, and market exchange) became connected to specific stages of cultural evolution: band, tribe, chiefdom, state (Service 1962). Therefore, in the checklists of traits indicative of different social forms, economic organization was taken as distinctive of social evolution. Renfrew (1973), for example, identified as chiefdoms the bronze age societies of Wessex, southern England, on the basis of archaeological evidence for redistribution.

Substantivist investigations of exchange and social organization expanded in the early 1970s (Sabloff and Lamberg-Karlovsky 1975; Wilmsen 1972). Sabloff and Freidel (1975) investigated the island of Cozumel as a way to understand how ports-of-trade function in long-distance trade between archaic states (see also Chapman 1957). As a broader study of state formation in south-east Asia, Wheatley (1975) investigated changes from reciprocity to redistribution as means of economic institutionalization.

Especially influential were Renfrew's (1975) models of the different types of exchange that could be anticipated archaeologically (Fig. 15.4). His article focused attention on the importance of exchange and led to influential edited volumes dealing with exchange and regional relationships in the evolution of social complexity, especially in Europe (Renfrew and Cherry 1986; Renfrew and Shennan 1982). In the United States, economic organization became a research focus for archaeologists at the University of Michigan, where the neoevolutionary paradigm of Service (1962) and the substantivist economics of Sahlins (1972) moulded a generation of graduate students (Braun and Plog 1982; Brumfiel 1980; Drennan 1976; Earle 1977; Johnson 1973; Wright 1969) working with Flannery (1972, 1976) and Wright (1972; Wright and Johnson 1975).

As one of Michigan's graduate students in the early 1970s, I was interested in the role of exchange in past societies. When I went to UCLA in 1973, graduate student interests in archaeological studies of economy were strong, inspired at least in part by Colin Renfrew, who had been a Visiting Professor in 1967. Two research traditions converged, and a flurry of graduate student projects on the methods and theory of prehistoric exchange resulted (Ericson 1977, 1981, 1982; Ericson and Purdy 1984; Findlow and Bolognese 1982; Sidrys 1977; Singer and Ericson 1977). Ericson and I organized a symposium at the 1975 Annual Meeting of the Society for American Archaeology that resulted in *Exchange Systems in Prehistory* (Earle and Ericson 1977). Two subsequent volumes (Earle and Christenson 1980; Ericson and Earle 1982) added to the emerging subfield of prehistoric economics (Earle 1982a).

The subfield was bolstered both by the materialist theories that were popular in the processual archaeology of the time and by a scientific revolution in archaeology based on new technical analyses and on the quantification of large databases. During the 1980s, archaeological studies of economic organization became a main research orientation that fostered important projects on prehistoric economies. To list but the most visible, regionally focused work would include items in Mesoamerica (Hirth 1984; Isaac 1986; Santley 1985; Voorhies 1989), North America (Baugh and Ericson 1994; Ericson and Baugh 1993), the eastern Mediterranean (Knapp and Stech 1985), ancient and medieval Europe (Hardh *et al.* 1988; Hodges 1982), and Melanesia (Kirch 1988, 1990, 1991b). Some of the most active field research focused on reconstructing ancient economies.

Starting in the 1980s, a growing radical/humanist critique questioned the scientific and evolutionary foundations of procedural archaeology (Bradley and Edmonds 1993; Friedman 1974; Hodder 1982a, 1984; Kristiansen 1984; cf. Earle and Preucel 1987). One of the most creative directions of post-processual archaeology has been to seek to understand the nature of exchange from a non-subsistence perspective. Although processualists had long considered the importance of exchange in social, political, and religious organization (see, for example, Braun 1986; Drennan 1976; Flannery 1968b), post-processualists emphasized the political and symbolic meaning and consequence of social exchange (Hodder 1982b; Hodder and Lane 1982; Miller and Tilley 1984). And so we arrive at the present, ready to consider the methodological and theoretical state of our enquiry into the economies of past societies.

SCIENTIFIC METHODS OF ANALYSIS

The reasons that modern archaeology fixed on economic studies are balanced equally by its theoretical interest and its methodological possibility (Earle 1982a). In the 1960s and 1970s, technological revolutions profoundly changed what is possible for archaeological investigations. Archaeometry, the use of hard science approaches in archaeological investigations, fuelled rapid technological advances in chemical characterization and computerization which have been particularly important for economic studies (see Chapter 9).

Chemical characterization, with a suite of analytical procedures including Neutron Activation Analysis (NAA) and X-Ray Fluorescence (XRF), revolutionized the study of exchange (Harbottle 1982). In simplest terms, the source of the raw material out of which an artefact was made is determined by matching its chemical composition against the potential sources for that material. Among the potential sources, the chemical composition is described so as to determine the set of elements, often trace elements, which distinguish one source from the next. These source characterization patterns are then matched against the artefactual material, often using a simple tripolar graph that describes the amount of three elements at once (Fig. 15.1). Source 'fingerprinting' depends on there being distinctive differences between potential sources and on sources being relatively homogeneous internally. Since the 1950s, technical capability to characterize has improved dramatically. The standard representation of such data is a map showing the findspots for objects from an identified source (Fig. 15.2).

Renfrew *et al.* (1966) used the chemical characterization of obsidian to study exchange in the Near East, and demonstrated to archaeologists the potential of such work to give accurate studies of early exchange patterns. Since that time, extensive work on obsidians from Mesopotamia (Renfrew and Dixon 1976; Wright 1969), the eastern Mediterranean (Dixon 1976; Torrence 1986), Mesoamerica (Hirth 1984), Peru (Burger and Asaro 1977), and North America (Ericson 1981; Hughes 1984) has demonstrated the extent and pattern of early exchange. Because of its limited and specific source locations, relatively simple chemistry, and apparent homogeneity in source, research on obsidian has become the best documented evidence for prehistoric exchange patterns.

A good example of the use of obsidian to study prehistoric exchange is the changing patterns of source procurement for obsidian in the Soconusco region of coastal Guatemala (Clark *et al.* 1989). Two main supply sources are noted for the region, Mexico and Guatemala. Initial use of obsidian focused on the nearer

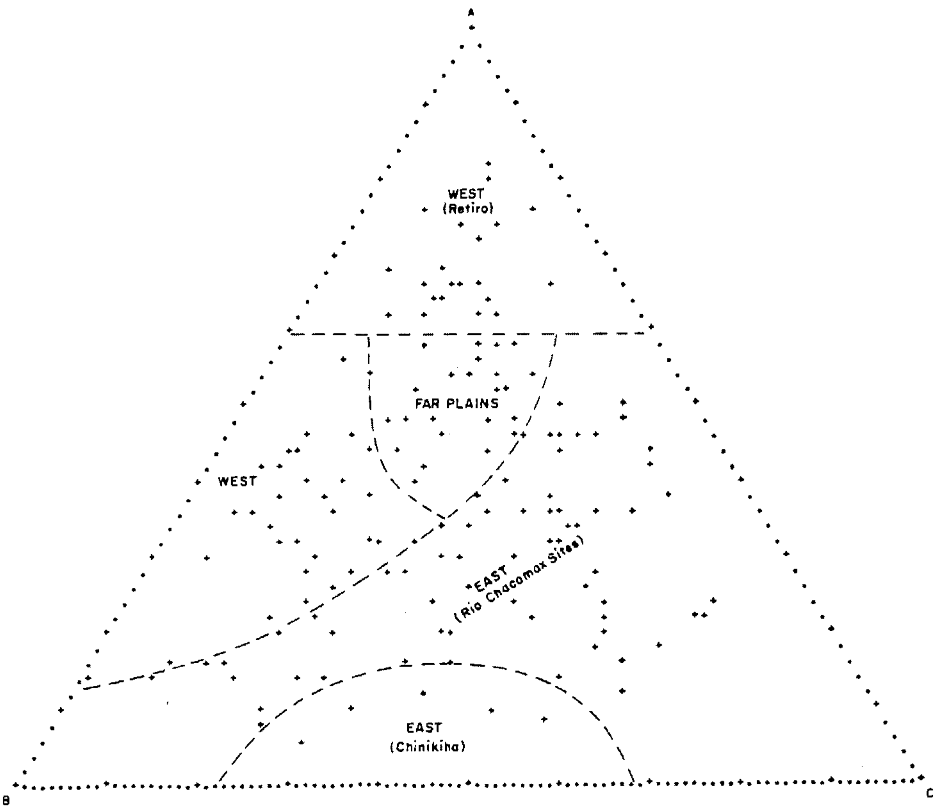

Figure 15.1 Tripolar graph describing with a Q-mode factor plot the regional distribution of plain ware Mayan ceramics; analysis shows different local production locales. Source: Fry 1980.

Guatemalan sources, and the Mexican sources became dominant only during Late Post-Classic, presumably as a result of the economic incorporation of the coastal region within the Aztec empire. Importantly, no comparable shift towards Mexican sources was documented for the Middle Classic Period, when Teotihuacan was at its height. This contrast in obsidian procurement suggests that these two great Mesoamerican empires had distinct economic relationships with the Guatemalan coast, at least as far as obsidian exchange was concern.

The focus on obsidian, at the exclusion of other materials that are technically more difficult to source, has probably given an unrealistically narrow view of early exchange. Obsidian is usually a fairly minor, utilitarian industry, and the nature of its production and exchange most probably did not accurately reflect economic activities involving bulkier craft industries such as potting, and wealth industries

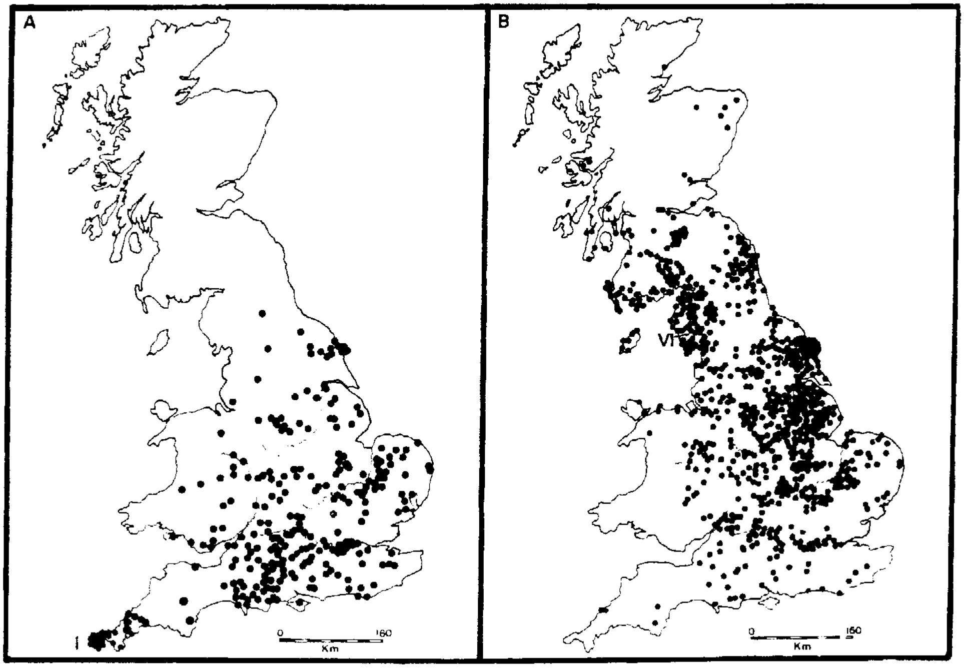

Figure 15.2 Distribution of British neolithic stone axes from source Group I (left) and Group IV (right). Source: Bradley and Edmonds 1993.

such as metalworking. These latter industries, however, involve synthetic materials highly altered from their original state and thus difficult to source. Promising characterization work is now available, as for Mesoamerican ceramics (Bishop 1980; D'Altroy and Bishop 1990; Fry 1979, 1980; Neff 1989), European bronzes (Liversage and Liversage 1989), Polynesian basalts (Weisler 1993), and other materials.

Accompanying the technical advances in chemical characterization, economic studies in archaeology have been greatly aided by improvements in computer technology. Harbottle (1982), for example, demonstrates the necessity of computer-aided clustering procedures in characterization studies. More generally though, computer analysis of large datasets is now the backbone of economic studies in archaeology.

An early breakthrough in 'archaeo-economics' was the application of mathematical, descriptive, procedures adapted from the quantitative geography of the 1960s (especially Haggett 1965) and introduced broadly to archaeology by David Clarke's (1972) *Models in Archaeology* and by Hodder and Orton's (1976) *Spatial Analysis in Archaeology*. These works, although largely descriptive, have proved extremely helpful in exchange studies. Hodder (1974), for example, used a two-dimensional analysis of fall-off in the frequency of materials from their sources to study different kinds of exchange. In such studies, the abundance of a material from a known source is expected to 'decay' (become less common) at sites of greater distances from the source. This fall-off in abundance reflects the increasing costs of transportation and other difficulties of exchange. Figure 15.3 illustrates how the fall-off curves for different goods contrast with each other, reflecting such things as value of the goods and their mechanisms of exchange.

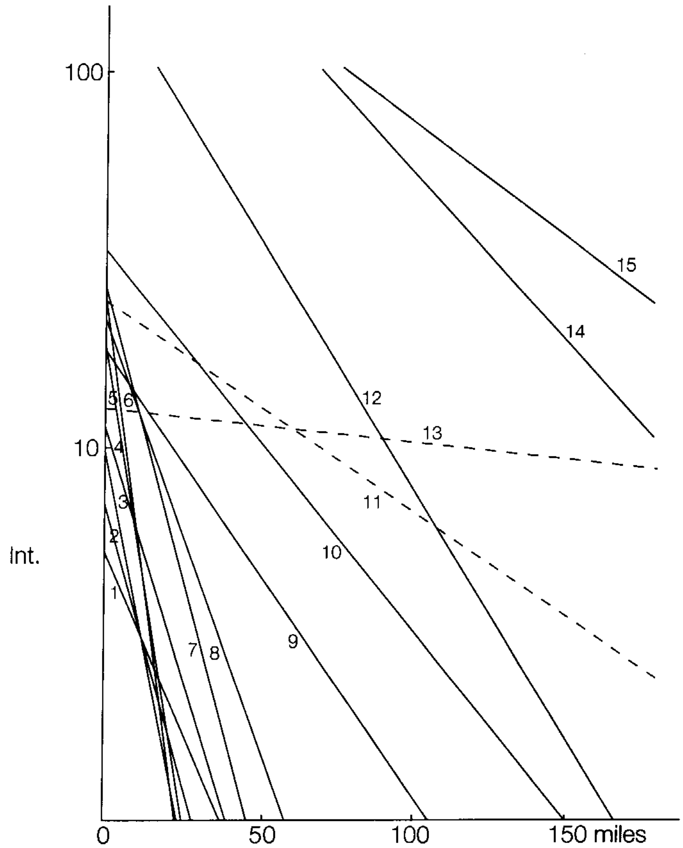

Figure 15.3 Contrasting fall-off gradients for different archaeological materials from the Old World. Regression lines 1 and 3–7 represent the rapid decline in most ceramic objects away from source; in contrast, lines 13 and 14 represent distributions of two neolithic axe groups, and line 12 represents Anatolian obsidian. Source: Hodder 1974.

Colin Renfrew (1975) developed a typology of exchange, based heavily on Polanyi's earlier work, and showed graphically how these would look in terms of the fall-off curves of commodities (Fig. 15.4). Thus with reciprocity, outside of the 'supply zone' where access to the resource was direct, the abundance of materials decays monotonically or uniformly with distance. In contrast, with redistribution, peaks in the frequency of goods would be observed at distribution centres. Originally it was hoped that different models of exchange would be represented by different regression formulae (Findlow and Bolognese 1982), such that specific fall-off models would identify specific mechanisms of exchange, but problems exist with simple correspondences (Renfrew 1977), and this exercise has been largely abandoned.

Three-dimensional analysis, as an alternative, involves surface trend studies such as SYMAP (Ericson 1977; Hodder and Orton 1976). SYMAP represents the frequency of traded materials by contour intervals on a map. In his description of California exchange, Ericson (1977) shows how the frequency of obsidian decays in concentric rings away from a source, distorted by such factors as the availability of high quality chert, a good substitute for obsidian among the chipped stones. Computer analysis permitted the use of large-scale, regional, databases and the fitting of data to various mathematical models.

Statistical analysis of large datasets has proved essential for increasingly sophisticated studies of production. For studies of lithic production, computer-aided analysis allows the routine study of chipping debris into the various steps of manufacture ('stages of reduction'). Production is broken down into stages such as core preparation, core reduction, blade requisition, and so on. Analysing manufacturing debris, Ammerman and Andrefsky (1982), for example, suggest how the composition of débitage may be matched to the appropriate stage in the reduction sequence, thus allowing the recognition of the different steps in the manufacturing process at different locations across the landscape.

Torrence (1986) argues for the need to develop middle-range theories that link specific social and economic behaviours with patterns of production and consumption debris. She develops these models from ethnographic description of lithic tools, in such diverse contexts as the generalized stone-age gatherers of Australia and the highly specialized gun-flint makers of Europe, and then uses descriptive statistics of archaeological obsidian debris from Melos, in the Aegean, to look at the degree of standardization and specialization in the blade industry there. Counter to earlier assumptions, she argues that, because of the lack of standardization in the artefactual classes, the obsidian was apparently produced opportunistically by many craftsmen with a low degree of standardization in the products, indicating little control in the production process. John Clark and William Perry (1986) have studied a large sample of ethnographic cases of specialization to develop the kind of middle-range theory envisaged by Torrence, and these models are being investigated now for materials other than obsidian.

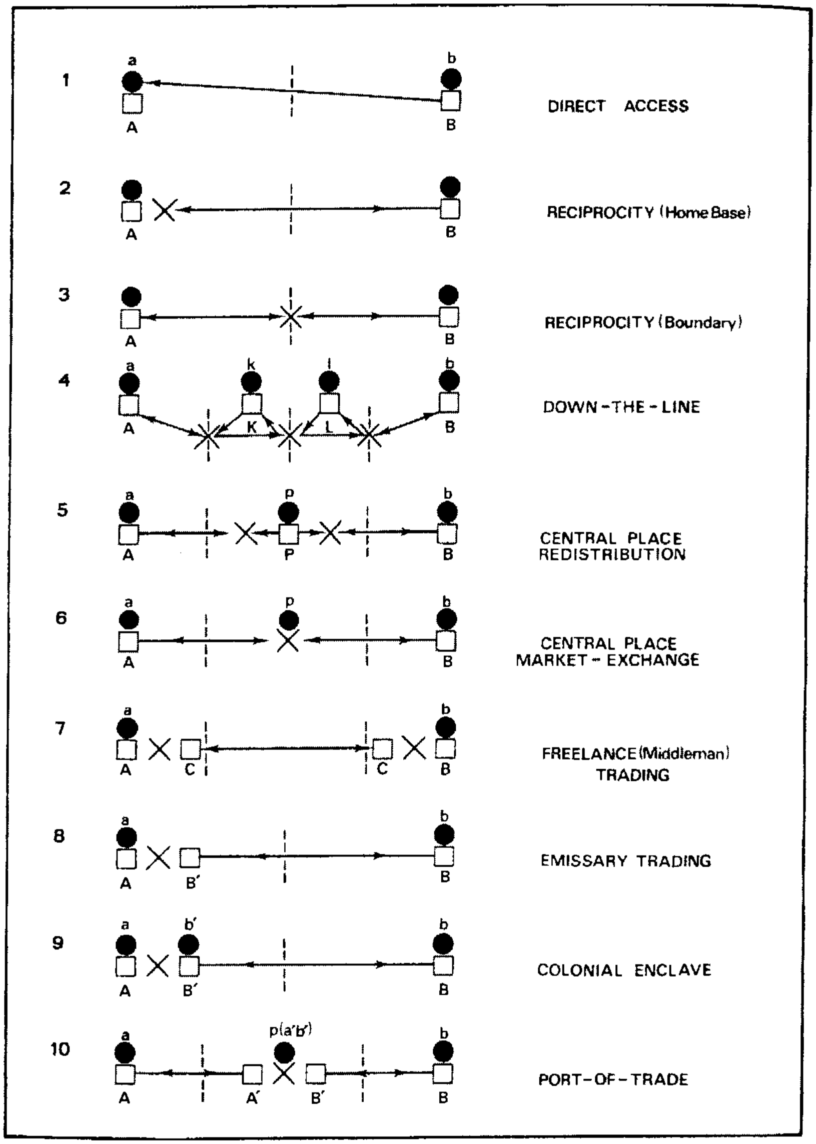

Figure 15.4 Models of different institutional forms of exchange and their spatial implications for archaeology. Circles a and b represent the points of origin and distribution for a commodity, with A and B representing the producer and recipient respectively. P indicates a central place with a central person who distributes objects. X represents exchange events. Source: Renfrew 1975.

For ceramics, similar systematic analyses of metric measurements for large datasets permit investigation of standardization and specialization. Using a large sample of Mayan sherds, Rice (1981) argues that particular variation in technological characteristics such as paste, temper and firing, indicate the relative number of hands at work (Hagstrum 1985). Using ethnographic studies to understand the social context of ceramic production, Hagstrum (1986) and Costin (1991) investigate the changing nature of production and exchange in ceramics following Inca imperial conquest of the Andean central highlands.

Because it is impossible to give an accurate and full description of the many techniques available and used in archaeological studies of production and exchange, I refer the reader to some of the synthetic treatments, including Harbottle (1982) on characterization, Renfrew (1975, 1977) on exchange, and Tosi (1984), Torrence (1986) and Costin (1991) on specialized production. What I want to concentrate on here is the theoretical significance for economic studies by giving examples of work in prehistoric archaeology.

PRODUCTION AND EXCHANGE: SIGNIFICANCE TO ARCHAEOLOGY

The material and economic foundation of human society is broadly recognized. A population must be fed, its institutions financed, and its culture fashioned. Past the obvious necessity, I shall argue that the details of production and exchange provide a critical means to understand how human society works. The goals of archaeology are many, but a central challenge is to explicate the processes resulting in the evolution of complex societies (see Chapters 22 and 23). In this regard, studies of economy play a particularly important role. It will be my argument here that the economy provides the foundations of power and symbolism upon which complex social institutions are constructed. Archaeology, with its temporal perspective and its rich material record, provides the suitable venue to investigate these evolutionary issues. In fact, I believe that these issues can best be investigated by archaeology, and that archaeo-economics should be a centre-piece for archaeology's contribution to knowledge of human societies. The three significant scenes of economic action that I discuss are the subsistence economy, the political economy, and symbolic materialization.

The subsistence economy

The first and most basic problem for any human society is material provisioning. Although humans do not live on bread alone, without bread they do not live at all. Making a living is so basic that it is often taken for granted, but the subsistence process suffuses social life and provides details of political control in complex societies (see Chapter 14). Intensification in the subsistence economy creates specific problems that require group coordination and thus offers opportunities for control by leaders (Johnson and Earle 1987: fig. 1). The legitimacy of a social order, its system of stratification and patterns of control, ultimately rest on the reliability of its subsistence system.

The most basic consideration in the subsistence economy is the actual provisioning of food. In pre-industrial society, provisioning seems to have been largely the responsibility of the householding group or extended family. The Domestic Mode of Production, in which households provided for their own subsistence, was at least an ideal in most societies down to recent times (Johnson and Earle 1987). In the Domestic Mode of Production, since production is for use by the household, exchange is non-existent. If this is ideal for most societies, why then should inter-household exchange develop? This is a central question for archaeology.

An answer that was generally accepted by the cultural ecologists of the 1950s and 1960s was that, as population grew and people settled down, local, sedentary households and groups became specialized in the most efficient and reliable local foods and then exchanged their local specializations regionally. Service (1962) saw this as the justification for the development of redistribution in chiefdoms, and Sanders (1956) saw it as the justification for the development of markets in early states. In both circumstances, the development of a regional political organization was interpreted as caused by a need for central management. Chiefs were thought to coordinate the regional distribution of foods, and the state provided the superstructure for the market.

Although logically sound, archaeological evidence has not supported this adaptationalist argument (Brumfiel and Earle 1987). First, it must be acknowledged that some level of exchange existed in all societies. Thus quite extensive food exchange was common in several hunter-gatherer cases such as the coastal Chumash (Arnold 1992) or the Eskimo (Johnson and Earle 1987). Correspondingly, it is surprising how little subsistence exchange has actually been documented archaeologically in complex societies. This negative evidence may in part be a result of inadequate data recovery procedures on excavations: where such procedures as flotation for botanical remains and screening for bones are used, as for example in the Mantaro Valley and at Pacatnamu in Peru, the evidence suggested that virtually all food was obtained from the immediate catchment of the excavated settlements (Earle 1985b; Gumerman 1991; Hastorf 1993). In Hawaii (Earle 1977), Europe (Friedman and Rowlands 1977; Kristiansen 1984), and the Valley of Mexico (Brumfiel 1976), archaeological evidence was used to question the adaptationalist logic of developing subsistence exchange linked to population growth and political integration. Rather, it is now thought that subsistence exchange became elaborated in many situations as a result of development in the political economy, as described in the next section.

Alternatively, exchange may be tied to a need to reduce subsistence risk. Using ethnographic evidence from the !Kung San hunter-gatherers of the Kalahari, Polly Wiessner (1982) has argued that social relationships maintained by continual interpersonal exchange solve the problem of high risk in subsistence. For the American Southwest (Minnis 1985) and the Midwest (Braun and Plog 1982; Halstead and O'Shea 1989), social relations and exchange are seen as solving problems of risk. On the Marquesan Islands of Polynesia, large subterranean pits used to store fermented breadfruit buffered the local community against devastating droughts (Kirch 1991b).

Less problematic has been the archaeological evidence for exchange in utilitarian craft products, whose raw materials are localized in their distribution or whose manufacture requires unusual skill (Andrefski 1994). In terms of localized distribution of raw material, the most important factor appears to be the mobility of the population. In the Archaic and Woodland periods of the American Midwest, for example, Morrow and Jefferies (1989) argue that, by picking up stone resources during the seasonal round (that is, by 'embedded procurement'), there was no need for inter-group exchange. For the Melos obsidian, Torrence (1986) envisages that a maritime population would simply have exploited this island source as part of their broader subsistence strategies. Under these circumstances, localized resource use would only require exchange if the annual movement of a group did not encompass the distribution of the required resource.

The localized distribution of raw materials used for formal tools resulted in exchange in working tools and utensils in situations where local groups defended territories. This would explain, for example, the fairly extensive exchange in obsidian among the hunter-gathering populations of California (Ericson 1977, 1981). Close by the obsidian sources, within a local group's territory, obsidian was used generally for all lithic implements; at greater distances, where territorial boundaries must be passed, it became used for special tools such as arrow points, for which obsidian is particularly well suited (Bettinger 1982; Ericson 1982).

An excellent example of trade in pottery is described for the simply organized island populations off the northern coast of New Guinea (Allen 1985; Irwin 1978, 1985; Yoffee 1985). In this island environment, clay suitable for pottery was not generally available, and a specialized industry of ceramic manufacture was developed on the island of Mailu, from whence it was distributed by traders along the coast of New Guinea and to the off-shore islands. This trade existed in the absence of a complex regionally organized society.

As another example of exchange in utilitarian goods, late in the prehistory of the Peruvian highlands, most stone tools were produced from immediately available stone, but sickle blades were manufactured by a few villages positioned close to a high quality chert source and then exchanged to other communities in the vicinity (Russell 1988). In the same region, production of utilitarian pots for local exchange took place at a few communities, presumably because of localized clay resources or the skill required in potting (Costin 1986; Hagstrum 1989). Considering the size and complexity of the Inca empire, the archaeology showed that the overall extent and volume of specialization and exchange were, however, unexpectedly limited.

These three case studies raise the intriguing question of how exchange in utilitarian products relates to the evolution of complex societies (see also Chapter 23). Minimally, increasing population density and decreasing mobility require either increasing exchange or the shift to more local (and often inferior) materials. Both Sanders (1956) and Service (1962) see the increase in population density resulting in an initial settling in and intensification of production that necessitates exchange and the development of regional polities with central managers to regulate exchange. Since these provocative early statements, however, archaeological and historic evidence on specialization and exchange seems to contradict these adaptational propositions (see, for example, Hughes 1994).

The first thing to note is that there is not a simple relationship between the amount of exchange and social complexity. Therefore, in New Guinea, opportunities for exchange did not result in the development of chiefdoms or states. In fact, although the early hierarchical society of Lapita may have been based to some measure on broad-scale exchange (Kirch and Hunt 1988), extensive exchange has been documented in the absence of strong leadership and regional organization (Allen 1985). In contrast, among the Mississippian chiefdoms, the extensive production and exchange of localized salt lay outside chiefly control (Muller 1987), and in Hawaii the complex chiefdoms of late prehistory existed with a low volume of exchange in food and utilitarian products; the exchange that did exist seems largely unregulated by the chiefly hierarchy (Earle 1977; Lass 1994). In other words, the chiefly redistribution on Hawaii did not involve staples or working tools, thus making Service's argument invalid. In terms of more complex societies, the highland Andean Inca state existed without a market, and exchange in utilitarian products was limited and highly specific; it was not controlled by the state apparatus (Earle 1985b; LaLone 1982). Where markets did exist, as in the Aztec state, the justification for their development seems to be more political than subsistence-based. In simple terms, exchange does not uniformly increase through prehistory, as might be expected in simpler evolutionary models; rather, the amount of exchange documented archaeologically is highly variable through both time and space (Earle 1994).

What we are seeing is that the development of exchange in subsistence goods was tied in large measure to the development of the political economy. I shall now consider the nature of the political economy in non-industrial societies to see the political causes for the development of systems of specialized production and exchange.

The political economy

The evolution of social complexity involves two related processes: (1) increasing social stratification, as wealth becomes concentrated in socially distinguished segments of society; and (2) increasing political integration as institutional mechanisms of control are elaborated. The political economy provides the organizational mechanism to mobilize the resources that enrich the élites and finance their institutions of control. Evidently, the evolution of social complexity depends on the development of the political economy, and these developments involve radical transformations in systems of production and exchange. Essentially I am arguing that economic transformation was largely a result not of a gradual process of adaptation but of a revolutionary process of political transformation.

D'Altroy and Earle (1985) have distinguished staple finance and wealth finance as two means to mobilize the materials required for the support of the ostentatious lifestyles and governing institutions of the ruling élite. For some purposes it is desirable to consider these types of finance as alternative opportunities representing different advantages and limitations to an emerging élite. The use of a particular system of finance is seen as creating specific properties of stability and growth that have profound ramifications for the long-term maintenance and expansion of the related polities. In fact, any political system depends on hybrid systems that seek to overcome limitations in the ideal forms. I shall first consider how the two systems can be considered separately and then consider how they must be combined.

Staple finance (Polanyi 1968) involves the mobilization of staple goods, especially food and rough cloth, from a commoner population, as rent for access to land owned by the élite class or specific institutions. A good example of how this works is the political economy of the complex chiefdoms of Hawaii in the late prehistoric period (Earle 1977, 1978; compare Stein 1994 for 'Ubaid chiefdoms). The chiefdoms depended on systems of 'redistribution' —not for commodity exchange but for finance. In these systems, chiefs, as owners of the land through conquest and allocation by the ruling paramount, offered subsistence land plots to commoners in return for their labour on lands producing for the chiefs. The food grown on the chiefly lands provided for the chiefs' subsistence, for periodic feasts which they hosted, and for support of specialists working for the chiefs. These specialists included warriors to protect the chief and to seize new lands, managers to guarantee the production on the chiefs' lands, craft specialists manufacturing weapons and wealth, and a cadre of other personnel. Essentially the development of a non-producing sector to the society simply involved an expropriation of staples from the commoners who produced them so as to support the élite sector of society. Staple finance is a simple form of rent or taxation, in which the products needed by the élites are demanded from the commoners in return for guarantees of access to needed productive resources.

The best known example of staple finance is the famous redistribution system of the Inca empire. Although state redistribution was originally thought by the substantivist John Murra ([1956] 1980) to be a system of commodity exchange, archaeological investigations have shown that it served primarily as a system of state finance. In his excavations of the massive Inca storage facilities at Huanuco Viejo, Morris (1967) showed that the contents of the store houses were produced within the administrative region of the state centre and did not involve transfer of specialized goods across the diverse environmental zones dominated by the Inca state. In other words, although the state was spread over areas where local specialization could have been appropriate, the state was not involved in the exchange of specialized subsistence products.

Rather, the mobilization and local massive storage of staple products involved maize, tubers, quinoa, sandals, and cloth that were used by the military and others working for the state (D'Altroy 1992; D'Altroy and Earle 1985; Earle and D'Altroy 1982, 1989; LeVine 1992). The land was the property of the state through conquest. In return for access to community lands used for subsistence, the community had to provide labour to cultivate the state's lands and for special state projects related to construction, wealth manufacture, and warfare. As in the Hawaiian case, no market system developed. A complex political system, with a wide range of non-producing personnel (warriors, priests, managers, builders, and craftsmen), was supported directly by the mobilized staples. The best evidence of the staple finance is the massive storage complexes constructed by the Inca through their empire (LeVine 1992).

The alternative ideal type of finance involves the production and circulation of wealth. Wealth is concentrated value which, in contrast to staples, is relatively easy to move and which is used as a political currency to compensate those working for a ruling institution (D'Altroy and Earle 1985).

How does wealth work in the political economy? First, wealth must be rare and valued. The simplest form of wealth, perhaps, is domesticated animals (see Chapter 14): rich in fat and protein, animals are highly desired both for subsistence and for the special meals of feasts. Animals are rare because of the labour needed in husbandry. For example, the raising of pigs is the base for the political economy of highland New Guinea, but the problems of raising pigs are extraordinary. In fact, when pig density exceeds what can be supported by simple foraging, it takes as much human labour to support one pig as it does to support one person (Johnson and Earle 1987)! Interestingly, the growth and elaboration of chiefdoms in late neolithic/early bronze age England and Denmark seem to be related to the elaboration of an economy conditioned by animal production (Earle 1991; Randsborg 1989). Such a system represents certainly an intermediate case between wealth and staple finance.

The development of wealth finance typically involves the local manufacture of special goods by gifted craftsmen and/or the long-distance exchange of wealth from foreign lands. For Formative Mesoamerica (roughly 1500–500 BC), Flannery (1968b) describes how wealth was exchanged over great distances during the development of the Olmec and other chiefdoms of Mesoamerica. He sees this exchange as being part of alliances linking chiefdoms that had developed autarkically: the separate chiefdoms of Oaxaca, producing magnetite mirrors used by the Olmec, came to share elements of a common élite culture. For the chiefdoms of Panama, Mary Helms (1979) argues that long-distance exchange of wealth, such as the gold from Colombia, was not a trivial exchange for foreign trinkets: rather, foreign objects were fundamentally linked to esoteric knowledge external to daily, mundane existence. This knowledge represented power to chiefs vying for access to the esoteric objects and their related knowledge. The symbols, represented frequently on items of personal adornment such as jewellery and clothing, identified the ruling chiefs closely with divine forces. The feather cloaks of the Hawaii chiefs, as an example, were quite literally clothing of the gods (Earle 1990). Chiefs controlled, or at least sought to control, access to foreign wealth and associated esoteric knowledge by negotiating personal networks of exchange and in some cases monopolizing the technology of transport—boats.

Wealth could of course also involve the local manufacture of special objects. To be especially valued, the supply of this wealth needs to be limited. Locally produced wealth characteristically included highly crafted ceramics and metal goods, both requiring sophisticated manufacturing procedures, and cloth, able to absorb unlimited amounts of labour in its manufacture. The control over production of such wealth was exercised through patronizing highly gifted specialists attached directly to the chiefly households. Thus, in the pre-contact Hawaiian chiefdom, the craftsmen who manufactured the elaborate cloaks of the chiefs were part of the paramount chief's personal household (Earle 1987). Alternatively, control over the technology of transport may be a source of chiefly power, as in the chiefly Chumash planked canoes (Arnold 1992). The development of such attached specialization as manufactured fine craft items can be seen as part of the broader political process to control the production and circulation of wealth.

Europe in the Late Neolithic and Early Bronze Ages provides excellent examples of the dynamic role of wealth in political manoeuvring among chiefdoms inter-locked by exchange over vast areas. Friedman and Rowlands (1977) constructed a model of 'prestige goods systems', in which they showed how the development of ranking results from political manipulation of exchanges in wealth and wives, building the prestige of individual lineages in a positive feedback system—their model is a sophisticated representation of what Renfrew and Cherry (1986) called 'peer polity interaction'. The application of the Friedman-Rowlands model to Europe has been developed especially by Kristiansen (1984, 1987, 1991). Starting in the neolithic period, production and circulation of wealth involved polished stone axes (Bradley and Edmonds 1993; Hodder and Lane 1982), stone daggers and battle axes

(Kristiansen 1984), and cattle (Earle 1991; Kristiansen 1991). Shennan (1986) describes how the dramatic social transformation associated with the Bell Beaker complex stretched across much of Europe and involved exchange in amber, copper daggers, and their local flint copies. Objects of exchanged wealth became the medium for political rivalry and status definition. Their production and circulation, however, were difficult to control, and the degree of stratification and political centralization was modest.

With the increasing role of metal used for both personal adornment and weaponry, a new source of wealth was created that was easier to control and thus could better form the basis for increasing social differentiation. In particular, the metal came from a greater distance and was manufactured only by craftsmen possessing the remarkable (and occult?) knowledge of metallurgy. Kristiansen (1987) argues that the technical sophistication of metallurgy meant that the few gifted and knowledgeable craftsmen could be easily controlled by their attachment to the highly ranked chiefs. He also shows how the symbols represented by the wealth of the Bronze Age identified chiefs in a very broad cultural system that stretched from Scandinavia to the Aegean.

A related set of theories that investigate broad-scale systems of production and trade with social evolution is the literature on World Systems Theory (see also Chapter 16). Originally formulated by Wallerstein (1974), the development of European capitalism is seen as based on the creation of a world-wide economy in which the industrializing core (Europe) dominated the periphery (the Third World). Schneider (1977) argued that Wallerstein's original conception could be applied successfully to pre-capitalist economies by focusing on the production and circulation of wealth. Attempts to apply World Systems Theory to the evolution of society in pre-industrial contexts are now widespread. Frankenstein and Rowlands's (1978) pioneering study showed how the development of stratification in the European Iron Age could be understood by its articulation with the state societies of the Mediterranean. Rowlands *et al.* (1987) bring together case studies from archaeology which investigate core—periphery economic relationships. The Uruk empire of early Mesopotamia is a well-studied case of how an imperial core, rich in irrigated agricultural lands, ultimately depended on establishing external trade and tribute relationships with a periphery that was rich in raw materials such as obsidian, metal, wood, and the like (Algaze 1989). The most important point of these works is to show that the social dynamics of any region can only be understood in the context of broad patterns of interaction and dependency. Kristiansen (1991) argues that social evolution must be conceived of as a spatial (as well as a temporal) process; therefore, the chiefdoms of northern Europe must be understood as they articulated with the Mediterranean states in a continuing, active system of commodity exchange and ideological interchange.

A good example of this large-scale, economic dynamic can be seen during the Roman Iron Age in Scandinavia. Located four to six hundred kilometres north of the imperial border zone (the *limes*), a rich and select inventory of Roman glass, silver, gold, and other metalwork goods was distributed widely through Scandinavia, but concentrated on the Danish islands such as at Gudme (Thrane 1988), Hoby, and Himlingoje (Hansen 1987). Why is all this wealth found so distant from the civilized Roman world? Minimally, it seems that the concentration of finds along the coasts and islands of the Baltic suggests that the goods were moved by ship (Thrane 1988:194). Hedeager argues that the careful selection of goods and their distribution 'can only be explained as being the result of a very deliberate and well-organized trade, whose business it was to obtain these sought-after Roman goods in fairly large consignments for the North' (1988:149). Later, during the Viking period, the economy of northern Europe was transformed from a prestige goods exchange system into (more or less: see Chapter 16) a mercantile market economy (Hedeager 1994). Early on, Viking warriors raided the south for metal wealth that was reworked into decorative objects of status worn especially by women, but then, as regional market towns developed through the Viking world, wealth became minted instead into currencies to finance emerging international markets.

When considering the role of wealth and related ideology, it is essential to see how these economic systems are grounded in the more mundane world of the subsistence economy. For example, the control over production by attached specialization may be exercised simply through control over a system of staple finance in which the mobilized goods are used in part to support the specialists who produce the wealth (D'Altroy and Earle 1985; Earle 1978).

In his analysis of the grinding querns from the Aegean from the Neolithic into the Bronze Age, Runnels (1985) describes a marked increase in the size of the grinding equipment correlated with increasing exchange for the stone needed for the grinding equipment. Why should the grinding querns have increased in size? What we know is that, during the Bronze Age, the development of complex society and the palace economy of Knossos and Mycenae financed itself through an export economy involving such items as wine and olive oil (Gilman 1991; Runnels 1985). To support the labour required in this economy, it was probably necessary to develop a local market to supply the labourers with their daily bread. At the same time, local markets also expanded in ceramics (Davis and Lewis 1985).

Using archaeological data, Brumfiel (1980) described how the development of marketing in the Valley of Mexico was an outcome of an expanding Aztec political economy. She begins by arguing against the idea presented originally by Sanders (1956) that markets developed to feed an expanding population specializing in local products. Rather, she shows how the markets of the Aztecs provided a means by which objects of wealth received in payment for state services could be converted into staple goods. The development of an integrated wealth finance system depends on means for the emerging specialized sector, paid in wealth goods, to obtain staple goods. Here the market acted to channel the flow of staples from the commoners to support the new class of administrators and officials. Polanyi (1968) has argued that currency developed not as a medium of exchange, but as a means of political payment by which a state superstructure operated.

The important point is that complex societies rely on a political economy as a means to obtain and retain dominance. Systems of finance develop as part of emerging institutional complexity, and these can involve a variety of means to move goods in a systematic way. Most importantly, two problems must be solved: (1) support of a non-producing sector of society; and (2) central control over the economy. The solution was tailored to particular local conditions reflecting economic opportunities as external demand for local goods and foreign wealth, but in all situations a mechanism to link subsistence mobilization and wealth integration was sought.

Symbolic materialization

A critical problem in all human society is of course the continual maintenance ('reproduction') of social order and social relationships. Much of the literature in sociology, social anthropology, and structural Marxism has described how social relationships are created. Such work stems from the functionalist traditions of the French sociologist Durkheim and has been elaborated especially by British social anthropologists such as Radcliffe-Brown and Evans-Pritchard. The substantivist economists pick up on this theme. For them, the economy is a process institutionalized in the established social order (see Polanyi *et al.* 1957). This structural functionalism has been reborn and reconstructed in the popular sociological and anthropological literature of structural Marxism (Friedman 1974; Giddens 1979; Godelier 1977; Gregory 1982). For example, in the historically documented exchange involving spouses and prestige goods between the islands of Tonga, Fiji, and Samoa, objects can be seen as 'material manifestations of social relations' (Kaeppler 1978:246). The essence of the economy was the social and political relationships that it materialized. The important point from this perspective is that social structure and political process are the main determinants of economic organization and operation. Individuals act within this system to position themselves advantageously, and in these individual acts transform the system.

In archaeology, structuralism and structural Marxism have been significant threads of the radical critique of the New Archaeology (Friedman and Rowlands 1977; Hodder 1982a; Kristiansen 1984). This critique, often referred to as 'post-processual' archaeology, raises important questions about the adequacy of popular adaptationalist theories (cf. Earle and Preucel 1987). In terms of archaeological views of the economy, the main thrust has been to focus on the social determinants of economic behaviour in ways not dissimilar to the earlier substantivists.

Hodder argues for a 'contextual approach to prehistoric exchange':

> An exchange act involves an appropriate choice of gift within a social and ideological context. The thing exchanged is not arbitrary, and its associations and symbolism play an active part in the construction of social strategies. As archaeologists, we need to examine the symbolic and ideological dimensions of exchange.
>
> (Hodder 1982a:199)

This focus on meaning develops the substantivists' notion of values which were relative to an individual society and existed because of their appropriateness for maintaining the existing social order. Hodder, however, stresses the meaning itself rather than the function of it in social process.

The find contexts, for example, of neolithic polished flint axes away from their sources demonstrate varying ritual and utilitarian uses (Hodder and Lane 1982). For axe production (especially at the Great Langdale source) and subsequent exchange, Bradley and Edmonds (1993) argue that the expansion and collapse of the axe trade must be viewed in terms of the changing nature of socio-political relationships within and between regions through Britain. To understand pre-historic economies thus leads researchers towards an understanding of human organization and cultural meaning in the past.

In a provocative essay, Appadurai (1986) argues that commodities have 'social lives'. Commodities are objects of material culture intended for exchange; the exchange life of the object is imbued with meaning that it takes on in actual interpersonal transactions. The prime example is of course the Kula objects, the exchange history of which is known and which creates increased value for the objects. In order to understand the development of specialization and complex economies with such commodities, Renfrew (1986) discusses the wealth objects from the famous chalcolithic cemetery at Varna in the Balkans. He argues that the creation of this wealth was part of a broader social process of display and personal differentiation and identification. Value, or so he postulates, was created by social exchange and not from the inherent properties of the object.

As described earlier, Helms (1979) describes how the exchange of special objects like gold ornaments from Colombia or the magnetite mirrors from Oaxaca was linked to obtaining esoteric knowledge used by chiefs as a source of power and legitimacy. To understand exchange is to understand how the objects carried meaning and how possession or gifting of such objects created specific social relationships of alliance and dependency.

The analysis of the meaning of objects is essential to determine the reasons for their production and exchange and the significance of that exchange in social life. Sørensen (1987), for example, analyses how female decorative objects of bronze were used in Denmark to define styles with local referents, in direct contrast to male weaponry that was used to establish strong external referants to warrior élite styles across Europe. For many, material culture has become a useful window into cultural meaning. I suggest that it is more than this.

Culture must be materialized, given physical form in speech, ceremony, and object (DeMarrais *et al.* 1996). If you conceive of culture as shared rules of behaviour passed on through socialized learning, all culture must be held within an individual's head, and likelihood for coherence would be low. Rather, social groups and cultural meaning can be seen as created in ceremony and at least partially recorded in the material culture. It is common for post-processualists to talk of reading the past. In fact that may be apt if one considers that material culture is the means to encode, represent, and transfer social meaning. Thus material culture becomes the very essence of culture and not simply a window into its form.

CONCLUSION

Production and exchange are very basic to social life. Because of recent scientific breakthroughs involving everything from chemical characterization to computer modelling, the archaeologist's ability to study exchange has increased dramatically. Sustained investigations of production and exchange have illustrated how archaeological evidence of these economic events permits insights into the social organization of past human societies. Theoretically, attention has focused on production and exchange as critical causes of social evolution and as the very medium in which social life becomes realized. Of all archaeological work, investigations of production and exchange will continue to play a central role as we derive new knowledge of and meaning about the past.

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Regrettably no single book deals with the archaeology of prehistoric economies, although the best synthesis of spatial methods is Hodder and Orton (1976). The seminal work on substantivist economics is Karl Polanyi *et al.* (1957) *Trade and Market in the Early Empires,* and the most useful application to archaeology is Renfrew (1975). Starting in the 1970s, processual archaeologists published a series of influential edited books on prehistoric production and exchange that includes many worthwhile chapters dealing with substantial results, research methods, and theoretical implications: Wilmsen (1972), Sabloff and Lamberg-Karlovsky (1975), Earle and Ericson (1977), Ericson and Earle (1982), Renfrew and Shennan (1982), Renfrew and Cherry (1986), Brumfiel and Earle (1987). Broad regional syntheses are available for Mesoamerica (Ericson and Baugh 1993) and North America (Baugh and Ericson 1994). Studies of particular thoroughness focus on Aegean obsidian trade (Torrence 1986), British stone axe trade (Bradley and Edmonds 1993), and Inca imperial finance (D'Altroy 1992; LeVine 1992). A few of the most quoted theoretical articles include D'Altroy and Earle (1985), Earle (1977), Flannery (1968b), Friedman and Rowlands (1977), and Helms (1979).

16

PRODUCTION AND EXCHANGE IN HISTORICAL ARCHAEOLOGY

John Moreland

The view we must adopt regarding these Melanesian peoples…is very different from the view which is normally taken. They have an extra domestic economy and a highly developed exchange system, and are busier commercially than French peasants and fishermen have been for the past hundred years. They have an extensive economic life and a considerable trade that cuts across geographical and linguistic boundaries. They replace our system of sale and purchase with one of gifts and return gifts…

Thus we see that a part of mankind, wealthy, hard-working and creating large surpluses, exchanges vast amounts in ways and for reasons other than those with which we are familiar from our own societies.

(Mauss 1967:30–31)

UNDERSTANDING HISTORICAL ECONOMIES

The economy in the past?

At the beginning of the second volume of his magisterial and comprehensive history of *Civilization and Capitalism,* Fernand Braudel considered the functioning of the economy. For him it consisted 'at first sight' of two areas—production and consumption. However, 'between these two worlds slides another, as narrow but as turbulent as a river, and like the others instantly recognizable: exchange, trade, in other words the market economy' (Braudel 1982:25). The economy thus consists of 'three worlds'—production, exchange (circulation), consumption. This same triad formed the basis of Marx's analysis of the emergence and development of capitalism (Marx 1973:83–100).

Figure 16.1 Market scene in Tononicapán Western Highlands, Guatemala. Photograph: P.Chiles.

For Braudel, 'the market' spelt 'liberation, openness, access to another world' (Braudel 1982:26) (Fig. 16.1). Through participation in the market, through access to the goods offered there, the world of the early modern European peasant was linked to the wider world which was at that time being revealed. Through 'the market' 'the traditional, the archaic and the modern and the ultra-modern' were conjoined (Braudel 1982:26).

The problem we have to face in writing of production and exchange in historical archaeology, however, is to what extent the three worlds of Braudel's economy can be discerned in the 'traditional' and in 'archaic' societies. Both Marx and Braudel were analysing the emergence and functioning of one particular form of economy—capitalism.

Although it is true that we can speak of production, exchange and consumption in all societies, can we assume that they took the same form in all societies? that the relationship between them was the same—production for exchange through the market? that they can (or should) be separated analytically? that 'the economy' can be studied in and of itself? We could surely argue that to make these assumptions is to impose on the world of the pre-capitalist past the values, mores and *mentalité* of the present. If we (unconsciously) make such an imposition, could we not argue that we must fail to understand the past, arid the role of production and exchange in that past? Might we not be better to heed the words of Karl Polanyi when he said that

> we must rid ourselves of the ingrained notion that the economy is a field of experience of which human beings have necessarily always been conscious…The crystallization of the concept of economy was a matter of time and history.
>
> (Polanyi 1957:74)

Might we not better consider a pre-capitalist past in which those activities which we see as 'economic' were not separate from, but embedded in, the other structures of society?

The expansion of the European powers to conquer and dominate the rest of the world from the late fifteenth century to the early twentieth resulted in dramatic changes in the lives of the conquered peoples. Not only did the Europeans bring their own technologies and diseases which contributed to the decimation of the indigenous populations of the Americas (McNeill 1976; Wright 1992), they also brought their particular way of seeing the natural world and their ideas about people's relationship with that world. Gradually they imposed those ideas on others.

The basis of the production of all material goods, and therefore of their exchange, is the natural world, the world of nature. In the accounts of sixteenth- and early seventeenth-century visitors to North America, we get a very particular image of the landscape, an image which reflects a Europeanized perspective on the world of nature.

> Most of the early explorers sought to discover what Richard Hakluyt had called 'merchantable commodities' in his classic *Discourse Concerning Western Planting* in 1584. These were the natural products which could be shipped to Europe and sold at a profit in order to provide a steady income for colonial settlements.
>
> (Cronon 1983:20)

This perception of the world of nature as a source of commodities stemmed partly from a view widely held in Europe that 'the world had been created for man's sake and that other species were meant to be subordinate to his needs and wishes' (Thomas 1984:17). When Europeans encountered peoples who did not see and use the natural world in the same way, the reaction was one of 'baffled contempt' (Thomas 1984:21). To people whose systems of production and exchange were based on landscapes of ordered fields and domesticated animals, and who were imbued with notions of the God-given superiority of human beings, the Native American use of their landscape rendered them barely human (if at all) and unfit to possess the land. Because the Indians, in the course of their hunting activities 'do but run over the grass, as do also the foxes and wild beasts', Robert Cushman in 1621 declared that the land was 'spacious and void' and therefore free for English taking (Cronon 1983:56; see also Jennings 1975). This was one aspect of the general 'myth of emptiness' which was used to justify the expropriation of native lands: 'the colonized had no property rights to…land because they had no concept of property rights in land' (Blaut 1993:25).

The purpose of the above discussion has been to illustrate the fact that the relationship between man and the natural world which was prevalent in Europe at the time of the 'voyages of discovery' was not natural, in the sense that it was not inherent in all human beings. It had emerged in a particular place, at a particular point in time. In other parts of the world, at other times in the past, the relationship between man and the natural world was different. The rationale behind production and exchange would also therefore have been different. In these worlds, people would have produced and exchanged 'for reasons other than those with which we are familiar from our own societies' (Mauss 1967:31). To understand these worlds we cannot use the logic of capitalism.

The theme of 'production and exchange in historical archaeology' must, of course, be concerned with the development and spread of capitalism. In fact, there are those archaeologists, usually American, who argue (in my view erroneously) that historical archaeology is the archaeology of the 'modern world', 'the time when colonialism, Eurocentrism, capitalism, and modernity all come together' (Orser 1996:86), or indeed 'the archaeology of capitalism' (Deagan 1994:16–23; see also Deetz 1977:5; Leone and Potter 1988:19), but many pre-capitalist societies existed 'in history' (see below, p. 649; for a further critique of this view, see Moreland, forthcoming). The questions we have to consider are: How are we to understand the logics of production and exchange in pre-capitalist, historical societies? In what ways did these logics differ from those of capitalist societies? How did they react to and interact with the spread of capitalism? We can only begin to address questions of such magnitude in this chapter, but we have to start by considering how we can gain an insight into worlds so different from our own.

Anthropology, production and exchange

Given that we are seeking to understand pre-capitalist as well as capitalist societies, might we not argue that a study of those societies encountered by anthropologists would give us insights into the pre-capitalist, historical world? This has indeed been argued by many archaeologists and historians. At the turn of the twentieth century, Sir Baldwin Spencer wrote:

> Australia is the present home and refuge of creatures, often crude and quaint, that have elsewhere passed away and given place to higher forms. This applies equally to the Aboriginal as to the platypus and kangaroo. Just as the platypus…reveals a mammal in the making, so does the aboriginal show us, at least in broad outline, what early man must have been like before he learned to read and write, domesticate animals, cultivate crops and use a metal tool. It has been possible to study in Australia human beings that still remain on the culture level of men of the Stone Age.
>
> (cited in Bahn 1996:181; see also Trigger 1989:143)

The attitudes expressed here represent a version of the ‘theory of our contemporary ancestors’ which asserts that ‘as we move farther and farther away from civilized Europe, we encounter people who, successively, reflect earlier and earlier epochs of history and culture’ (Blaut 1993:16). Oriental cultures were condescendingly venerated because they contained ‘the eternal in its present’. ‘In other words, contemporary India was not truly contemporary, but showed Europe its own past’ (Dirlik 1996:102, fn. 16). The eternal in the Indian present was the world we had lost through the rupture caused by capitalism. We could rediscover for ourselves the supposed values of that lost world, and understand our own past, through a study of the Indian (and other non-European) presents.

The same Eurocentric views are made much more explicit in the work of some evolutionary anthropologists (Marcus and Fischer 1986:17). Perhaps the clearest expression was given by Marshall Sahlins in 1963 (although it must be emphasized that his later work (Sahlins 1974, 1987, 1995) demonstrates a much more sophisticated understanding of the relationship between the West and the peoples encountered by anthropology):

> the native peoples of Pacific islands…present to anthropologists a generous scientific gift; an extended series of experiments in cultural adaptation and evolutionary development…From Australian aborigines, whose hunting and gathering activities duplicate in outline the cultural life of the later palaeolithic, to the great chiefdoms of Hawaii, where society approached the formative levels of the old Fertile Crescent civilizations, almost every phase in the progress of primitive culture is exemplified.
> (Sahlins 1963:285)

It would appear then, from these perspectives, that to understand the logic of production and exchange in the pre-capitalist world (prehistoric and historic) anthropology provided a key. Particularly influential for archaeologists was Elman Service’s typology of bands > tribes > chiefdoms > early states (Service 1971; see Fig. 12.2). Chiefdoms and early states began to appear in profusion in archaeologists’ discussions of early historic societies. Service’s typology is explicitly adopted by Richard Hodges in his analysis of the production and exchange systems operative in north-western Europe in the early Middle Ages (Hodges 1982:26–27); Klavs Randsborg uses chiefdoms, early states and secondary states as analytical concepts around which to hang his discussion of the Viking Age in Denmark (Randsborg 1980:7–10, 167–69); we have complex chiefdoms in the European Iron Age (Champion and Champion 1986; Collis 1984:18–19) and in early North America (Peebles 1987; Steponaitis 1978; Renfrew and Bahn 1991:155–56).

In terms of production and exchange, these chiefdoms are supposed to have been organized around the principle of redistribution. As we have seen in Chapter 15, this was one element in the typology of exchange systems developed by Karl Polanyi (1957). It is useful in so far as it provides us with a logic for the organization of production and exchange 'other than those with which we are familiar from our own societies' (Mauss 1967:31). However, this appreciation must be set against the fact that it seems capable of application to societies from the late Neolithic onwards. Real understanding of the historical communities labelled 'chiefdoms' or 'early states' is denied through the assertion of identity—they are all chiefdoms; they all operate through redistribution:

> Identity is always the primordial term. Although each documented chiefdom…is distinct from any other chiefdom…, in an evolutionary framework these differences become subsumed and relegated as secondary or contingent.
>
> (Shanks and Tilley 1987:149)

So rather than providing a key to the understanding of the different logics of production and exchange in pre-capitalist historical communities, evolutionary frameworks, like the one just discussed, deny such difference through the imposition of another form of identity. However, before we conclude this discussion of anthropology and its impact on our understanding of pre-capitalist, historical economies we must return to Marcel Mauss, for he provided archaeologists with an alternative logic for the organization of production and exchange—the Gift.

Mauss and the Gift

Writing originally in 1925, Mauss argued that Man had only recently become 'an economic animal…a machine, a calculating machine' (1967:74); before this transformation into *homo economicus,* exchanges involved

> not exclusively goods and wealth, real and personal property, and things of economic value. They exchange rather courtesies, entertainments, ritual, military assistance, women, children, dances, and feasts; and fairs in which the market is but one element and the circulation of wealth but one part of a wide and enduring contract.
>
> (Mauss 1967:3)

For Mauss, 'the exchanges of archaic societies…are *total social movements* or activities. They are at the same time economic, juridical, moral, aesthetic, religious, mythological and socio-morphological phenomena. Their meaning can therefore only be grasped if they are viewed as a complex concrete reality' (Evans-Pritchard 1967:vii). This is an important insight and is one developed by some of the anthropologists I have already discussed. In pre-capitalist societies, production and exchange were not only (or even) 'economic' activities. They were part of the total fabric of society. When the Quebec Eskimo killed a reindeer they were not merely performing an economic activity—'from the hunters' point of view their slaughter and consumption is an integral and necessary part of the creative cycle of renewal' (Ingold 1986:250).

It is only with capitalism (and perhaps not even fully there— Mauss 1967:2; Hodder 1986:30; Samson 1991:88), that the 'economy' becomes disembedded from the other structures of society (Polanyi 1957; Sahlins 1974; Goelier 1977). Mauss argued that many 'embedded' exchanges took place through the medium of *the gift*.

Mauss argued that gift exchange was characterized by three obligations—the obligation to give; the obligation to receive; and the obligation to repay (1967: 37–41). The giving of gifts to others demonstrates the power of the donor. The receiving of gifts puts the recipient in the 'moral debt' of the donor, creating a relationship of subordination. Hence the obligation to repay. Failure to repay, at the appropriate time and in an appropriate manner, reproduces the social relationship of subordination. It was impossible to avoid getting into 'social debt' by refusing a gift, since normally refusal resulted in loss of face and social subordination. (The above is a very brief summary of Mauss's arguments on gift exchange, supplemented by the discussions of Gregory (1982) and Gosden (1989).)

This system, although different from ours, was not inferior. It provided the logic for some of the most extensive movements of products in the non-capitalist world—e.g. the Trobriand Island system (Mauss 1967:18–31).

Mauss constructed his picture of gift exchange on the basis of the study of a few societies, most of them on the Pacific rim. Despite this, he argues that the concept of gift exchange as a means of structuring society was 'not merely local' (Mauss 1967:16). Its greater applicability in time and space is supported by the quotation from *Hávamál,* an Icelandic saga, with which he begins his book: 'A man ought to be a friend to a friend and repay a gift with a gift'; by the fact that the French historian Paul Veyne used a variation of the concept to explain substantial 'economic' exchanges in the Greek and Roman world (Veyne 1990); and by the fact that archaeologists and historians have found it useful as a heuristic device in their interpretation of prehistoric and early historic societies (see for example Balzaretti 1992; Geary 1994; Gosden 1989; Hauken 1991; Wickham 1992). Might 'the Gift' then provide us with an 'alternative' logic for the organization of production and exchange in pre-capitalist, historical societies?

Gifts and commodities

In recent years substantive critiques of the concept of the gift have emerged (see, for example, Sahlins 1974:149–83). In particular, the notion of the morally-binding force of the gift has been called into question. It will be remembered that the exchange of gifts created social relationships. For Mauss, the focus was on the construction of these relationships, not on the objects exchanged (except in so far as the objects were thought to contain 'the spirit of things', 'a spiritual power' *'hau'* (Mauss 1967:8–9; Vestergaard 1991:97–99; Samson 1991). Here the contrast is with the societies 'with which we are familiar', where exchange is an impersonal process, mediated through the anonymity of money and the market (Mauss 1967: 93–94; Evans-Pritchard 1967:ix). In gift-giving societies, exchange, as part of the total social fabric, creates and reproduces *personal* relationships: '[w]ithout exchange social life, social communication, would not be' (Vestergaard 1991:98). In our societies, exchange creates relationships between *things*.

In his recent book *Entangled Objects: Exchange, Material Culture and Colonialism in the Pacific,* Nicholas Thomas (1991:15) summarizes the perceived differences between exchange in capitalist and non-capitalist societies as follows (see also Geary 1994:216):

Commodities	*Gifts*
Alienable	Inalienable
Independence	Dependence
Quantity (price)	Quality (rank)
Objects	Subjects

He points out that the difference between 'the gift' and 'the commodity' is so great that one can be seen as the inverse of the other. He argues that we have constructed the concept of the gift, not from the dispassionate observation of the process in action, but on the basis of our perception of the (im)morality of exchange in our own society (see also Rowlands 1994:2).

There is a tendency in the writing of history and anthropology to see capitalist, industrial society as devoid of the humanity which is the essence of the small-scale societies which we reconstruct for the past (Thomas 1991:10). This 'ideology of primitivism', this dissatisfaction with the world we live in, encourages us to emphasize the differences between it and the world of 'the others', to the extent that their world becomes the desired antithesis of our own. Such 'constructed idylls' can be found in some of the earliest ethnohistorical works (for an eighteenth-century view of the Kahnawake in north-east America, see Demos 1996:150), and can be traced at least as early as the description of the Germans presented to the Romans by Tacitus in the first century AD.

Nicholas Thomas suggests that, although the Gift may have been the basis for exchange and social reproduction in some societies, some of the time, Mauss over-generalized from his particular case studies, and we have subsequently developed Mauss's images to construct a desired-for world of simplicity, morality, and humanity—a world closer to nature.

What recent work (archaeological, historical and anthropological) has made clear is that, even when gift exchange can be demonstrated, it was not always the only system of exchange in operation, nor did it always function in the socially cohesive fashion proposed by Mauss, nor was money the 'subversive threatening force' which it has been presented as (Bloch and Parry 1989; Carsten 1989; Rowlands 1994; and Samson 1991 for details).

What has to be made clear is that there are no ‘pristine’ societies in which we can disinterestedly observe pre-capitalist systems of production and exchange to use as models for the historical past. The worlds of anthropology have been linked to that of capitalism since the inception of the discipline and they have profoundly influenced each other. In fact it can be (and has been) argued that anthropology is not the disinterested observation, recording, and analysis of the people encountered in the process of colonialism, but was itself an active participant in the imperialist process (Said 1994, [1978] 1995). At the same time as the land and rights of the indigenous peoples of the world were being removed by the imperialists, their culture and traditions were being appropriated by anthropologists and historians as models for the European past (see pp. 640–42). We can draw three conclusions from all of this which are of direct relevance to our attempts to reconstruct pre-capitalist, historical economies.

First, our vision of anthropology and ethnohistory has been too simple. A consequence of this is that the imposition of models drawn from these disciplines onto the more distant past results in our under-playing the complexity of production and exchange activities. As a reaction to the iniquities and immorality of capitalism, we have constructed monolithic worlds of reciprocity, redistribution and gift exchange. We should understand that such monoliths can rarely have existed and realize that no society in the past was constructed on the basis of a single mode of production or exchange (Rowlands 1994; Wickham 1984).

Second, we must appreciate that the ‘entanglement with capitalism’ has produced the historically specific societies which anthropologists have observed, and which archaeologists and historians have used as the basis for analogies. We can see that the development and spread of ‘dominant’ systems of production and exchange in historical periods can radically transform all aspects of society and economy in formerly ‘independent’ worlds. The spread of capitalism is the most obvious, and most pervasive, example. Numerous studies have now been devoted to showing how, from the sixteenth century onwards, the expansion of the European powers and their modes of organizing production and exchange profoundly altered the social structure, economy, and *mentalité* of societies in Africa, America, Australasia, and the Far East (among many others, see Dincauze and Hasenstab 1989; Wolf 1982; Brenner 1988; Rowlands 1979; Deagan 1983).

What is clear from these studies, however, is that, whenever capitalism came into contact with other modes of organizing production and exchange, the ‘native’ forms did not just disappear. Just because capitalism became the dominant mode does not mean that it was adopted wholesale and without modification by non-European societies. The interaction between the capitalist and the non-capitalist modes of production and exchange produced hybrid economies and, as Carol Smith has pointed out as a result of her study of Guatemalan peasants, in some cases the interaction could alter the form of the dominant mode itself (Smith 1984).

Third, we can argue that the capacity to interact with and transform 'native' economies is not a unique feature of capitalism. There have been other world empires and world economies—to use the phraseology of Wallerstein (1984:147– 58)—whose dominant mode of production must have had an impact on the economies of the societies with which they came into contact. One thinks immediately of the Roman empire and its transformation of the structure of the economy in, for example, the province of Britannia (see, amongst others, Millett 1990; for north-west Europe generally see Hedeager 1992). However, we can also refer to the impact of Islamic silver, and general contacts with the Middle East, on the structure of society in early medieval Denmark (Randsborg 1980), and in a slightly different mode we should note the relationships between the Middle East, India, and China fostered by the fact of trade across the Indian Ocean:

> The Indian Ocean itself created a…kind of unity through the long-distance trade and the great urban emporia. The free port and the trading city of caravan routes represented the essence of many different civilisations, a distillation of a multitude of geographical images.
>
> (Chaudhuri 1990:147)

In the Americas, Randy McGuire has charted the impact of Mesoamerican contact on the thirteenth-century Anasazi, in the south-western United States (McGuire 1989).

Nicholas Thomas has argued that 'there should be a movement of perspective from economic abstractions to historical forms' (1991:16). In other words, we should cease imposing the constructs of western anthropological thought and concentrate on analysing the specifics of exchange relations and their impact on particular historical communities (Geary 1994:218; see Sahlins 1987 for a fine example of how this can be done).

We can only appreciate the historical specificity of past historical economies if we study them in all the detail that the combination of the archaeological and the historical record allows (Thomas 1991:16). The non-capitalist economic categories proposed by Mauss, Polanyi and others may be useful as heuristic devices, as foils for developing our ideas about the nature of production and exchange in particular societies, but they only obscure our vision when they are *imposed* on the past as reified conceptual categories. Before we turn to look at the complexities which analyses of real, historical production and exchange systems reveal, we must consider two 'institutions' which both partially differentiate such systems from those encountered by anthropologists and partially define the former as entities in their own right: money and writing.

Money and writing

> Money stored value, and helped to foster the growth of long-distance markets. Writing stored rights and obligations, and helped to create a larger store of knowledge, a system of laws, and a market in cultural skills and values. Their operation was mutually reinforcing, since both money and writing are systems of impersonal, symbolic exchange …Writing and money were two powerful agents of communication and control…
>
> (Hopkins 1991:157)

As with many of the terms we use in the human sciences, money and writing at first sight appear easily understandable—they are things with which we are familiar, recognizable aspects of the modern world. However, such understanding is illusory. Definitions of money and of writing, which apply across time and space, have proved difficult to produce (see, for example, McKitterick 1990; Goody 1968; Stock 1983 for literacy; Dalton 1977; Hodges 1988 for money). I do not intend to try to produce such definitions here. Equally I do not intend to try to differentiate the 'money-like' things and the 'writing-like' things recorded by anthropologists, from the coins and documents which we will encounter in the text below (although some references to such differences will appear) (see Mauss 1967:93–4; Dalton 1977; Gregory 1982; Sahlins 1974:277–314 for 'money-like things'; Hooker 1990 for texts and 'text-like' things). Here I want to consider briefly the 'function' of these institutions in historical economies.

Money is held by some to be one of the defining characteristics of complex historical economies. Fernand Braudel wrote that 'the operation of the money supply can be seen as an instrument, a fundamental and regular phenomenon of any moderately developed commercial life' (Braudel 1981:436). It was a powerful force in the creation, transformation, and reproduction of those economies, since the development of media through which all exchange could be conducted enhanced the speed of exchange and the quantity of goods involved. Anthony Giddens argues that money makes possible the circulation of exchange values across vast areas of time and space. In addition it permits the storage of wealth on a massive scale (Giddens 1981:116–17). As such, a consideration of money would be central to any understanding of production and exchange activities in historical economies.

The role of writing in the organization of production and exchange activities is less self-evident, but no less important (Fig. 16.2). Giddens has argued that the use of writing was more important than technological change in the generation of surplus, since writing allowed greater control of knowledge about the production process (Giddens 1981:94–95). The full implications of writing for society in general, and for systems of production and exchange in particular, have been spelt out by Jack Goody:

> The importance of writing lies in its creating a new medium of communication between

Figure 16.2 Writing and the market—Mexico City. Photograph: P.Chiles.

men. Its essential service is to objectify speech, to provide language with a material correlative, a set of visible signs. In this material form speech can be transmitted over space and preserved over time…The range of human intercourse can now be greatly extended both in time and space. The potentialities of this new instrument of communication can affect the gamut of human activity, political, economic, legal and religious. In the administrative sphere, complex bureaucratic organizations are directly

> dependent upon writing for the organization of their activities, especially financial. It provides a reliable method for transmitting information between the centre and the periphery… So too in the organization of long-distance trade and estate agriculture: it is writing that assists with the calculation of profit and loss.
>
> (Goody 1968:1–2; see also Giddens 1979:200–4)

Goody argues that, even in its earliest manifestations (Fig. 16.3), writing was directly implicated in the production and exchange activities of complex economies (see Maisels 1990; Nissen 1986; Larsen 1988; Hallo 1979 for *cuneiform* and production in early Mesopotamia; Chadwick 1990 and Halstead 1992 for *Linear B* and ancient Crete; Baines 1983 for hieroglyphs and ancient Egypt).

Where it exists, there is generally an integral link between writing, production and exchange. This is true even when the use of writing is restricted to a small élite —as it generally was up until (and even beyond) the invention of the printing press (Eisenstein 1979). In societies with 'restricted literacy', writing and the word were frequently linked to the Gods and the supernatural, and therefore to 'power' (Bowman and Woolf 1994). This was not only true of the 'religions of the Book' — Christianity, Judaism and Islam (Goody 1986:1): a similar link has also been argued for Roman paganism (Beard 1991), ancient Egypt (Baines 1983, 1989), the Minoan palaces on Crete (Cherry 1986), and for early medieval Sri Lanka (Goody 1986: 59–61). Writing, through its connections with the élite and the Gods, legitimated the social relationships which lay behind many of the production and exchange activities of the historical past. This connection added to the power which writing endowed on élites by virtue of its capacity to list, record and transmit information across time and space. As such, even the illiterate became entangled in the tentacles of writing (Hopkins 1991).

So far I have been speaking in generalities about the 'function' and power of money and writing to affect the operation of systems of production and exchange in historical economies. But as with the anthropological analogies which I discussed above, it is important not to reduce the analysis of past economies to the level of

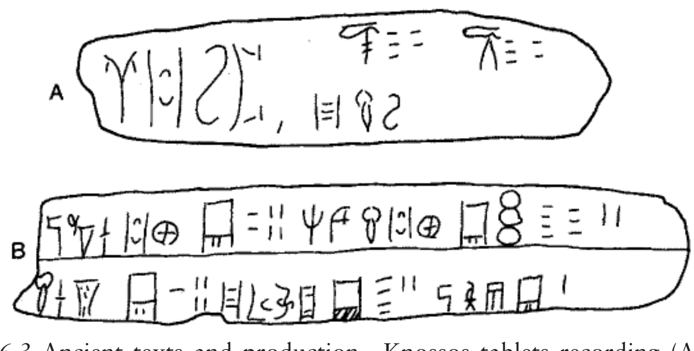

Figure 16.3 Ancient texts and production—Knossos tablets recording (A) fifty rams and fifty ewes, and (B) different kinds of cloth. Source: Chadwick 1976.

'sameness' through the uncritical application of these generalities to the whole of the historical past. It is now time to turn from these 'economic abstractions' and consider some 'historical forms' (Thomas 1991:16). In doing so, I hope to use the insights derived from the generalized discussions of the anthropology of 'pre-capitalist' societies, money and writing, to uncover the complexities of historical economies and to understand them in their own terms rather than as simplified worlds we have lost. In each of the studies below, I shall examine the 'historical forms' as entities in their own right, but also as exemplars of the kind of complexity which we might expect to find in all historical economies.

RECONSTRUCTING HISTORICAL ECONOMIES

Money and morality in the medieval world

> A mere handful of men—unending emptiness stretching so far west, north, and east that it covers everything…clearings here and there, wrested from the forest but still only half-tamed; shallow pitiful furrows that wooden implements drawn by scrawny oxen have scratched on the unyielding soil;…huts of stone, mud, or branches clustered in hamlets surrounded by thorn hedges and a belt of gardens; sometimes inside the palisade that shields it, a chieftain's dwelling, a wooden hangar, granaries, the slaves' sheds and the cooking hearth some ways off to the side; sparsely scattered towns, the mere whitened skeletons of Roman cities invaded by rural nature,…near them a few dozen huts that house the vinegrowers, weavers and blacksmiths, all the domestic craftsmen who make ornaments and arms for the garrison and the local bishop; two or three Jewish families who lend a little money on pledge; trails, the long lines of men at portage, flotillas of small boats on every waterway…
>
> Such is the Western world in the year 1000…it seems rustic, very poor and defenceless. A wild world ringed round by hunger. Its meagre population is in fact too large.
>
> (Duby 1981:3)

This was the image of the western world in the early Middle Ages, and of the systems of production and exchange which sustained it, which prevailed until recently. It is an image which fits well with perceptions of degradation and ruin following the demise of complex social systems (see Renfrew 1979; Tainter 1988). Production is at the level of bare subsistence; technology is fighting a losing battle with a combative Nature; craft production is limited and controlled by the élite living in the decayed remains of once splendid Roman cities. Trade is small scale and conducted only with difficulty. There appear to be two 'economies'—that of the self-sufficient or autarkic peasant, struggling to wrest a living from nature; and that of the bishop linked to a wider world through 'flotillas of small boats' and the loans of Jewish merchants.

However, even before this highly pessimistic account of the early Middle Ages was written, archaeology was providing the documentation for another story. Excavations across north-western Europe were revealing evidence for organized villages and planned landscapes, for palatial and ecclesiastical complexes; much of this recent evidence is summarized by Hamerow (1994) and Randsborg (1991). Together, archaeology and history have been documenting fairly complex systems of agricultural production (Astill and Grant 1988).

More surprisingly (but only in terms of the 'catastrophist' bent of much previous history writing), archaeologists had been bringing to light the remains of a series of coastal settlements (emporia) with abundant evidence for long distance trade. It had been a commonplace of historical interpretation of the early Middle Ages that the movement of goods over long distances had been reduced to minimal levels. However, as long ago as 1939 the excavations of the Sutton Hoo ship burial demonstrated the long distance movement of goods from the Mediterranean to Britain— the Anastasias dish and the Coptic bowls for example (Bruce-Mitford 1975–83). (For the location of Sutton Hoo and other sites mentioned in this section, see Fig. 16.4.) The discovery of a sixth- to seventh-century north Indian Buddha at Heglö in Sweden shows more wide-ranging contacts (illustrated in Graham-Campbell 1994:33). The analysis of pottery from the west of Britain has shown the persistence of long distance contacts with the East Mediterranean throughout late Antiquity (Fulford 1989; Thomas 1993:93–96).

Most significantly, the excavations of the numerous west European emporia (coastal trading sites) in the period since the Second World War have demonstrated a dramatic increase in the range of contacts and the movement of goods in the eighth and ninth centuries (see Clarke and Ambrosiani 1991; Hodges 1982; Hodges and Hobley 1988). More often than not, analogies drawn from anthropology, and specifically concepts of gift exchange, were used to account for such movements (Hodges 1982, especially pp. 52–56; Jones 1993). In addition, control over this exchange was seen as one of the principal bases for power in many early medieval kingdoms, and the trade itself was seen as 'directional' between the elite trading partners in participating kingdoms (Hodges 1982:54). What is especially significant about emporia such as that at *Hamwic* (Saxon Southampton) is that it was part of a 'world system' of production and exchange. Through trading links with other emporia in Holland (Dorestad), Denmark (Ribe and Hedeby), Sweden (Birka), and Russia (Staraya Ladoga), connections were created which linked the kingdoms of western Europe with the Near and Far East, and which supplied the European elites with exotic products such as the Buddha found at Heglö (for this 'world' system see Graham-Campbell 1994; Hodges 1982; Hodges and Whitehouse 1983).

More recent results suggest that it was not just low-volume, high-prestige goods which were being traded at this time. Recent historical research has begun to investigate the movement of the 'everyday' goods which must have constituted the majority of traded products at the local and regional levels (for example, Blair 1994; Everitt 1986; Hooke 1989; Kelly 1992). However, it is also now clear that ordinary

Figure 16.4 Exchange in early medieval England—location of sites mentioned in the text. Source: J.Moreland. Drawn by D.Miles-Williams.

produce could be moved over quite long distances. An analysis of the weed seeds from the Dutch emporium of Dorestad has demonstrated the importation of grain in the eighth and ninth centuries (van Zeist 1990), while the movement of bulk staples has also been noted in the Baltic at a slightly later date (Randsborg 1980: 100). John Blair has argued for the continued importance of the long distance movement of salt from the Droitwich region in the early Middle Ages (Blair 1994: 84–87). Chemical analyses of the interior surfaces of pottery from Saxon Southampton show the presence of olive oil (Evans 1988). Archaeozoological evidence suggests that the Danish emporium of Hedeby was being supplied with meat from rural settlements, like that at Elisenhof some 50 km to the south (Randsborg 1980: 57–59), and that the region around the English emporium of Hamwic (Saxon Southampton) was supplying the population with the meat for their stews (Bourdillon 1988:180; 1994), and flour for their bread (Fowler 1982:276). (From now on I will focus mainly on the evidence from Anglo-Saxon England, and particularly the site of Hamwic.)

It would now appear that the emporia were not solely concerned with long-distance trade. In the past, archaeological attention was focused on the exotic material found on the emporia sites, as evidence for the postulated significance of long-distance 'directional trade between elites' (Hodges 1980, and 1982:56–60). More recently, an analysis of the pottery from Hamwic has shown that locally made coarse wares dominated the assemblage (82 per cent of the total—Timby 1988: 73), perhaps indicating that our perspective on the nature of the Anglo-Saxon economy, and on the role of long-distance trade in prestige goods within it, has been coloured by the presence of a small number of items of exotic material culture.

The evidence from the emporia is now being reassessed and it is clear that at, for example, Hamwic, Dorestad, and Hedeby (Denmark), the production of craft goods was a major activity (Fig. 16.5) (Brisbane 1988; Morton 1992; Randsborg 1980; van Es 1990). At Hamwic there is direct or indirect evidence for

> iron working (mostly smithing, but perhaps also smelting), copper-alloy working, lead working, gold working (including mercuric gilding), bone and antler working, wool processing, textile production, leatherworking, glass working…woodworking, and butchery.
>
> (Brisbane 1988:104)

From the evidence of the production facilities, the amount of waste produced and the objects themselves, it is clear that this production was above and beyond the needs of the community. Production *and* exchange of 'craft goods' are clearly involved, and control over the production of craft goods is now seen as a critical factor in the reproduction of power relations (Hodges 1989:70; more generally, see Gosden 1989).

Finally, we must briefly consider the fact that small silver coins *(sceattas)* have been found on many of the sites of the eighth century in England. I cannot discuss their origins or evolution in any detail (see Grierson and Blackburn 1986:164–89, 266–95; Hodges 1989:71–79). All we need to note here is that they are frequently found on emporia sites and that there is some evidence that at least some of them may have been produced there (Hodges 1989:83; Jensen 1991:11). They are also found in association with craft production activities (Fenwick 1984). We should also note that, although many more have been found in the last few years, primarily by metal detectors (Blair 1994:84), the numbers known are still counted in the low thousands. In addition, it is perhaps important that these 'coins' were struck in silver, and only in silver.

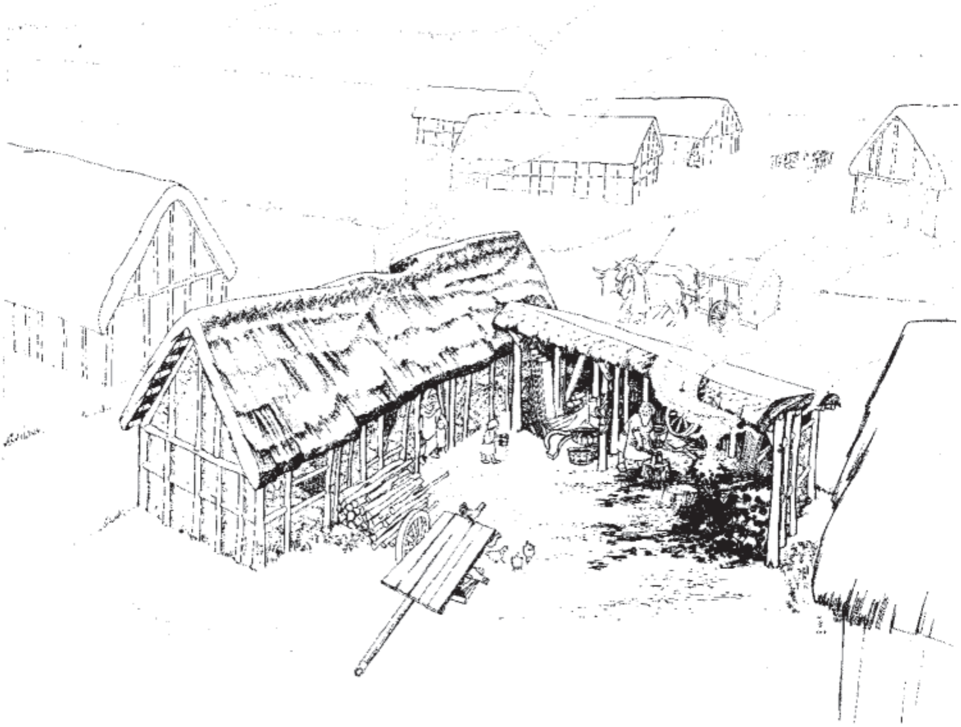

Figure 16.5 Houses and production in Hamwic. © J.Hodgson.

Archaeology has moved us a long way from a 'rustic, very poor and defenceless world'. But we would also appear to have contrasting pictures, with several 'economies'. On the one hand we have the evidence for long-distance trade in 'prestige goods', explained by many in terms of a version of Maussian gift exchange; then we have the provisioning of settlements like Hamwic with the raw materials for subsistence and craft production; we have craft production which, although focused on emporia, was not restricted to them (Carr *et al.* 1988; Haslam 1980); we have the association between *sceattas,* exchange, and craft production; and finally we have the agricultural production of the vast majority of the population, living and working from villages and hamlets spread throughout the landscape of England. How were these systems of production and exchange linked? What was the underlying logic of the system? Was there in fact a single logic, a single early medieval economy?

More than usual, we should be wary of assuming a single overarching structure for the economies of early medieval north-west Europe since, socially and politically, the region was extremely fragmented. However, given the presence of *sceattas* across

Figure 16.6 Sceatta from Hamwic. © Southampton City Council.

much of north-western Europe and the discovery of 'foreign' *sceattas* at sites like Hamwic (Fig. 16.6), might we not see this coinage as evidence for the reemergence of a monetary, commercialized economy? Might not coinage have been the medium through which the economies of this period were articulated? If so what was the role of the putative gift exchange and what was the relationship between this, the 'money economy' and the ubiquitous system of agricultural production and exchange? Here we have to consider the detail of the archaeological and historical evidence.

In his discussion of the *sceatta* coinage, D.M.Metcalf (1984) presents his arguments in terms which are unambiguously 'modernist'. Thus he argues that

> These scarce early coins seem to be relatively more plentiful as continental finds than their output in relation to the succeeding primary series would have led us to expect. In monetary terms the pattern is one of contacts between Kent and the Thames estuary and the Rhine mouths, and quite possibly a net drift of coin from south eastern England to the Continent; that is to say, England may have run a small *balance-of-payments deficit,* which was inimical to a net drift of coin in the other direction, namely towards the English midlands.
>
> (Metcalf 1984:30, emphasis added)

In essence, Metcalf is suggesting that *sceattas* were coins used in a monetary economy. He implies that his argument is supported by the number of coins which he assumes to have been in existence. He estimates that some 2–3 million coins may have been produced in some of the *sceatta* series, while the coinage of Offa, the late eighth-century king of Mercia, should be numbered in tens of millions (Metcalf 1965). Here we see an Anglo-Saxon economy in which production and exchange are structured through money and the market, much like today. Presumably gift exchange is epiphenomenal in such a system.

Some support for the idea that we should be talking about a commercialized economy is to be found in the historical sources. In a study of documents recording the sale of land in Anglo-Saxon England, James Campbell notes that in the late seventh century, Abbot Haedda paid 500 *solidi* to Ethelred, king of Mercia, for a piece of land (Campbell 1989:27). This, and other documents, would seem to confirm that that most precious of commodities—land—could be alienated from the kin group through the medium of coinage. But before we go any further we should note what the rest of this document says. Campbell continues as follows:

> Before the chink of coin has died from our ears it [the text] goes on to explain what is meant by 500 *solidi; id est,* it says, twelve beds, namely feather mattresses and elaborate pillows together with muslin and linen sheets as is customary in Britain; also a slave, with a slave girl; also a gold brooch and two horses with wagons.
>
> (Campbell 1989:29)

This apparently transparent transaction begins to look less like a straightforward commercial sale, and should caution us against too literal a reading of other written sources which might seem to imply commercialized exchange (see Jones 1993:664 for other examples; and Bloch 1965:66–67 for a general discussion).

The archaeological evidence is also not as straightforward as it appears. We cannot doubt the existence of silver coins from the late seventh century, but we can question the numbers postulated and the interpretation presented by Metcalf. First we should consider the numbers of coins in circulation. Metcalf's figures are based on a formula used to estimate the volume of coins of Queen Elizabeth I (1558–1603), which involves multiplying the number of dies used by the number of coins which *may* have been minted from any one die. Metcalf argues that up to 10,000 coins could have been produced from one die, and that no less than 150 obverse dies would have been used. This results in millions of coins produced (Metcalf 1965). However, as several observers have pointed out, it might not be appropriate to apply the figures for coin production in the sixteenth century, a period when we see the beginnings of the emergence of the 'modern world system', to the economies of early medieval England. Thus Hodges argues that in the eighth century it is as likely that one *sceatta* was struck from a die as 10,000 (1982:115). Although we cannot give precise figures for the number of *sceattas* struck and put into circulation, the comparatively low numbers (*c.* 127) found at major sites like Hamwic (Saxon Southampton) suggest that we should be talking in terms of tens of thousands rather than millions (for the number of *sceattas,* see Metcalf 1988:15). This must affect our perception of the efficacy of these 'coins' as media of exchange and as providing a logic for the overall economy. It is perhaps worth noting that '[t]he foreign sceattas found in Hamwic would have been sufficient…to requite the damage to only five or six ox horns: and all the Dark Age coins [from Hamwic] would have been a payment for only twenty ox horns' (Morton 1992:66).

In this context we must also consider the fact that these coins were made of silver, and only of silver; there were no other denominations. Although the silver content of the coins fluctuated (Hodges 1982:113, fig. 28), they cannot be regarded as small change (for the comparative value of early tenth-century coins, see Whitelock 1955: 388, n. 37, 6.2). It is doubtful, therefore, that they were involved in many ordinary market transactions. The discovery of these coins on certain classes of site—emporia, ecclesiastical and royal settlements, hill top 'fair' sites—does link them with exchange, perhaps with the 'closed sphere of foreign trade' (Hodges 1989:76), but their comparatively low numbers, their distribution, and their occurrence in a single (high value) denomination all suggest that they were not the only, or even the most important, medium of exchange. They coexisted and articulated with other forms and it is to a short consideration of these that we must now turn.

It is evident that much production in the early Middle Ages was focused on the provision of objects for use as gifts, even if it is now also clear that such gifts were produced and acquired in circumstances very different from the 'primitivist' ones envisaged by Georges Duby (see p. 650; Geary 1994). Gifts may have been given and exchanged at all levels of society. The texts give us some hints as to what may have been exchanged at the highest levels. The 'belt and Hunnish sword' which we are told the Emperor Charlemagne sent to King Offa of Mercia can be seen as a gift from the ruler of one country to the ruler of another (Whitelock 1955:781–82, n. 197). The gold rings specified in charters of the ninth century should equally be seen as aristocratic gifts (Campbell 1989:27). We have already noted Mauss's quotation from the *Hávamál* ('a man ought to be a friend to a friend and repay a gift with a gift' (Mauss 1967:xiv), and Stephen White has written on 'gifts to saints' in eleventh- and twelfth-century France (White 1988). Equally, there can be little doubt that, although the *sceattas* did not function like modern coins and that the Anglo-Saxon economy was not a monetary economy, these coins had some connection with systems of craft production and long-distance trade. As importantly, we always have to remember that most production and exchange took place in the context of relations of dependency between lord and tenant, relations which would have been mediated through custom and tradition and not through money.

Having recognized the multiplicity of ways in which production and exchange might have been structured in the early Middle Ages, and having down-played the role of coinage as a structuring mechanism, we again have to face the crucial question as to how they were articulated

We should begin by noting that emporia like Hamwic seem to have been set up and controlled by kings. These kings also owned estates worked by peasants who delivered renders. John Blair has argued that some of the cattle consumed at Hamwic may have been supplied from as far away as the Upper Thames valley, with salt travelling even greater distances. It is perhaps significant that Hamwic-type *sceattas* have been found in the Upper Thames region (Blair 1994:82–89).

Estates will have produced more than agricultural produce. The eighth-century settlement at Ramsbury in Wiltshire may have been part of a royal estate, and the archaeological evidence suggests that one of its principal activities may have been the production of iron (Haslam 1980). German lava quern stones found at Ramsbury may originally have been imported through Hamwic, travelling to Ramsbury partly by the same route (in reverse) postulated by Blair for salt and cattle (Haslam 1980:56).

It is possible that the people of Hamwic were supported by peasant renders to the *villa regalis* (the royal centre) which we know existed there, and that they used the renders from estates like Ramsbury to produce craft items. These items may then have been exchanged (as gifts?) at the regional and perhaps international level (the letter from Charlemagne to Offa also mentions cloaks and 'black stones'—presumably quern stones), to reproduce social relations in a way similar to that proposed by Mauss. More prestige items, like the late eighth- or early ninth-century Anglo-Saxon embroideries from Maaseik in Belgium, were gifts between the secular and ecclesiastical élites of north-west Europe (Budny 1984). They may have been traded through the emporia, but they were probably made elsewhere—in the case of the embroideries, an ecclesiastical context is most likely. Whatever the case, their production rested on the basis of an economic infrastructure dominated by relations of peasant dependency. If we can summarize this complex situation, it would seem that production and exchange among the élites were dominated by gift exchange, but at more basic levels renders of food and services were predicated on relationships of subordination and dependency.

Coinage was used, in a way we do not yet understand, to link the systems of craft production and that of long-distance trade. As such, it should be connected both with the sphere of prestige goods exchange and with peasant production. Although we do not fully understand the nature of this connection, we can be sure that, at this stage in the development of the Anglo-Saxon economy, money did not provide the overall rationale for the operation of the system (for a partial explanation, see Jones 1993:661–63). To argue that it did is to ignore the evidence for the *mores* and values of the period which all point to the personalized nature of exchange.

The Anglo-Saxon economy of the eighth century was one in which 'economic' activities were still structured through personal relations rather than through the mechanism of the market. In that respect, it bears a strong resemblance to aspects of the economy of the late Roman empire, where, argues C.R.Whittaker '[a] good deal…of produce was moved internally, as it were, between domainal estates. Ausonius moved wine by cask from his Garonne estate to another of his estates at Saintes…just as Gregory transported timber to Rome from his papal estates in Bruttium' (1983:171). This observation is supported by Averil Cameron, who suggests that

> [w]hile…a landlord might well become involved in production and engage in long-distance transport, both might take place within an exchange system involving either simply his own estates, or those of himself and his friends; this is less an economic activity than a patronal relationship.
>
> (Cameron 1993:89)

It must be emphasized that I am not here offering support for an autarkic early Middle Ages. I am not here talking about 'l'économie domaniale fermée' (Devroey 1984:570), a closed manorial economy where all production and exchange took place within the bounds of estates. I am arguing that it is a mistake simply to assume that there were whole periods of the past in which only a *single* system of production and exchange operated. We have to envisage a network of relationships which linked the peasant in the Upper Thames valley, the lord in his villa, the craft producer at Hamwic, the king at Winchester or one of his other palaces; and a web of connections which linked this system with others—organized along the same lines or not—stretching across the North Sea into the Baltic and from there as far as the silver mines of the Far East.

We also have to remember that this was not a static situation. The texts and the archaeology all point to the growing importance of coinage from the ninth century onwards. In addition, the documentary evidence suggests that the transfer of land from one person to another, and outside kin relations, became more frequent at the same time, and that the documents were themselves a fundamental part of the process (see Kelly 1990; for the importance of texts in the process, see Moreland 1992). However, it is likely that most production and exchange remained socially 'embedded' throughout the Anglo-Saxon period. Money and the market were condemned by ecclesiastics right through the medieval period, and the clamour of the Church against the market reached its height at exactly the time (the thirteenth century) when we know that 'the market' was making real inroads into traditional means of production and exchange (Le Goff 1988). However, as Le Goff says, '[o]ne economic system replaces another only after it has passed through a long and varied obstacle course' (Le Goff 1988:93), and the evidence for the eighth and ninth centuries suggests that the obstacle course from gift and render to monetary exchange had not yet been completed. As the next section describes, archaeological evidence from Morocco suggests that the process was still not completed by the beginning of the modern world.

Morocco in a world system

Qsar es-Seghir is situated on the southern shores of the Straits of Gibraltar which separate Spain and Morocco. This location, at the crossroads of the Islamic and Western worlds, and controlling the entrance to and exit from the Mediterranean basin, made it a site of some importance in the developing world systems of the late medieval period (Fig. 16.7). The archaeology and history of the settlement are now well known due to the research carried out by Professor Charles Redman and his colleagues, and much of what follows is based on that work (Redman 1986).

The settlement appears to have been founded in the eighth century AD as a small fort, with an associated village, designed to provide a focus for the movement of

Islamic troops to and from Spain. Although the Islamic invasions of Europe provided the settlement with its original rationale, it only developed as a major settlement in the late twelfth century (Redman 1986:235). Between the eleventh and the fourteenth centuries, Qsar es-Seghir may have been one of a series of coastal entrepôts funnelling the products of long-distance trade from sub-Saharan Africa into Spain (Redman 1986:25). It reached a zenith in the fourteenth century, but the changing military, religious and economic circumstances of the following century resulted in major transformations in the fortunes of Qsar es-Seghir.

The town was conquered by the Portuguese in 1458, part of the more general *Reconquista* of Islamic territory by the kings of Spain and Portugal. However, this *Reconquista* cannot be seen as motivated purely by religious zeal. The world was at a crucial juncture. What has become known as the 'modern world system' was in its early stages of development (Wallerstein 1974) and this development needed infrastructural support. As Redman (1986:33) notes:

> Europe was in need of increasing amounts of gold to fuel the growing monetary economy of the era and raw materials for productive industries. The major source for the gold was sub-Saharan Africa, and the traders and trading cities that brought it to the Europeans were those in North Africa. Clearly, to control these trading centres would give a European power tremendous advantages in the growing monetary economy.
>
> (Redman 1986:33)

The historical and archaeological evidence indicates that, with the Portuguese conquest the settlement was isolated from the surrounding countryside (Redman 1986: 11). At the same time the Portuguese, and other European kingdoms, had begun to exploit the new trade routes opened up by the 'voyages of discovery' (see Wolf 1982). The products of sub-Saharan trade via Morocco became less important to the growing European economies and Qsar es-Seghir was abandoned in 1550.

The excavations at Qsar es-Seghir recovered thirty coins from the levels of Islamic occupation. Of these about two-thirds were high denomination silver or gold. Both the numbers and the type of coins stand in marked contrast to those discovered in the later Portuguese levels. Here were found over two thousand coins, mostly small denomination copper issues (Redman 1986:208). This suggests that the two communities (Islamic and Portuguese) used fundamentally different trading principles. Redman argues that the comparative scarcity of coins in the Islamic community means that '[t]he Muslims must have been able to deal with merchants on personal accounts, suggesting a community where everyone was acquainted and trusted', whereas an indication of a 'less co-operative situation in the Portuguese period was the abundance of coins at that time' (1986:246). In essence, Redman is here using the coins as indicators of the shift from a community in which much exchange would have been carried out without the use of coinage, instead being mediated through personal, and/or kin relationships (we should remember that most

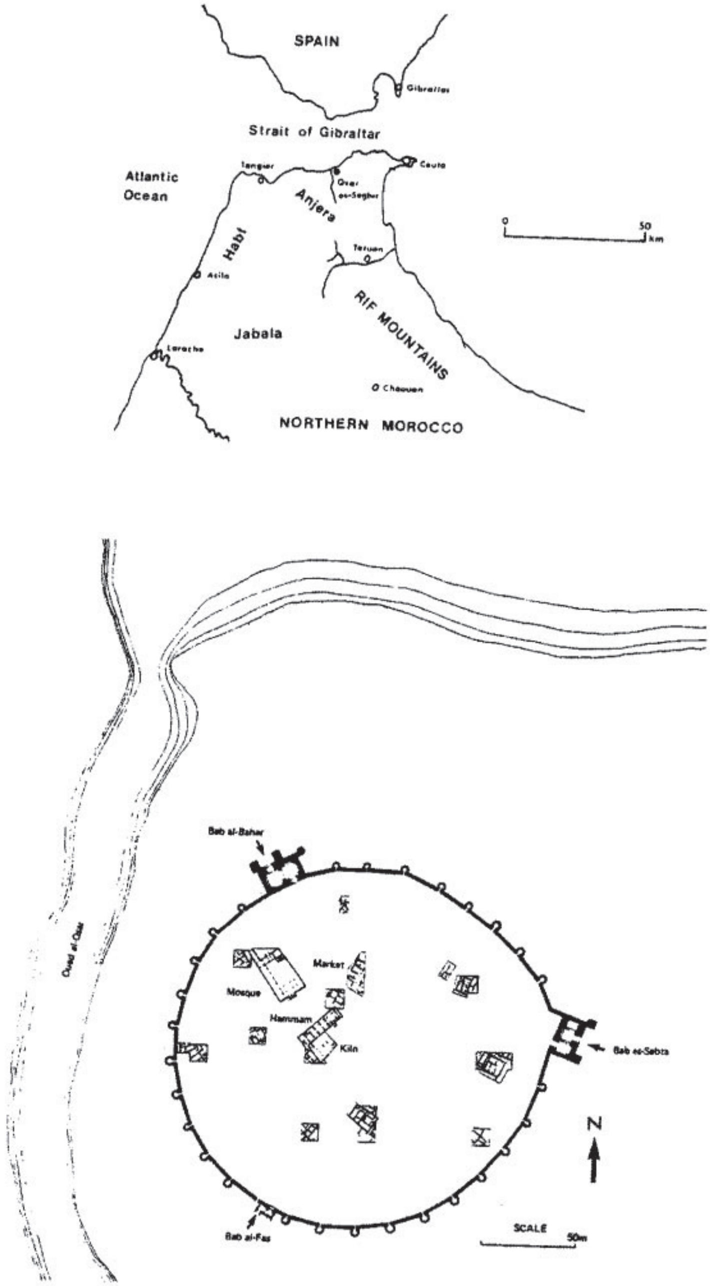

Figure 16.7 The medieval settlement of Qsar es-Seghir, Morocco: location map (above) and site plan (below). Source: Redman 1986.

of the Islamic coins were of very high denominations, useless for everyday economic activities), to one where coinage was used to mediate exchange relationships between both strangers and kin. He argues that this points to a more competitive and a more individualistic community in the Portuguese period; a community which was among the 'first spearheads of a world expansionist movement that was rapidly making Portugal a world power' (1986:247).

The 'Embarrassment of Riches': Holland in the seventeenth century

Holland in the seventeenth century was 'the most formidable capitalism the world had yet seen' (Schama 1987:323). From a region threatened with inundation by the sea, Holland had amassed an Empire and had come to dominate much of world trade (for the archaeology of this trade, see Gawronski 1990). The fruits of this trade produced what Simon Schama has called an 'Embarrassment of Riches': Dutch society in the seventeenth century was phenomenally wealthy. At the same time Calvinism was the most pervasive and powerful religious belief. The Dutch therefore faced the dilemma produced by the accumulation of wealth and the damnation which was the promised consequence of the building up of worldly goods.

One of the strangest, and at the same time most illuminating, episodes of Dutch history in this 'Golden Age' occurred between 1636 and 1637 and has been called the 'great tulip mania' (Schama 1987:350). Tulips originated in Turkey, and in the early decades of the seventeenth century their production and trade were in the hands of specialists. By the 1630s the market had expanded, and by 1634 the desirability of the tulip, especially rare varieties, had grown so rapidly that what we would call 'futures trading' had begun to take place. By 1637 the inevitable collapse took place. This, however, is not the point of relating this story. For this, we have to go back to 1636, to the height of the mania. In that year, at the same time as 'futures trading' was taking place:

> [a] quarter of a pound of White Crowns…were bought for fl. 525 to be paid on delivery together with four cows paid at once. A one-pound Centen was paid for by fl. 1,800 and immediate transfer of a 'best shot coat, one old rose noble and one coin with a silver chain to hang around a child's neck'…In all likelihood it was a farmer who paid fl. 2,500 for a single Viceroy in the form of two *last* of wheat and four of rye, four fat oxen, eight pigs, a dozen sheep, two oxheads of wine, four tons of butter, a thousand pounds of cheese, a bed, some clothing and a silver beaker.
>
> (Schama 1987:358)

These sales reveal the 'strangeness' of this phenomenon. That such an apparently humble item should be sold for such vast sums is strange enough to us. However, that strangeness is compounded when we look again at the objects exchanged.

'Futures trading' was taking place at the same time as farm produce (in large quantities) was being exchanged for tulips. This does not seem to be economic activity concomitant with Holland's status as 'the most formidable capitalism the world had yet seen' (Schama 1987:323). However, it does make the point that even in this very 'advanced' economy, money was not necessarily the only medium of exchange. These were exceptional circumstances to be sure, but the fact that such exchanges could still take place shows that at least the *mentalité* behind such exchanges persisted.

It would be no exaggeration to say that in this respect the Dutch were closer to the morality of the Middle Ages than that of the modern world. The warnings of the ministry and the magistracy about the dangers of the wealth generated by Holland's overseas trade stemmed from the abhorrence of 'riches acquired without labour' (Schama 1987:347), and were a strong echo, across the centuries, of Thomas of Chobham's thirteenth-century condemnation of usury:

> The usurer wants to make a profit without doing any work, even while he is sleeping, which goes against the precepts of the Lord, who said 'By the sweat of your face shall you get bread to eat' [Gen. 3:19].
>
> (quoted in Le Goff 1988:42)

In the thirteenth century, exceptions to the universal and unambiguous condemnation of usurers to damnation were being 'discovered'. Amongst these was the development of the concept of Purgatory, a 'half-way house' between Heaven and Hell to which the sinner was condemned for a limited period (for a full discussion, see Le Goff 1984), and an increased emphasis on the notion of contrition. According to Le Goff, the development of the concept of Purgatory was important not just for the soul but for the development of the economic system. He writes that

> Purgatory was just one of the complicitous winks that Christianity sent the usurer's way during the thirteenth century, but it was the only one that gave him unrestricted assurance of Paradise. Purgatory was *hope*...The hope of escaping Hell, thanks to Purgatory, permitted the usurer to propel the economy and society of the thirteenth century ahead towards capitalism.
>
> (Le Goff 1988:92–93)

The transformation in medieval attitudes to money may indeed have engendered changes in conceptions of labour and trade which helped the transition to capitalism (as well as allowing the usurer to eventually enter Paradise) but, as we have seen, remnants of such thought could still be found in seventeenth-century Holland, 'the most formidable capitalism the world had yet seen' (Schama 1987:323) and, if we believe Nicholas Thomas, Maurice Bloch and Jonathan Parry, they persist in the writings of anthropologists today.

Conclusion: 'Gnawing it out' in the heart of England

In 1942 Walter Rose published his memories of childhood in Buckinghamshire in the 1870s and 1880s (Reed 1990:85). He recalled that

> [a] large part of the trade within the village was carried out on a system called gnawing it out—a method something like the primitive trade by barter in days before coin came into general use. The butcher having had his cart repaired by the wheelwright, rather than part with ready cash, expected the wheelwright to run up a bill for meat in settlement.
>
> (cited in Reed 1990:85)

This was in the heart of England. This was the time when the British Empire was at its height, when the products of Empire filled British warehouses and when British colonial administrators ran one of the biggest economic and political systems the world had ever seen. In Buckinghamshire they were still 'gnawing it out'.

The point here is not to produce an exceptional example to show the strangeness of the past. Rather, I have been trying to argue that, at all periods of the past, modes of structuring production and exchange coexisted and interacted. The butcher and the wheelwright in this example may well have been 'gnawing it out', but they still had coins in their pockets with which they would rather not part for the purposes of this kind of exchange. However, they were still connected to, and participated in, the wider regional, national, and international systems of production and exchange. Pre-capitalist forms of exchange could coexist and articulate with capitalist forms in nineteenth-century Buckinghamshire, just as exchange through coinage coexisted with the personalized systems of production and exchange in the early Middle Ages. We shall always fail to understand the complexity of the situation, and the lived reality of the historical past, if we impose singular categories such as 'gift-exchange', 'capitalism', 'pre-capitalist', 'tributary', on that past. Only archaeology and history can provide us with the level of detail which we need if we are not to submerge the people of the past under the 'sameness' of a capitalist present or an undifferentiated 'otherness' derived from anthropology.

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The anthropology of production and exchange has been the subject of much discussion in the past. Sahlins (1974) must still be an essential starting point. More recent thinking on the notion of gift-exchange is presented by Thomas (1991), while archaeological approaches are summarized in Renfrew and Bahn (1991:307–8). It is still worth consulting Mauss's original essay on 'The Gift' (1967) for some of the nuances of his argument. Production and exchange in the early Middle Ages in north-west Europe is best analysed by Hodges (1989); for the other case studies cited, it is best to refer to the original publications: Redman (1986) and Schama (1987). More general pictures (but based on a wealth of detail) of production and exchange in the early modern world are produced in the magisterial works by Braudel (1981, 1982) and Wolf (1982).

17

POPULATION DYNAMICS

Fekri A.Hassan

Thus my little ones will speak of me,
As long as they travel in life's path
An Omaha song

INTRODUCTION

Population dynamics are inexorably linked to cultural events, as is clearly shown by pronounced demographic transformations accompanying major cultural transitions. In archaeology, the emergence of an interest in the cultural processes that have shaped our archaeological past (Childe 1936) fostered an examination of aspects of prehistoric populations related to subsistence and settlements. A particular emphasis was placed on estimating population size and density, as in the pioneer syntheses by Howells (1960) and Cook (1972). In 1968, Lewis Binford introduced population increase as a possible mechanism in the transition from hunting-gathering to agriculture, blasting a new trail of archaeological inquiry on the role of population growth in major cultural transitions (see Chapter 21). *Population Growth: Anthropological Implications* (Spooner 1972) set the stage for further avenues of future investigations, including a convergence with the studies undertaken by physical anthropologists interested in the lifespan and vital statistics of prehistoric populations (Vallois 1960). The pioneer work by J.L.Angel was extremely influential: his emphasis on the relationship between palaeodemography, palaeoecology, and health (Angel 1975) highlighted the importance of the study of palaeopathology as a means of assessing the relationship between health, disease and the fertility and mortality of ancient populations.

Palaeodemography, as used first by Acsádi and Nemeskéri (1957), Brothwell (1971) and Angel (1975) refers to the estimates of the biological population parameters from a study of skeletal remains. Such estimates include fertility rates and mortality rates, population structure, and life expectancy. With an increasing interest in the role of demographic variables in prehistory, and as a consequence of my early work on population growth during the Neolithic, *Demographic Archaeology* (Hassan 1981) presented a comprehensive overview of this budding field. In addition to encompassing the sister field palaeodemography, demographic archaeology deals with the use of archaeological, ecological, historical, and ethnographic data to estimate the size and density of local and regional populations, population growth rates, patterns and rates of population dispersal and migrations. These archaeodemographic data are utilized to explore the links between population dynamics and cultural events in prehistoric and pre-industrial societies.

During the last two decades, population studies in archaeology have shown that our understanding of social history can never be fully achieved without a full awareness of population dynamics. Social processes are a result of actions by human communities: the numbers, composition, and density of a community, as well as its variability in time and space, are crucial for comprehending the cultural pool of ideas, artefacts, and language. Moreover, no clear understanding of human evolution, population expansion and diffusion can be achieved without a determination of the growth rates, the relationship between resources and population movements and innovation, and the rates and patterns of population dispersal. The major transitions in the history of humanity are definitely associated with characteristic demographic parameters (M.Cohen 1995). Demographers often refer to *the* Demographic Transition, the change in population parameters in the wake of industrialization (Weinstein 1976; Wrigley 1971; Zelinsky 1979). However, there have been other major transitions, notably those following the emergence of our immediate ancestors *(Homo sapiens sapiens),* the advent of agriculture, and the establishment of towns and cities. The ingenuity and social organizational skills of modern humans created the potential to cope with natural scarcities and enable fertility to increase, promoting a relatively fast increase in world population.

Agriculture created new opportunities, promoting an increase in population size and density as well as the emergence of modes of social organization that in turn became a major incentive for both agrarian developments and economic growth. The emergence of the first cities created an unprecedented demographic situation that fostered the elements of our contemporary civilization. Before cities, the emergence of a cultural landscape crowded (relatively speaking) with large permanent communities, enabled regional differentiation and the development of fairly independent political units, thus establishing the foundation of state societies. Cities and agrarian states developed at different rates and tempos in different regions, creating a flux of people and ideas. Next to settled farming, nomadic pastoralists with their own demographic profiles interacted with settled farmers, causing major historical changes in the distribution and pattern of world populations.

In spite of regional variations in demographic conditions and short-term temporal fluctuations, world population as a whole has followed a course of population increase with varying rates since the inception of agriculture. At times, world population growth slowed down. There are also occasions when numbers were dramatically reduced. The dynamics of demographic transitions and social change are fascinating, and the exploration of the role of population in social affairs provides a corrective to historical theories that are divorced from the lives of ordinary people who make and change history. The number, density, and distribution of world populations influence production, markets, warfare, and politics (Thomlinson 1965). Both historical demography and demographic archaeology are essential for exploring the long-term dynamics of population and social change.

Our present concern for population and development (Cassen 1994; J.E.Cohen 1995) is an echo of human voices that are at least as old as 1600 BC, when overpopulation was feared in Mesopotamia (J.E.Cohen 1995:5). The study of the archaeology of human populations provides us with a sharper view of our present and helps us reflect on the future. From an archaeological perspective, the recent reduction of infant and child mortality and the prolongation of life expectancy in industrial nations, and the incredible numbers of people now alive, and the explosive rate of population growth in many para-industrial countries, are simultaneously astounding and alarming. Are we facing a time bomb? Has it already exploded? Or is all this talk of overpopulation an exaggerated doomsday vision? In this contribution I hope to sketch out the outstanding aspects of our demographic ancestry and explore the links between population dynamics and culture in the long prelude to the present. Inevitably in this topic, empirical data are still scanty and often misleading, and we can only hope to make plausible accounts of the past guided by the primary principles that structure population dynamics.

POPULATION PARAMETERS

The dynamics of a population may be described in terms of spatial or temporal variability. The spatial patterning of a population (for example, density, aggregation, dispersal, migrations, size hierarchy) are often included under the rubric of 'population geography'. Most population studies, however, are concerned with changes in the size and composition of a population through time. Temporal change in the number of a group is a function of three variables: number of births (fertility), number of deaths (mortality), and number of migrants (Newell 1989; Pressat 1972). A population will increase if the number of births and/or immigrants exceeds the number of deaths, and will decline if the number of deaths is persistently greater than the number of births and/or immigrants. This simple model becomes rather complicated when we consider that the numbers of births, deaths, and immigrants are in turn related to many variables such as age at marriage, sex ratio, age-specific fertility and mortality, disease, diet, and child-spacing practices. These variables are in turn related both to natural and cultural factors that vary from one population to another, and are also subject to historical change.

To estimate these parameters for past populations, information is obtained from the study of human skeletal remains and archaeological data (see Chapter 7). Palaeodemographic analysis of skeletal remains depends on the ageing and sexing of bones, as well as on certain assumptions about the stability of the population (Acsádi and Nemeskéri 1970; Brown 1995; Gage and Mode 1993; Horowitz *et al.* 1988; Howell 1976, 1986, 1992; Johansson and Horowitz 1986; Konigsberg and Frankenberg 1992; Sattenspiel and Harpending 1983; Saunders *et al.* 1992; Weiss 1973, 1976; Weiss and Smouse 1976). This type of analysis was criticized by Bocquet-Appel and Masset (1982), creating an ongoing debate (Jackes 1992; Konigsberg and Frankenberg 1994; Roth 1992; Saunders *et al.* 1992).

In addition to estimates based on the study of palaeodemographic analysis from skeletal series and by analogy from ethnographic cases, computer simulations may provide additional insights (Buikstra *et al.* 1986; Dyke and MacCluer 1975; Roth *et al.* 1984). Independently, all of these sources are not likely to provide accurate estimates of population parameters. Nevertheless, cross-checking data from different sources and different contexts can provide a basis for judging the adequacy of demographic inferences in archaeology. One notable example is the synthesis by Jaffe (1992) of the population history of Amerindians. Jaffe compiled, gleaned, and synthesized data from disparate and far-flung sources: archaeological and palaeodemographic 'guesstimates', census data, and historical accounts. In addition, he developed separate life tables for those Amerindians who practised agriculture and those who did not.

Archaeologists utilize settlement data (for example: Rice and Culbert 1990; Roche 1983; Zorn 1994), mortuary data, food remains, and artefacts, to determine the size, density, and growth of prehistoric populations (Hassan 1981), subject to certain assumptions and by reference to ethnographic analogues. Schlanger (1988) and Schlanger and Wilhusen (1990) presented not only a credible estimation of population growth and immigration in south-western Colorado, but also provided an insightful analysis of the fit between climatic change and population history. The contributors to *Precolumbian Population History in the Maya Lowlands* (Rice and Culbert 1990) provide an impressive display of the application of archaeological methods to develop the population history and population size of urban centres.

Historical data are also used to generate population data (for example, Broshi 1979; Russell 1958). The combination of data culled from palaeodemography, demographic archaeology and historical demography provides a basis for making certain inferences on ancient populations. The validity and adequacy of any explanations of population dynamics in the past rest both on the reliability of the estimates of primary population indexes, the logical coherence of the theoretical assumptions, and consistency of the data and the structures of explanation within the existing body of knowledge.

POPULATION GROWTH POTENTIALS

Were hunter-gatherers often at the brink of extinction besieged by diseases, food scarcity, and accidents, their numbers controlled by their short life and high infant mortality? Was their mobility the cause of low fertility, so that as soon as they settled down they began to show higher fertility rates? These questions and current debates concerning the determinants and controls of the rates of population growth before and after the transition to agriculture may be clarified by a consideration of the population growth potential of pre-industrial populations. This may be based on a determination of the length of the reproductive span and the 'natural' birth interval. With a long reproductive period and short live birth intervals, we should expect fertility to be high. The number of female live births that survive to child-bearing age and of females living until menopause will determine the reproductive potential of a population.

Women and men in prehistoric times died fairly young (Table 17.1; Fig. 17.1). The average age at death for adults was between 32 and 40 years (Angel 1972, 1975); women, in general, died a few years younger, and also reached menarche at a much older age than females in industrial societies, so the reproductive period was relatively short. With no cultural interference, the time interval between successive births (natural births interval) is about twenty-eight months (Barrett 1972).

Table 17.1 Average age at death for adults (15 or older)

Australopithecines	28 yr	Roman (Imperial)	40
Homo erectus	>30	Byzantine	38
Early *Homo sapiens*	33	Medieval	35
Upper Palaeolithic	32	Middle Ages (England)	33
Homo sapiens		Turkish	31
Epipalaeolithic (Natufian)	33	1687–91 (Breslau)	33.5
Neolithic (Çatal Hüyük)	32	Before 1789 (US)	35.5
Hunter-gatherers (historic)	41	1838–54 (England and Wales)	40.9
Early Bronze Age	34	1900–2 (US)	49.2
Late Bronze Age	39	1946 (US)	66.7
Mycenaean	36	1961–5 (Sweden)	73.6
Early Iron Age	39		

Sources: Data from Angel (1972, 1975), Pressat (1972).

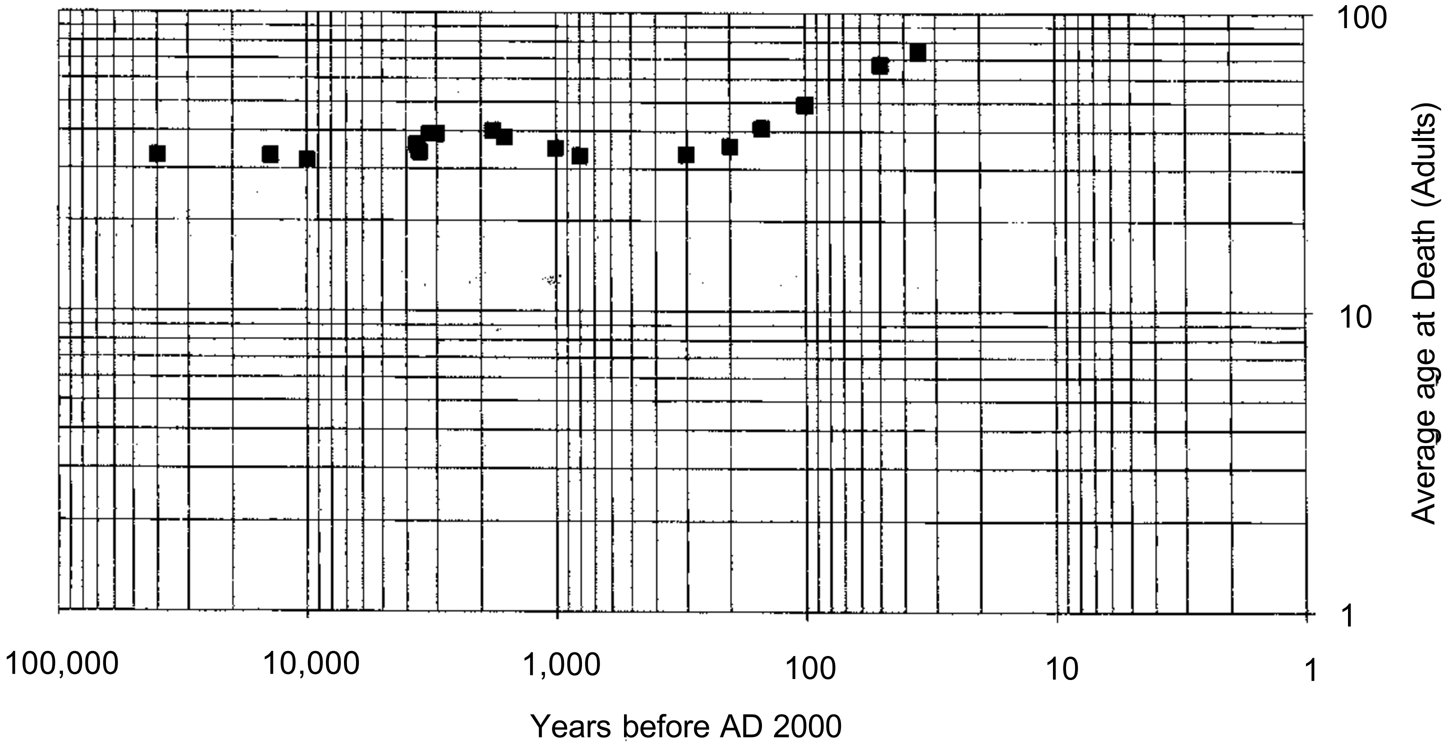

Figure 17.1 Average age at death for prehistoric and historic populations. Note a dramatic change beginning about 100 years ago. The recent high values are for industrial populations. Average ages at death for people in rural communities are still low. Source: F.Hassan.

Under prehistoric conditions, many children died before reaching adulthood: estimates range from 40–50 per cent of all born infants. However, even under these conditions a population can grow as fast as 1–2 per cent. This rate, however, is often reduced because the child-spacing period observed among most hunter-gatherers and farmers in non-industrial settings is between three and four years. In many contemporary agricultural (non-industrial) populations, as among Punjabi women, the age at marriage is about 17–19, and the end of the reproductive span is at about 34–37 years (Nag 1962). These women show a total fertility of 7.5, and rates of 1.5 per cent to 3 per cent are common among such populations in many parts of the world. In the traditional bands of the !Kung, often considered somewhat as analogues to prehistoric foragers, females have menarche at 16.5, first birth at 19.5, and long lactations of 42 months. The mean age at final birth is 34.4 years. A person expects to live 34 years from birth. Of all infants born, only 59 per cent survive to age 20 (Howell 1979). The number of live births per female is 4.20, which compares favourably with a range of 4.14 to 4.7 for the !Kung (Harpending 1976). Simulations by Howell (1979) reveal that a range of annual growth rates from –0.045 per cent to +0.047 per cent among the !Kung may be due to random variations.

CULTURAL PRACTICES AND POPULATION DYNAMICS

The dynamics of population growth are closely linked with diet, health, disease, and social norms and values. The social values are, in turn, linked with subsistence and economy, but the link is neither unidirectional nor necessarily harmonious. This is especially true in complex societies consisting of different socio-economic groups who may have different moral or social attitudes towards procreation or population controls. They may also have different political and economic interests.

In general, a model of population dynamics must take into consideration two factors: first, conditions that influence people regardless of their values or decision criteria (such as epidemics, or changes in food abundance due to climatic resources) and second, the family—the fundamental unit of reproduction. The family makes decisions concerning marriage and family planning. Their decisions may be made on the basis of the social and economic benefits of children relative to the cost of rearing children given the parents' expectations. The costs may be both economic and non-economic—social and psychological. Economic costs include the costs of food, clothing, sheltering, education, and health care, which may negatively affect the family's standard of living and the family savings and investments.

In many rural communities the desired size of a completed family (the number of surviving children in a family whose mother has completed her child-bearing period) is large, with a special preference towards males. Continuity of family name, support in old age, as well as a large labour force and social power, are perceived to be advantages associated with a large family. As long as there are work opportunities and as long as the cost to raise children is low, the preference towards a large family may persist.

CARRYING CAPACITY

Carrying capacity has become one of the fundamental notions in archaeological discussions of ancient populations (Chapman 1988; Dewar 1984; Hayden 1975). In general, the usage of the concept, first developed by ecologists, was linked with the potential number of people that can be supported given existing food resources. Carrying capacity, as used by ecologists, refers to the maximum population that can be supported in a given area under given conditions. The concept, however, is problematic, and must be applied with major modifications to human populations (Hassan 1981). First, we must acknowledge the role of human populations in changing economic conditions and so lifting or depressing carrying capacity. In addition, the term should be considered in a temporal dimension, with a consideration for changes in yield from subsistence activities subject to natural or cultural causes. Moreover, the number of people that can be sustained depends on the rates of consumption—not only of food resources, but also of other resources regarded as essential for a desirable standard of living. We must also consider the fluidity of spatial boundaries, as well as the changeable size and composition of the group, especially among hunter-gatherers.

The major modes of subsistence—foraging, farming, pastoralism, fishing, sea-mammal hunting, and modern agro-business—are all characterized by differences not only in carrying capacity but also in the *potential* to increase carrying capacity, and in the yield, quality, seasonality, concentration, storability, and spatio-temporal fluctuations of resources. For any subsistence regime, the amount of yield that can support people depends on resources of labour, management, knowledge, and technology. In modern farming conditions, it also depends on fossil fuels and other sources of energy and capital. In addition to major developments in technology, from using a chopping-tool to extract more meat from a carcass to genetically improving cultigens, changes in population respond also to the change in the labour requirements brought about by a transition from one mode of subsistence to another. Demands for a large labour force, as in farming communities, not only encourage greater fertility but also encourage the aggregation of groups in larger units. With a concentration of resources and higher yields, people can also reside permanently in villages.

One of the major difficulties with carrying capacity in archaeology is ‘operationalization’. Hayden (1975), for example, points out that it is difficult to calculate carrying capacity, and that the variability and cyclical nature of resources are not taken into consideration. Dewar (1984) suggests that carrying capacity is a conflation of functions for potential resources and technology, and a measure of the upper limit for population density. He also argues that it is difficult to demonstrate that human populations are density-dependent. The application of the concept of carrying capacity will continue to be a subject of debate and controversy, but it is important to realize that the concept is not applicable to human populations without significant overhauling. It is also essential to note the following considerations: the roles of diet, labour, and technology in defining the productive potential of a population; people do not respond culturally to a hypothetical long-term mean, but to variations that are within their knowledge domain; response by a human population to an environment is not limited to certain kinds of food but to a wide range of resources depending on economic expectations and standard of living; regulation of human population, and indeed many other animal populations, is neither solely nor strictly determined by factors related to population density relative to a presumed level of production; and models of 'economic rationality' and 'economic optimization' may not be the most appropriate in populations with limited knowledge and goals different from those prevailing in market economies.

POPULATION REGULATION

The potential for rapid population increase under natural conditions among hunter-gatherers, even with high infant mortality and short life expectancy, leads us to consider the means by which prehistoric populations would have been kept sufficiently low to explain the extremely low population density by the end of the Pleistocene before the adoption of agriculture. It has also been proposed that prehistoric populations were automatically regulated by a long breast-feeding period, suppressing the ability of the female to conceive (Wood 1990). Prolonged lactation, however, is not sufficient to regulate the population to the desired socio-economic levels. Nevertheless, frequent breast-feeding and late weaning must have extended the child-spacing period, thus relatively dampening fertility. Prolonged lactation provides infants with adequate nutrition and protection from diarrhoea-producing bacteria. Mother's milk also reduces the risk of respiratory infection (Kent 1987: 616). Children also receive more care and attention than they would otherwise if there are too many other children of similar age.

The long period of child-spacing cannot be viewed as an effective regulatory mechanism, because it does not eliminate the stochastic increase and decline of a population that characterizes small populations. Other expedient controls are necessary to regulate the population in order to maintain an adequate standard of living. Accordingly, it is important to consider population regulation in Antiquity as a result of decisions based on perceptions of either an undesirably large population or an insufficient population size. Lacking an overall view of the population as a whole and a centralized management of fertility and mortality, decisions are likely to have been made by individuals and families on the basis of cues related to their own conditions. The cues for an excessive population increase can be reflected in an increase in the ratio of dependants to producers (more children than they can feed), an increase in the number of children (interfering with the woman's ability to gather food, undertake domestic activities, and care for other children), or any other cues related to diet, work, and acceptable levels of social welfare.

Population regulation could be achieved through a variety of behavioural controls, such as abstinence, celibacy, delayed or restricted marriage, reducing the frequency of coitus, the practice of *coitus interruptus,* contraceptives, induced sterility, abortion, infanticide, or preferential homicide (Harris and Ross 1987). Data on legal abortions, for example, suggest 260–450 such abortions per 1,000 live births (Peters and Larkin 1979). Abortions are also very common among non-industrial groups and are regarded as a universal practice (Harris and Ross 1987). Nurge (1973:12) suggested that the rate of abortion during the Pleistocene may have amounted to 10–25 per cent. Infanticide, a common practice among all human populations, is presumed to have been widely practised in prehistoric times (Harris and Ross 1987).

The checks on population can be subdivided into those that have an immediate impact on the extant population size and composition, such as abortion, infanticide, and homicide, and those that would have a delayed effect, such as marriage rules, timing and frequency of coitus, contraceptives, induced sterility, and induced morbidity. They may also be subdivided in terms of their efficacy. One can argue that, under severe conditions of population/resource imbalance, infanticide is likely to be the most efficacious and speedy mechanism to prevent an additional increase in group size. The alternatives are highly disruptive to social order, and include high morbidity, indiscriminate infant mortality, violence and aggression, as well as sexual aberrations (Welinder 1979:54).

Regulation of a population is not to be equated with deliberate population checks. The practice of a prolonged child-spacing period is a regulatory mechanism even if it is practised to safeguard the health of the mother or the survival of existing children. Poor health during periods of scarcity, or as a result of poverty in a system of inequality, influences many population parameters. In addition, when a population is fixed to a certain level with minor or wild oscillations (as, for example, during the Pleistocene or in the ancient civilizations), a model of population equilibrium is sometimes hypothesized (Wrigley 1971). Over hundreds or thousands of years, with the prevalence of specific conditions of fertility and mortality, the population grows, declines, or remains stationary within a certain range. Before and after the prevalence of such conditions, cultural change will bring about changes in the factors influencing fertility and mortality. As long as such conditions prevail, a new 'platform' will be reached. We may thus view the population history of humankind in terms of phases or situations of certain fertility and mortality parameters that are markedly different.

HUMAN EVOLUTION AND POPULATION GROWTH

It was believed at one time that early human populations were malnourished, ridden by disease, and hardly capable of survival, but recent investigations of the skeletal remains of prehistoric peoples, archaeological sites, simulations, as well as studies of contemporary hunters and gatherers, have revealed that early human populations were, in general, much better off than previously believed (M.Cohen 1995). It is also evident now that such populations were potentially capable of producing more children than were required for replacement and that they practised birth control. However, population growth during the Pleistocene was drastically lower than the current world population growth rate.

In general, the size of early hominid populations was exceedingly small in comparison with the present human population. The early populations of *Homo sapiens sapiens* were also comparatively small. Deevey (1960) estimated the size of populations during the Lower Palaeolithic, Middle Palaeolithic, Upper Palaeolithic, and Mesolithic as 0.125, 1, 3.34, and 5.32 million, respectively. Birdsell (1972) provided estimates for the Lower Palaeolithic, Middle Palaeolithic, and Upper Palaeolithic of 0.4, 1.0, and 2.3 million. In 1981, I recalculated the probable density and distribution of the populations and arrived at estimates of 0.4, 0.8, 1.2, 6, and 8–9 million for Basal Pleistocene, Lower Palaeolithic, Middle Palaeolithic, Upper Palaeolithic and Mesolithic/Epipalaeolithic populations respectively (Hassan 1981:198–99).

The overall trend of world population growth shows an increase from a few millions by the end of the Pleistocene to about 100 million by 2500 BP and about 230 million by 200 BC (Table 17.2; Fig. 17.2). From 200 BC to AD 1000 the world population fluctuated between 200 and 250 million, with no appreciable gain over 1,200 years! A spurt of increase after AD 1200 and again after AD 1500 led to an increase to 545 million by AD 1650. The world population then began to soar, with a noticeable acceleration in growth rate leading to a total population approaching a billion in the early part of the nineteenth century. Within the span of the following two centuries, the world population achieved an all-time record high of population growth rate approaching 2 per cent after 1975. In 1994, as representatives from world nations gathered in Cairo to debate population issues, the world population had reached 5.66 billion.

By comparison with the historical rates of increase, and particularly the growth rates during the last two centuries, the Palaeolithic growth rates, and even the

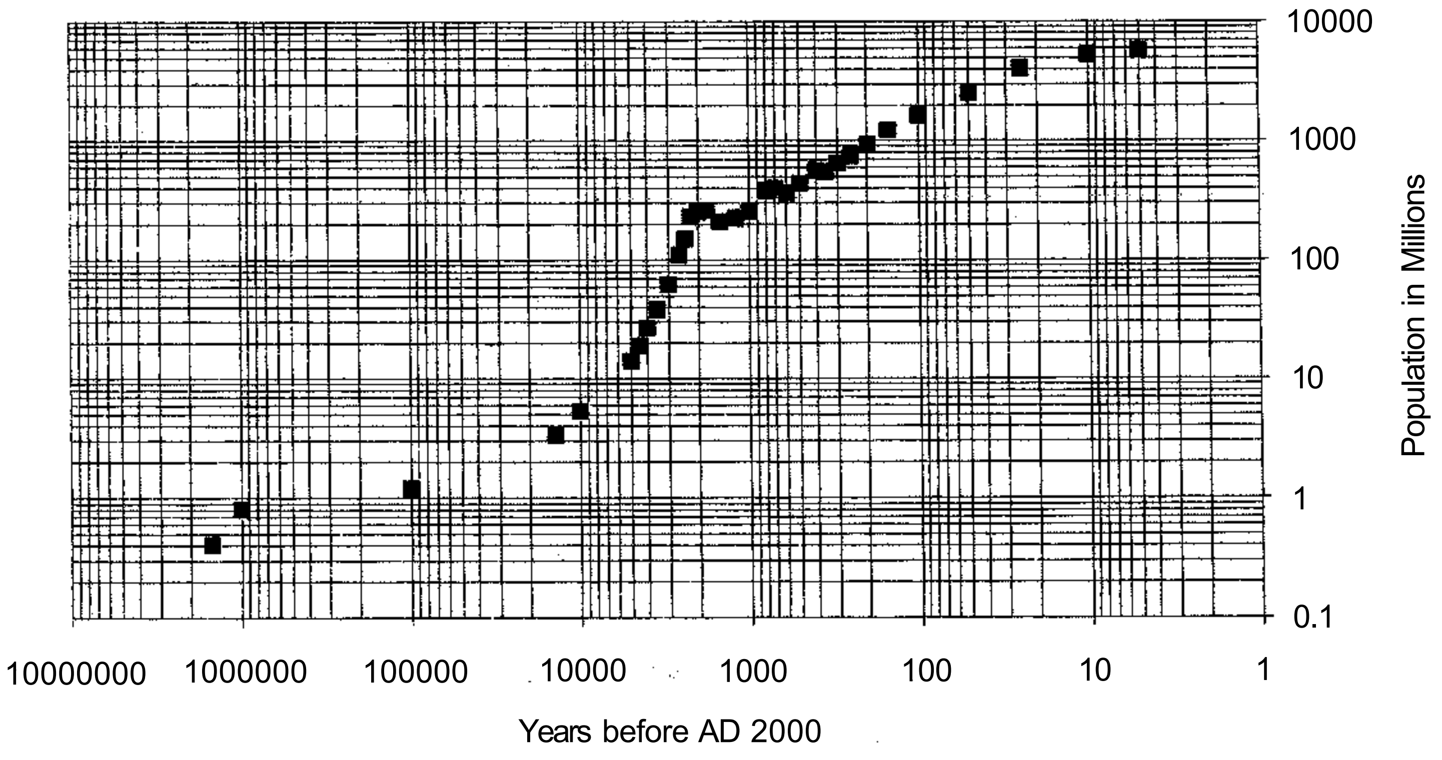

Figure 17.2 Global human population increase in the past 10,000,000 years. Note that the scale is log-log (logarithmic scale for both population and time). Source: F.Hassan.

Table 17.2 General trend of world population

Period	*World population (in millions)*	*Growth rate (% per year)*	*Doubling time (in years)*
Basal Pleistocene	0.4		
1,500,000 BP	0.8	0.00007	1,000,000
100,000 BP	1.2	0.00054	140,000
140,000 BP	3.3	0.0039	18,000
8000 BC	5.3	0.0088	8,000
3000 BC	14	0.032	2,000
2500 BC	19	0.061	1,000
2000 BC	27	0.070	1,000
1500 BC	38	0.068	1,000
1000 BC	62	0.098	700
600 BC	110	0.143	480
400 BC	153–162	0.164–0.194	420–350
200 BC	225–231	0.193–0.176	420–390
1 AD	252	0.211–0.043	330–1,600
200 AD	257	0.010	7,000
500 AD	207	–0.05	
800 AD	224	0.026	3,850
1000 AD	253–265	0.061–0.084	800–450
1200 AD	360–400	0.153–0.229	450–300
1300 AD	360–432	0–0.074	⇒900
1400 AD	350–375	–0.139 to –0.028	
1500 AD	425–461	0.0194–0.206	3,500–485
1600 AD	545–578	0.226–0.248	300–280
1650 AD	545	0	
1700 AD	610–680	0.225	308
1750 AD	720–770	0.251–0.332	275–200
1800 AD	900–954	0.43–0.446	160–155
1850 AD	1,200–1,241	0.525–0.575	130–120
1900 AD	1,625–1,633	0.55–0.606	125–115
1950	2,513–2,516	0.874	80
1975	4,075	1.93	36
1990	5,292–5,333	1.74	40
1995	5,700	1.49	47

'explosive' growth rates of early agricultural societies, are practically negligible: average annual rates are calculated as of 0.0054 per cent during the Middle Palaeolithic, 0.011 per cent during the Upper Palaeolithic (Hassan 1981:200), and 0.064– 0.0152 per cent for the Upper Palaeolithic (Groube 1996:102). On the basis of the growth rates during the Neolithic in the Near East, the world population during that period has been estimated at 50 million, climbing to this figure as a result of a growth rate estimated at about 0.1 per cent (Carneiro and Hilse 1966; Hassan 1981: 221). In the light of more recent estimates of world population between 3000 BC and the present by Livi-Bacci (1992), Eckhardt (1992) and Kremer (1993), the global figure of 50 million for the Neolithic is apparently too excessive. These estimates provide an average (global) annual growth rate during the early Neolithic of 0.03 per cent (Fig. 17.3).

Undoubtedly, the global average annual growth rates mask short-term and regional variations. The fastest growth rates during the early agrarian cultures, as in the Near East, were on average as high as 0.1 per cent. Peak rates after 3000 BC within the context of agrarian state societies were probably as high as 0.35–0.59 per cent (Blanton 1972). The increase in world population associated with the spread of agriculture altered both the natural and cultural landscape: hunter-gatherers and foragers were absorbed in the tide of agrarian expansion, or either isolated or pushed into marginal agricultural land. Foragers also developed diversified economic patterns which included elements of food production and technology. The numbers of hunter-gatherers are difficult to establish, because in places they might have been subjected to diseases brought about by contact with farming communities. However, symbiosis with farmers and food exchanges could have led to an increase in the population size of others. Nevertheless the total number of foragers is not likely to have exceeded 6–10 million.

In addition to variations on a regional scale, great variations must have also prevailed among small local populations. Given that prehistoric population units were in the range of 400–1,000 persons (20–500 females), consisting of several bands of 25–50 persons each, stochastic variations are likely to have led to frequent episodes of high population growth alternating with others of no growth or depopulation (Wobst 1974). Naturally, this must have been more so for the small bands, necessitating constant demographic flux to maintain the appropriate size of the workforce and to secure mates for marriageable adults.

In addition, fluctuations in the abundance, quality, and distribution of natural resources are likely to have influenced the yield that could be extracted, as well as the size, mobility, and the territorial range of the population. It is thus inevitable that a population would have to engage in inter-population interactions to even out the random fluctuations affecting individual situations. Sometimes, however, the situation could not be remedied by inter-population demographic rearrangements of work mates and spouses, or even whole groups (by processes such as internal migration, external migration, flux, or dispersal), especially when adjacent populations underwent synchronous conditions of population increase, depopulation, or a fall in the productivity or quality of resources. Accordingly, fertility dampening practices and infanticide during episodes of regional population increase were as advantageous as a relaxation of population checks when the threat of depopulation was imminent.

There must also have been another complicating factor: the nature of chaotic dynamic systems, in which a slight change in the initial conditions can lead to unexpected major variations in the outcome (May 1976). Experimenting with the

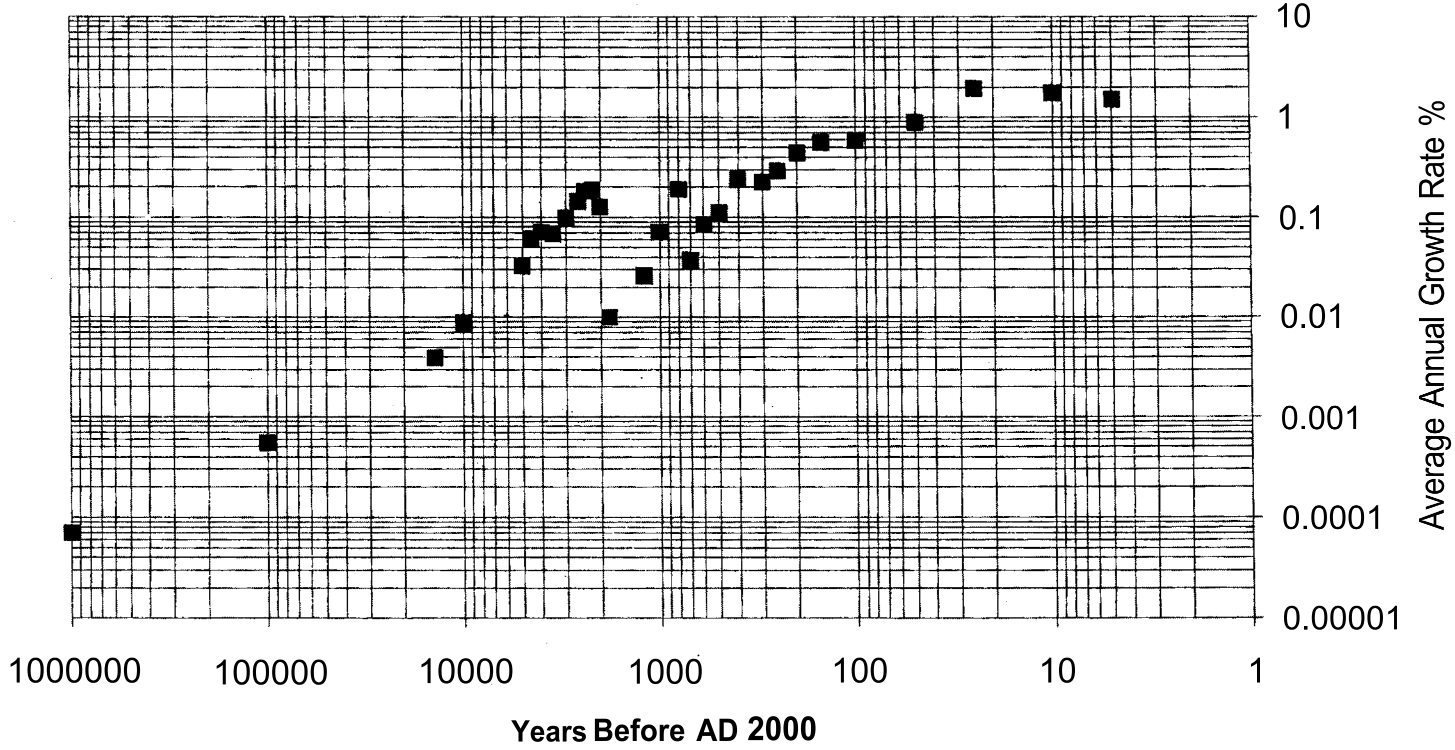

Figure 17.3 Changes in global population growth rates showing that population growth followed a non-linear pattern, with key transitions marked by slowing down or lack of growth following episodes of rapid increase.

impact of variations in the population growth rate on the outcome of population growth using a logistic curve, May discovered that raising the parameter changed not just the quantity of the outcome but also its quality. When the parameter was low, his simple model settled at a steady state. When the parameter was high, the population would break apart and would oscillate between two alternating values. With higher values, more splitting is observed, and at yet higher values the system becomes chaotic, and the population visits many different values.

Small groups are prone to marked random variations, compounded by the erratic fluctuations of the environment, especially those at a scale that could not be recognized and understood by Pleistocene foragers. Jorde and Harpending (1976) suggested that, as people develop mechanisms to cope with short-term fluctuations, they may render themselves less stable in the face of long-term phenomena. Worse still, economic set-backs might have precipitated further fluctuations as, for example, when infanticide influences the sex ratio (the number of females relative to males) and population structure. Stochastic variations may also lead to severe imbalance in the sex ratio. Simulations reveal aberrant sex ratios (as high as 195), which are liable to throw the marriageable generation out of balance because of the lack of suitable mates (Bocquet-Appel and Masset 1982:331). The Pleistocene demographic system was most likely chaotic, with non-linear growth patterns. Population flux, exogamy, migrations, fluid territoriality, and flexible group composition were necessities for overcoming the changing size and structure of regional population. As a by-product of this demographic solution, which ultimately leads to the transmission of genes, ideas, and artefacts from one region to another, we have evolved into a single species with a universal aptitude for culture and with fundamental similarities, in spite of the vast territories we occupy.

The interaction of human populations during periods of migration may in some cases have been disadvantageous to one of the groups, especially between groups with different economies and disease regimes. Such encounters include the impact of colonizing farmers on indigenous foragers, the interactions between pastoralists, foragers, and farmers, as well as the better known example of the impact of the spread of modern populations into territories occupied by foragers and other tribal populations.

In the remainder of this chapter I explore the possible demographic patterns of human populations during the successive cultural stages of human evolution. This will shed more light on the population history of humanity and the linkage between population dynamics and culture change.

PLEISTOCENE FORAGERS

Throughout the Pleistocene, from the appearance of *Homo habilis* to the advent of agriculture, several developments can be assessed from a demographic perspective.

The emergence of these practices may or may not have been directly related to population regulation, but, in as much as they were a part of the dynamic demographic system, they must be considered in attempting to understand population growth rates during the Pleistocene.

The Basal Pleistocene

During the Basal Pleistocene, the earliest hominids were most probably faced with severe problems resulting from food procurement difficulties, inadequate diet, and defence against predators. The situation was aggravated by the long period of infant dependence, which was likely to have posed a heavy nutritional load on nursing mothers, an additional workload, and the burden of carrying the infants during the movement of the troop or band. The birth of 'immature neonates' and the low fat and protein of the mother's milk meant that the breast must be always available and, hence, that the mother had to carry the infant while foraging. Nursing on demand was also likely to have kept early hominids from ovulating during at least a two-year period following birth, thus prolonging the birth interval to 3–4 years. This birth interval is comparable to the 3.5–4.5 years for gorillas (Sussman 1972).

However, with a long child-spacing period, the likelihood of greater maternal drain subjected the females to greater health hazards. The burdened females, as well as the helpless infants, were also likely to be more vulnerable to predation and less effective in securing meat. Meat would have to be obtained from either scavenging or hunting. Scavenging, the most likely practice for obtaining meat at the time (see Chapter 20), would have exposed the females and their infants to competing carnivores. Bipedalism would have also made it difficult for infants to cling to the mother. Nevertheless, bipedal locomotion freed the hands of women to carry an infant and engage in other activities, and allowed males to carry food to a sheltered location (Klein 1989:181). In addition to the rise of group solidarity and bonding between males and females, the ability to store fat in the body, the potential to have intercourse unhindered by oestrus, and the enlargement of breasts, provided factors that might have increased fertility through increasing food yield available per capita, especially for pregnant or nursing females. This, in turn, increased the frequency of coitus, as well as increasing the ability of a female to cope with the burden of child rearing. The chances of infants surviving to child-bearing age were improved. A prolongation of the reproductive span could have been a key variable in enhancing the reproductive success of the Australopithecines. Equally effective would have been a reduction in the child-spacing period, but this would have increased female morbidity and mortality, thus ultimately lowering the growth rate.

Finds outside of Africa of one to two million years ago indicate that dispersal out of Africa may have occurred as an outcome of budding-off and dispersal during episodes of population increase as a response to climatic fluctuations, or just as a result of random walk. Population dispersal occurred perhaps in waves, reflecting both peaks of population increase resulting from the chaotic dynamics of the population system and as a result of improved ecological conditions in response to climatic changes. Parent populations with no option for further dispersal would have had either to yield to natural checks or deliberate behavioural controls. Given that infanticide was already common among primates, it is not unlikely that it was practised by early hominids as necessity dictated.

A significant development that would have had a strong influence on early hominid populations was a greater investment in a few offspring by females and males in a biological family and by the social group. This strategy may be referred to as a 'strong K-strategy' or even a 'Super K-strategy'. A K-strategy is preferred when environmental conditions are stable. A strong K-strategy would thus require stabilization of the environment. The emergence of a strong K-strategy might thus have been closely linked with an increasing ability to procure food of high quality, to protect females and infants, and to achieve a social organization that bonded males and females/infants, as well as one that ensured a basis for a durable social organization. Undoubtedly a human-like brain, the ability for complex learning, and an advanced level of communication (even if it were by signs) would have been tremendous advantages (see Chapter 18). Intelligence and better sensory—motor coordination would have facilitated tool-making and improved diet.

The Middle Pleistocene

The appearance of tools about 2.5 million years ago, as well as evidence of food sharing at about that time, attests to the emergence of genetic and cultural traits that were to lead to better food-procurement practices. More effective and sophisticated tools, as well as the widespread use of fire, were to emerge later in association with *Homo erectus*. With these biological and cultural traits, we can assume better control of the environment as well as greater abilities for behavioural population controls.

With increasing encephalization (the increase in brain size from 700 to 1,000 cc), gestation is not likely to have increased beyond that of the Australopithecines, or the gorillas for that matter. If the foetus gestated longer, the head would become too large at delivery to pass through the birth canal. If the head did pass, it might cause trauma or perhaps lead to the death of the mother. A selection for immature neonates placed still greater selective advantage for mothers who invested their newborn with care and a social organization that included male parental care and group solidarity. Midwifery might have become a traditional behavioural trait, because it would have reduced neonate mortality and female death during child birth (see also Harpending *et al.* 1990 on parental care and mortality).

The spatial distribution of *Homo erectus* and the stone tools of the Acheulian tradition associated with *Homo erectus* suggest expansion into India, Burma, Thailand, Malay, China, Java, central Spain, southern France and Hungary during the early Pleistocene, and farther north during the Middle Pleistocene (Klein 1989). The earliest human populations lived in open grasslands or parklands. In the course of human evolution, people moved into other biomes. Initially human dispersal and migrations probably took place in familiar habitats or in corridors of hospitable biotopes, perhaps at times of climatic amelioration. Further expansion into northern latitudes, as well as into arid habitats, during the later part of the Middle Pleistocene was associated with increasing use of fire and greater hunting and organizational skills (Dennell and Roebroeks 1996; Roebroeks and van Kolfschoten 1995; and see Chapter 19). The temperate environment, with its low winter and night temperature, might have led to an added stress on females. Seasonal scarcity of food may have reduced body fat proportions. In addition, poorer diet combined with cold stress and infections may have increased female morbidity, delayed menarche, and interrupted ovulation and menstruation. These factors would have also caused a higher infant mortality.

In spite of these difficulties, the greater care of neonates and mothers, an advanced brain, and more than two million years of cultural tradition, provided the basis for better food procurement, adequate shelter, and effective protection from predators and enemies. Age at death climbed to an average in excess of thirty years, perhaps approaching the 33–37 years characteristic of contemporary hunter-gatherers (Acsádi and Nemeskéri 1970:146). Selection for late onset of first reproduction to perhaps twelve years would have benefited the females, who would have had a chance to mature physically before being subjected to the heavy demands of child-bearing and nursing. A late entry to motherhood and domestic home activities would have allowed the female to become properly socialized and trained, especially if we assume that monogamous marriage arrangements may have emerged by that time.

The Late Pleistocene

The Late Pleistocene was a period of major transformation in human biology, involving the disappearance of archaic *Homo sapiens* and Neanderthals and the emergence of modern *Homo sapiens sapiens* or near-modern humans in Africa between 130,000 and 50,000/40,000 years ago (Klein 1989). The spread of modern humans sometime between 60,000 and 40,000 years ago led to the demise of earlier populations and the homogenization of human populations into a single species.

Within a span of 10,000 years, the Neanderthal populations were replaced or absorbed into modern humans.

Average age at death of adults was about 33–34.5 years (Hassan 1981:101; Weiss 1973). The Neanderthals attained old age, as we know it now. The long-term average population growth rate among the Neanderthals and early *Homo sapiens* rose dramatically compared with that of *Homo erectus* populations, perhaps in the magnitude of seven to eight times the previous long-term average rate. The estimated world-wide average long-term rate during the Middle Palaeolithic was perhaps about 0.0005 per cent, compared with an estimate of 0.00007 per cent for the Lower Palaeolithic. Given that the increase in longevity was probably not much higher than that of *Homo erectus,* it is possible that greater survival of infants to child-bearing age was the most significant factor behind the dramatic rise in population growth rate in the long run. The greater survival of children might have been related to advanced midwifery (Trevathan 1987:224–29), greater group support of infants, better genetic and cultural adaptive responses to cold environments, advanced cognitive abilities, and a fully developed language. The greater survival of children might have overcompensated for further retardation of menarche to fifteen to sixteen years (see p. 678). According to Trinkaus and Tompkins (1990), the degree of the shift in longevity and other aspects of the life cycle from late Archaic humans like the Neanderthals and modern humans, was modest. Klein (1989) notes the various injuries sustained by the Neanderthals, as well as the evidence for substantial help and care from their comrades.

The emergence of *Homo sapiens sapiens* was associated with still greater average long-term growth rate than that of earlier populates, perhaps again seven or eight times the rate during the Middle Palaeolithic. The average age at death does not seem to have been much higher than that of the Neanderthals (about 34 years), and we must hypothesize that the assumed increase in population growth rate was a function of greater success in coping with population and resource stochastic fluctuations. One of the successful strategies was the continued dispersal into new lands.

At the beginning of the Late Pleistocene, modern or near-modern human populations ventured farther north into the cold steppes of the Ukraine, the Iranian Plateau, Turkmenia, and Uzbekistan in Asia, and into central Germany and southern Poland in Europe. They also expanded into Australia, where a recent examination of radio-carbon and TL dates, in the light of U/Th dating of coral reefs, has led Chappell *et al.* (1996) to suggest that the luminescence-based age of 50–60,000 is the best available estimate of the age of human presence in Australia; an even earlier date is also suggested by recent discoveries. Human colonization of the Americas is well attested by 12,000 BP, but may have been preceded by initial infiltrations between 25,000 to 20,000 years ago, and perhaps earlier according to some scholars (Taylor *et al.* 1996). The expansion into North America was fairly rapid: Haynes

(1969) estimates an average annual growth rate of 0.08 per cent from the increase in the number of sites. At such a rate, an initially small population would have required about 10,000 years to saturate North America (Hassan 1981: 202). If the movement was not a result of population increase and expansion, but a leap-frog movement by small, mobile groups, the rate of dispersal would have been much faster.

The improvement in the adaptive success of the human population emerging during the Middle Palaeolithic was enhanced by the rapid increase in the size of the world population. By the end of the Pleistocene, about 3 million individuals spread over much of the space currently occupied, consisting of 3,000–6,000 local population units in different habitats and with various degrees of partial isolation and contact. Geographic separation allowed for regional cultural differences to appear. However, interpopulation gene flow was sufficiently effective for maintaining the unity of a single species. The increase in the number of people represented an increase in the number of potential innovations. With language and some sort of notational book-keeping, an information revolution was achieved (see Chapters 18 and 20). Pooling information allowed the exploitation of a wide range of resources. The exploitation of aquatic resources, small game animals, and cereal grasses, as well as the widespread usage of food-processing devices ranging from grinding stones to smoking fish, together with adequate storage, were the basis for expanding the carrying capacity and a relatively rapid rate of population growth as in certain parts of western Europe, estimated at 0.1–0.13 per cent by ConstandseWestermann and Newell (1984).

EARLY FARMING POPULATIONS

The most remarkable achievement in the history of human population was the emergence about 10,000 years ago of the ability to manipulate the productivity of natural resources, allowing large human groups to settle in permanent communities close to each other in a pattern that has radically altered both the natural and the human landscape (Cowan and Watson 1992; Harris 1996a; and see Chapter 21). In his overview of the current evidence for agricultural origins, Harris (1996b, 1996c) provides a model of evolutionary stages marked by an increasing dependence on domesticated plants and greater sophistication of farming practices. He also favours linking the emergence of agriculture in southwest Asia, and very possibly also east Asia, with the widespread climatic and vegetation changes that occurred at, and immediately after, the transition from the terminal Pleistocene to the early Holocene (see also: Hassan 1981; Henry 1989; McCorrison and Hole 1991). Matthews *et al.* (1995) also explore the global climatic conditions at the time of agricultural origins, and Hillman (1996) provides a cogent argument for the role of climatic-environmental changes starting at 15,000 years ago in increasing the gross yield of potential starch-protein staples.

A hitherto unexplored factor associated with global postglacial warming has recently been put forward by Groube (1996), who suggests that the warming was a bonanza for many temperature and humidity micro-organisms that utilize part of the human body for food or reproduction (such as *vivax* malaria). Populations close to zero growth either settled to increase fertility, or moved away from infested regions. With sedentism, they began to intensify the food quest from specific resources that ultimately led to food production. This theory suffers from lack of empirical support and does not explain why sedentism, which would make communities more vulnerable, would have been adopted. It also does not provide a mechanism for the transition from foraging to farming. The emergence of agriculture has also been attributed to population pressure (see Sanderson (1995) for a recent endorsement of that model), coevolutionary changes (Rindos 1984), and ecological stress (Harris 1977). The population pressure model has been dismissed by Cowgill (1975) and Hassan (1981). The coevolutionary model has been criticized by Blumler (1996). Nevertheless, Sanderson (1995) rejected all models in favour of the population pressure model.

More recently, the transition to agriculture has been characterized as the result of rapid, discrete, responses to severe and abrupt climatic events (Gasse and van Campo 1994; Hassan 1996). By 14,000 years ago, postglacial warming began a series of climatic changes that were crucial in upsetting previously established glacial regimes of atmospheric circulation. Populations situated in arid and semi-arid regions in climatically unstable zones were particularly vulnerable to seasonal and spatial unpredictability (see Hassan 1977, and Hassan 1981:214). One of the critical events was a severe episode of cold climate known as the Younger Dryas about 11,500 radio-carbon years ago (Hillman 1996; Matthews *et al.* 1995), the first of a series of such spells that each lasted less than a century, at about 10,000, 8,500, and 7,500/6,000 years ago. These short-term severe variations, associated with dramatic increases in inter-annual variability, prompted modes of actions that previously might only have been used occasionally and as a matter of necessity because they were not compatible with a mobile and 'free' foraging-hunting ethos: intensively utilizing particular wild grasses that were high yielding and storable, and managing certain animal species, leading to coevolutionary changes that increased the dependence of people on specific resources and vice versa. These changes coincided with demographic developments such as congregation of large groups in seasonal and permanent settlements. An increase in the size of the family was due to labour shortage at the times of sowing and harvesting, which provided opportunities for productive child labour. Relaxation of population controls, coupled with the effects of unpredictable climatic events and failures of agricultural production, are likely to have led to dispersal and relocation.

The transition from hunting-gathering to agriculture represents a major population change within a short time interval, from a low, relatively inelastic, ceiling of population, to another state of dynamic growth, which not only allowed larger populations but also sustained the acceleration in the rate of population growth during the end of the Pleistocene. Birth rates perhaps as high as 0.1 per cent in agrarian zones were matched by slower rates elsewhere, until the spread and intensification of agriculture led to a global annual rate exceeding 0.1 per cent after 1000 BC: by that time, the world was between ten and twenty times the world at the eve of the agricultural revolution. Thereafter, and as a consequence of improvements in agricultural production, the world today is populated by more than 6 billion people. The ability to feed this vast number of people and sustain other economic gains is a testimony to the tremendous potential of agriculture as a subsistence pursuit.

Carr-Saunders (1922:216–17), and later Sussman (1972), attributed the relatively rapid growth following agriculture to the effect of *sedentary* residence on shortening the child-spacing interval. Handwerker (1983) strongly dismisses the link between sedentariness and higher fertility and suggests that the 'demand for children did not appreciably affect fertility and does not account for variation in fertility among settled agricultural populations' (1983:19).

The correlation between higher fertility and sedentism is probably not causal. A long child-spacing period among foragers is not simply a function of foraging mobility (Cashdan 1985): it seems to be primarily a response to heavy workloads, the young age of mothers increasing the effect of maternal drain on their health, the lack of baby foods, and the hazards of child-bearing (Hassan 1981:223). The transition to agriculture provided 'a definite economic motive to enlarging the size of the family unit and the size of the labour pool' (Hassan 1981:224). The increase in population concomitant with the advent of agriculture was a function of the change in socio-economic conditions, favouring slight relaxation of the controls damping fertility without too much prolongation of the child-spacing period. The availability of weaning foods could have reduced the nutritional cost of children. The impact of the diet on survivorship and age at menarche was most probably negligible, but the cereal diet may have increased infant mortality (Hassan 1981: 224).

The causes of the increase in human population coincident with the emergence of food production have also been explored recently by Pennington (1996), who draws upon findings that indicate substantial increase in the survival of children as populations switch from nomadic to sedentary lives. Given a schedule of mortality and fertility, a projection of life tables shows that moderate increases in child survival rates have more substantial effects on population growth than mortality at later ages. Higher child survival rates may be so critical that even a reduction in life expectancy at birth of more than a decade can occur without a reduction in population growth rate. However, the basis for Pennington's projection is flawed, since the ethnographic example used for analogy is based on the !Kung Bushmen of the northern Kalahari desert in Botswana, where a reduction in child mortality was a function of increased access to milk, which was not the case among early farmers. Nevertheless, an increase in child survival in such early agricultural communities, as posited by Pennington, was more likely a result of relaxing population controls even as infant mortality rates increased.

Demographic conditions following the transition to agriculture were closely linked to changes in diet, work activities, labour requirements, food quality and abundance, storage, and health. Mark Cohen (1995, with references) posits that infection and infectious disease observable on bone seem to increase as human settlements increase in size and permanence. A case study by Kent (1987) shows that the sedentary environment can lead to the contamination of mother's milk by transmitted viral and bacterial infections. Mothers transmitted infectious agents to their infants causing diarrhoeal diseases. Kent argues that a high rate of infant death (50–60 per cent of all infant death) from diarrhoeal diseases in agrarian communities would have been a result of aggregation and sedentary residence rather than poor diet.

A combination of crowded, sedentary residence, combined with poor diet, would have been particularly disadvantageous. M.Cohen (1995) suggests that early farmers were less well nourished than their ancestral hunter-gatherers, but comparison of Harris lines in hunting-gathering populations and early farmers indicates that the lines are more common in hunter-gatherers. This probably suggests that early farmers were *less* prone to spells of biological stress, because the frequency of Harris lines suggests seasonal stress or episodes of famines and feasting. A full study of the palaeopathology of a sample of aboriginal Australians (Webb 1995) revealed that the Harris lines as well as dental enamel hypoplasia and *Cribra orbitalia* are common, comparable with those of early farmers in North America. The evidence suggests that males were more prone to childhood stress and that they were more likely to recover, possibly due to a cultural preference which favoured male children.

Contrary to M.Cohen's (1989, 1995) suggestion that health declined with the advent of farming and associated sedentism and large population size, Wood *et al.* (1992) argue that the reverse is possible. Using the same data, they suggest that lesions indicate healthy individuals who recovered, whereas those who died because of poor health are not likely to show healing lesions. Although such a debate may continue until ancillary evidence is marshalled, it appears that a discussion of health cannot be solely based on a partial record of certain diseases from skeletal remains. Models of ancient disease should be constructed with a clear understanding of the cultural context and the natural environment. Crowding, contact with 'strangers' in trading communities, division of labour between the sexes and gender status, social hierarchy and differential access to high quality food, health care, differences in workload and exposure—all are clearly factors that came in the wake of agriculture. These factors are likely to have influenced health and mortality. Archaeological proxies for such cultural factors must be obtained in conjunction with bio-anthropological data. It may also be important to note that the segments of population buried among farmers may not be representative of the masses of farmers, but of those who had burial privileges, which was certainly the case among the early state societies.

The emergence of cultivation and animal husbandry was also associated with marked dislocation of populations and dispersal from the source areas. In some situations, symbiotic relationships existed between foragers who persisted in areas marginal to pastoralism or agriculture. Other major population movements in later prehistory and classical Antiquity were associated variously with: the sedentarization of pastoralists and later fusion with agricultural communities; conquests of agrarian polities by organized nomadic pastoralists; forced relocation of farming populations by powerful states; colonization of distant regions by military force; and relocation motivated by better economic opportunities. In the most recent period of human evolution, the motivations for territorial expansion or migrations have not necessarily been related to subsistence, but rather to the standard of living set by an élite in societies with a hierarchical social organization.

Examination of the landscape and the distribution of Neolithic sites in Europe has led van Andel and Runnels (1995) to present a model of migration in discrete steps with time lapses in between. This model is a modification of an earlier model by Ammerman and Cavalli-Sforza (1984:6) which assumed a continuous spread in a wave driven by steady population growth. The new model does not depend on population increase, since there is no evidence of high population density or crowding in south-eastern Europe. The implication of the model is that migrants were small in numbers and that they are likely to have mingled with the indigenous foraging populations. The peopling of Europe raises interesting questions concerning the possibility of using genetics to discern prehistoric and historical population movements and regional variations (Cavalli-Sforza 1994, 1996). Although one must guard against racial abuses of population studies (see Evison 1996, with references to critics of the applications of genetics in archeology), genetic data are sources of information that, together with linguistic, archaeological, and historical data, are likely to clarify prehistoric population geography. In a joinder to the contribution by Cavalli-Sforza, Renfrew (1996) cautions against the uncritical application of molecular genetic data to linguistic and historical phenomena.

EARLY STATE SOCIETIES

Early state societies consisted of local communities connected in a large population agglomerate, bound together by an administrative cadre of officials who legitimated their power by religious ideology, and—as warranted—by coercion (Chapter 23).

The total population of an early state was a function of the number of communities that could be strung together as well as the size of local communities. The size of local communities was, in turn, a function of agricultural productivity. Under pre-industrial agricultural technology, agricultural productivity was relatively low, with modern records of food production which were only exceeded in post-medieval times. Low agricultural yields supported people at a density of less than ten persons per square kilometre to more than a hundred persons per square kilometre, with perhaps an average of 10–25 persons per square kilometre in the earliest farming communities. In general, these communities rarely farmed an area more than 5 kilometres from their settlement; more often, the farming area was within 1–2 kilometres, an area of 1–4 square kilometres. The minimal population units in an early state may thus have consisted of a few families in a hamlet, or 25–100 persons in small villages. Larger village size was possible with greater productivity and a larger farming area: estimates of prehistoric villages from Mesoamerica range from 15–50 people to 114–285 people.

A number of villages and hamlets in a single valley or a region with access to each other, may form a polity, a village chiefdom. Such an alliance may have been motivated by the need to overcome fluctuations in yield that may have affected villages differentially as a result of variations in rainfall, pest infestations, or other unforeseen causes in farming practices. The number of communities that can be amalgamated together was a function of access and transport. Since most transport before modern times was by foot, pack animals, or boats, the distance travelled within a reasonable time was relatively short. With an average travel distance of 10–20 kilometres per day, a strip of land 80–100 kilometres long (and say 10 kilometres wide) could be traversed in a week or less. A human carrier can carry a load of 20–30 kilograms for a distance of about 20 kilometres a day (Blanton *et al.* 1981: 248), compared with the 150–200 kilograms that can be carried the same distance by a donkey. A carrier will consume about 0.44–0.55 kilograms of food per day, so for a return trip of two weeks one way (a distance of 240 kilometres), the carrier would need 14 kilograms, or more than 50 per cent of the load. To be 'cost-effective', the distance should be within the range allowing the delivery of about 70 per cent of the load. The earliest petty states may have thus covered relatively small areas. With an average of 10–25 persons per square kilometre, the population of the villages forming the polity may have been between 8,000 and 25,000 persons in an area of 800–1,000 square kilometres.

With good coordination, consisting of central storage and redistribution of grain to communities facing food shortages, a higher population density could be supported. Also, with accumulating agricultural experiences, more yields could be obtained. In addition, certain communities in favoured localities would have higher yields that could support as many as 40 persons per square kilometre. Such a density could have made possible a population of 32,000 and up to 40,000 persons in an area of 800–1,000 square kilometres. Petty states in Mesoamerica and Predynastic Egypt were fairly limited in their territorial range, covering areas between around 100 to 400 square kilometres. The consolidation of several regions in late Predynastic Egypt created units that covered 1,200–1,600 square kilometres, with as many as 20,000 to 30,000 people. The unification of Egypt led to the establishment of a state covering about 30,000 square kilometres.

Empires after 1500 BC (Chapter 24) controlled vast areas: the Harappan civilization, for example, covered an area of approximately 5.5 million square kilometres. Imperial expansion was facilitated both by advances in water transport and construction of roads. The Inca empire, which covered five times the area of Europe between AD 1100 and 1400, was linked together by a 16,000-kilometre network of highways. Estimates of the size of empires by Taagepera (1978) and Eckhardt (1992), recently reviewed by Sanderson (1995), indicate that there were three stages; from 3000 to 600 BC, 600 BC to AD 1600, and after AD 1600. During the first phase, the Egyptian empire in 1500 BC was one square megametre (one square megametre=386,000 square miles), compared with 0.45 of a square megametre in China at 1000 BC. Persia controlled an empire of 5.5 square megametres around 600 BC. By AD 1300, China had an empire as large as 15 square megametres.

A large population provides both economic and political power. The ratio of workers in a pre-industrial population ranges from 40–70 per cent of the population. A unit that manages to achieve a population unit with as many as 40,000 people will have as many as 16,000 to 28,000 workers. The population will also include 10–15 per cent male adults that can be mobilized as warriors, amounting to as many as 4,000 to 6,000 warriors. If all adult males were 'drafted', that would provide perhaps as many as 10,000 warriors. Large kingdoms with as many as 1–2 million people could easily amass armies of 20,000–40,000 warriors, about 15–25 per cent of all adult males. States that manage to control such a large population (equivalent to the size of Egypt during the Old Kingdom), other factors being equal, could conquer and dominate smaller states. Large states can also afford to lose large numbers of warriors that can be replaced by warriors from other provinces.

Areas with naturally high productivity were more likely to achieve higher population density than others. This accounts for the rise of many early state societies in river valleys, such as the Tigris and Euphrates, the Nile, the Indus, and the Yang-tzse and the Hwang Ho. The rivers also provided the potential for water transport, as well as a better overland transport network than mountainous or plateau areas. Certain settings and historical factors thus created a favourable environment for the emergence of people under state organization. In Mesoamerica, about 35 million people occupied an area of 1 million square kilometres. In China, the population is estimated at 60 million in AD 180 and 200 million in AD 1585. In Egypt, with a much smaller agricultural area (roughly 30,000 square kilometres), the population is estimated at 1.2 million during the Old Kingdom (third millennium BC) and 3.2 million in Hellenistic times (Hassan 1993). By comparison, the population of the Roman empire is estimated at 54 million.

Population and power were thus closely linked since the beginning of farming and political coordination of neighbouring villages. The groups that managed to achieve a political union were far more powerful than other scattered villages and could, under suitable conditions, manage to extend their control over them. The synchronous emergence of polities may also lead to conflicts and competition. Motivations for extending political control over a large area is a function of the inherent unpredictability of agricultural production. The larger a group, the greater the amount that can be saved to redistribute in times of need. However, an increase in the size of population leads to an increase in administrators who are entrusted with collecting and storing food in communal storage facilities. This leads to an increase in 'overhead', especially since administrators manage to subsist because of the power they control at a higher standard of living than peasants. Greater security is also maintained by improving transportation, by investing in pack animals, and by boat building. In addition, with accumulation of grain and wealth, the need for defence increases. Investment in temples and priests, as well as in gifts to provincial chiefs and headmen, is also necessary to bind the group in a 'national' unity and to mitigate against revolts and schism. There is also a need for a police force to coax those who defect in paying tribute to comply. Disputes likely to emerge in a large population where accounts become important require clerks, scribes, and judges. Accordingly, as a state grows bigger, the cost of its operation rises precipitously. At a certain point, the cost of running the affairs of the state outpaces the amount of tribute that can be extracted from the region under control. Military expansion follows. The process is repeated until, finally, the cost of controlling territory rises beyond returns, as a function of transport cost and the military as well as administrative force required to keep outlying regions under check. The expansion of states is also motivated by incidence of drops in yield due to natural disasters and mismanagement, in part, of land fertility due to soil erosion or salinization (Conrad and Demarest 1984; Tainter 1988; and see Chapter 25).

The formation of a state was also inexorably linked with greater demands for increasing yield from village communities. Technological advances were limited and were not likely to have led to a major increase in productivity until after post-medieval times, with the application of chemical fertilizers, pesticides, herbicides, mechanized farming, use of fossil fuels and other forms of energy, modern irrigation, genetic improvement of cultigens, and modern storage methods. Increasing yield was based on expanding the area cultivated and increasing the yield from areas cultivated by labour-intensive practices, such as weeding, water-lifting, hoeing, ploughing, and so on. Families were thus faced with the need to increase the number of children as a means of meeting the labour demands placed upon them by high taxation. In the Valley of Oaxaca, for example, population increase in the piedmont area during Monte Alban I was a consequence of urban administrative demands (Blanton *et al.* 1981:223–24).

As a result of labour demands, an ethos emphasizing large family size and preference for males (for heavy farm labour) became dominant. Larger families placed additional burdens on mothers, who had to cope with a large number of children in addition to the chores associated with farming. Heavy taxation and tribute also reduced families to a state of misery and poverty, which was commonly associated with high infant mortality, poor health, and malnutrition.

The emergence of state societies (Chapter 23) was associated not only with the regional integration of many local communities, but was also characterized by the emergence of a major distinction between villages and the settlements where administrators and state officials resided. These settlements included relatively more people than the neighbouring villages, had a relatively higher population density, and included amenities associated with wealth and power. These settlements were called towns and cities and were often characterized by a temple or a fort. Towns generally included a few thousand people, while cities in early civilizations attained populations of as many as 40,000 people. In general, pre-industrial capital cities consisted of 20,000 to 40,000, with many other cities with little more than 10,000 and perhaps only 5,000 people (Sjoberg 1960:83). In Mesopotamia, Ur had 24,000–34,000 inhabitants, Lagesh 19,000, Umma 16,000, and Khafaje 12,000. In the Indus valley, Mohenjo-Daro and Harappa probably contained a population of 20,000 (Piggott 1950). The population of Tell el-Amarna in Egypt has been estimated at between 20,000 and 29,000 (Kemp 1981:97), and Thebes in 1300 BC was a city of 20,000–40,000 people (Hassan 1993).

A survey of the size of the largest cities since 2250 BC (Sanderson 1995) reveals that about 40,000 persons was the minimum size of the largest cities until AD 1300. In 650 BC, the largest cities consisted of about 120,000 persons. The maximum size increased to a range from 400,000 to 700,000 between AD 100 and AD 1500. However, the maximum population of Rome in the late sixth century BC is estimated at 35,000–50,000 (Cornell 1995:204–7): census data of 103,000–152,000 adult male citizens for 508–392 BC 'can on no account be genuine' (Cornell 1995:208)—it might refer to the total population of Rome and its territories.

The size of towns and cities was limited by low agricultural productivity, the limitations on the speed and load of transport, and the lack of professional armies. The emergence of professional soldiers in a later stage of state societies associated with investment in fast, military ships led to the rise of ancient empires in the Near East, Persia, Greece, and Italy. The territorial expansion allowed large cities to emerge. Cities also became larger by attracting or forcing farmers to reside within the city limits in order to secure access to food, to reduce cost, and to minimize the threat of siege or reduction of tributes. Teotihuacán in Mesoamerica increased from 15,000 to 125,000 people in the Middle Classic Period by the displacement of rural settlements to the city. Lowland Maya cities included urban cores ranging from 13,000 to 60,000 people, with smaller centres consisting of 1,500–10,000 persons (Rice and Culbert 1990). Large cities were thus more the exception than the rule. This situation prevailed until manufacture and trade in Europe allowed cities to expand. During the twelfth century, Milan may have had as many as 80,000 people, of whom 20,000 were artisans. Most city-states, however, consisted of smaller populations: Pisa, for example, consisted of 10,000 people. In medieval times, Cairo had 25,000 inhabitants.

The estimation of the population of cities in archaeology is often based on ethnographic analogy. Early estimates provide figures between 200 and 300 persons per hectare. Sumner (1989) provided estimates of 66–293 persons per hectare in Near Eastern settlements. Russell (1958:64–66) provides estimates of 160 persons per hectare for ancient Pompeii, 250–350 persons per hectare for Imperial Rome, and 200 persons per hectare for Constantinople in the fifth century AD. For ancient walled cities in Palestine, Broshi (1979) suggests that as many as 400–500 persons per hectare were crowded within the city walls. However, before estimating population sizes of early cities from ethnographic analogies of so many people per unit of space, we should have information on three factors: the density of houses; the percentage of non-living space; and the area actually occupied at any given time. A good example of this approach is the work by Kemp (1981) at Tell el-Amarna: using archaeological data he estimates a density of 60–75 persons per hectare.

Modern urbanization, after AD 1650 (Fig. 17.4), has been associated with industry and commerce, whereas early urbanization was based on manufacture or trade under the patronage of the king or the temple. Manufactured goods were for the state functionaries, to be awarded by the head of the state. The expansion of manufacture and trade in later times was not only related to advances in technology, but also to the breakdown in the monopoly of manufacture and trade by divine kings, allowing many individuals to engage in such activities and raising the number of consumers by allowing commoners to have access to luxury goods. However, some early states generated income for the élite through manufacture and trade: in Teotihuacán, for example, it is presumed that one-third of the population consisted of craft specialists. Commercialization during the Post-classic period in Mesoamerica was apparently linked with weak state control and the appearance of an autonomous and self-regulating economy after the collapse of the powerful governments (Blanton *et al.* 1981:251).

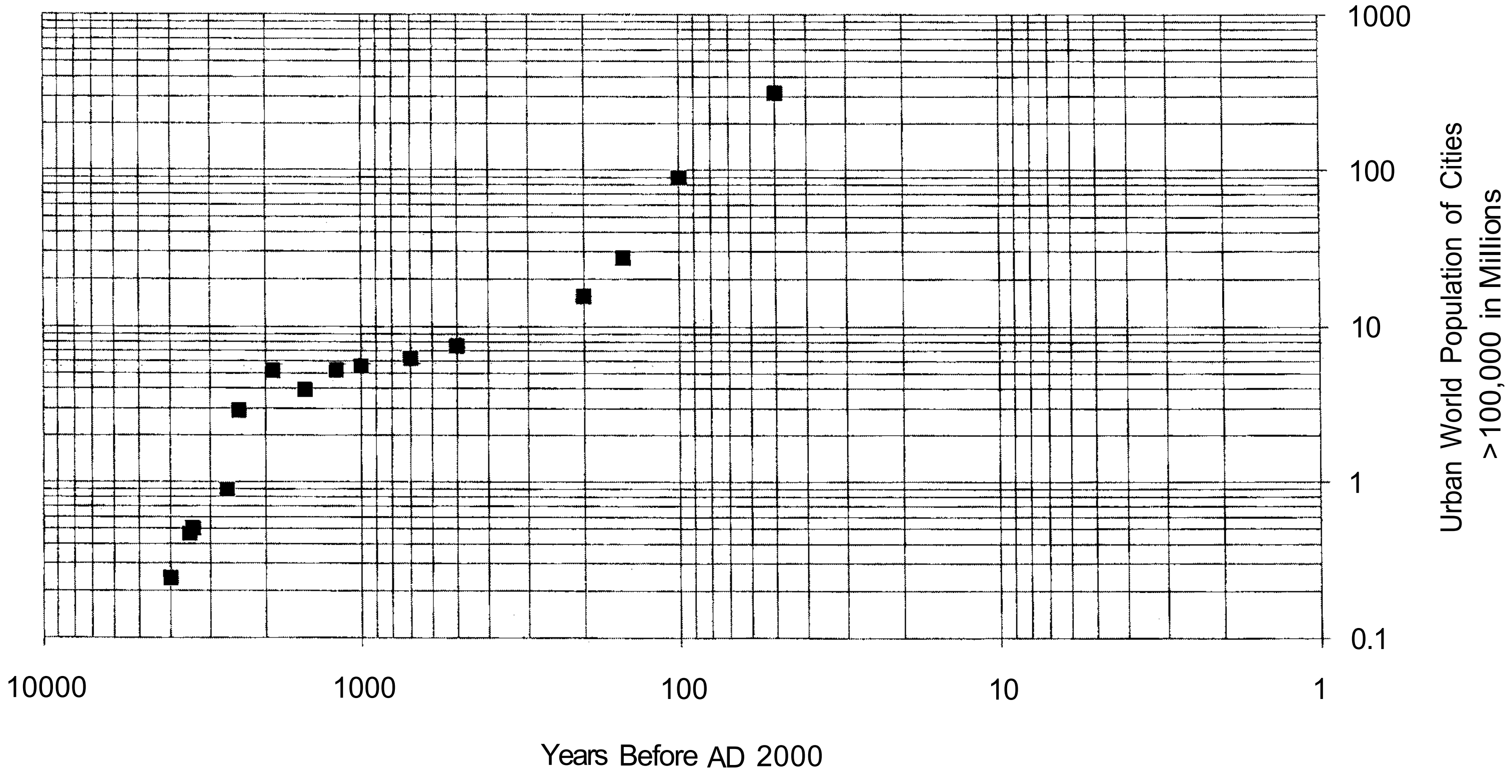

Figure 17.4 Urban population of cities >100,000 in millions over the last 4,000 years.

Many cities began as cult centres, as places identified with ancestral homes, settlements of a prestigious lineage, or trade loci. Agricultural potential in the immediate vicinity of the city may be high or low because the growth of a city depends primarily on food imports from tribute, taxation, or trade (Herbert and Thomas 1990). The enlargement of population units in early state societies was associated with a hierarchy of settlements of different sizes. Capital cities maintained access to the rural area through large towns serving as urban centres of administrative regions. These towns, in turn, were surrounded by a cluster of smaller towns or large villages that served as local markets for local produce and administrative posts. The capitals were, in some cases as in Uruk, many times larger than any town, in a pattern known as primate distribution. In other cases, distribution of settlement size followed a log-normal or rank-size distribution in which settlements were only slightly larger than the next smaller settlement.

The urban population in early state societies was a very small proportion of the total population. In fact, this was the case until modern urbanization: as late as 1790, the urban population of the USA was no more than 5.1 per cent of the total population (Thomlinson 1965:21). In pre-industrial societies, the urban population was often about 5 per cent, and rarely as high as 8–10 per cent of the population (Sjoberg 1960:83).

The size of a city clearly varied according to political and economic conditions. Ancient Jerusalem varied from a town of 2,000 inhabitants at the time of David (965 BC) to 53,000 at the time of Justinian (AD 565) (Broshi 1975). The major expansion of the city coincided with the Roman and Byzantine empires. In Egypt, a population of 2.1 million during the New Kingdom had an urban population of about 150,000, with forty-four provincial towns, each with an average of 2,000–3,000 people and a national capital with about 30,000 people (Hassan 1993).

CONCLUSION

To gain even a partial vision of the demographic conditions of prehistoric peoples is a daunting task. Painstaking analysis of settlement areas, density of settlements, frequency of artefacts, and food remains, provide a possibility of making some reasonable estimates in the light of our knowledge of contemporary foragers and pre-industrial peoples. Important information is also adduced from ageing and sexing skeletal remains and investigations of ancient diseases—palaeopathology (Chapter 7). Not without problems, palaeodemographic studies provide approximate measures of the development, longevity, and fertility of ancient populations. Population studies in archaeology (including palaeodemography, demographic archaeology, and historical demography) have provided a wealth of information over the last three decades, but much remains to be done. We are still in need of more reliable methods to provide better proxies of the demographic profiles of prehistoric peoples. We also need to develop models of prehistoric mortality and fertility that do not suffer from a close adherence to models developed within a western, industrial context.

Simulations and a closer consideration of stochastic oscillations may provide a deeper understanding of population dynamics. Based on uniform demographic principles with attention to the structure of proximate, intermediate and distal causes and the mode of causality, simulations of individual life cycle for groups in dynamic cultural and natural contexts promise to provide answers to some vexing questions (see Mangel and Tier (1993) on the dynamics of metapopulation with demographic stochasticity and environmental catastrophes). Such dynamic, open-ended, micro-models with unexpected random variables create mathematical nightmares, but we may be consoled by the elegance of the simple principle underlying such hellish complexity. Prehistoric populations were probably far from being discrete, stationary, and stable. This was in part due to the foraging mode of existence that prevailed for millions of years. However, the biological changes in hominid evolution enabling the rearing of children in a protective social context and the ability to overcome scarcities and overcrowding through dispersal, migration, technological, social, and ideological means, are the greatest demographic feat of humanity.

Although we can trace our biological ancestry to more than three million years ago, our current cultural milieu has been shaped by forces that were set into motion in the wake of the adoption of farming and herding communities between 10,000 and 6,000 years ago. We can hardly imagine a world with no more than 3–5 million people as the stock of our crowded world with more than 6 billion on all continents. Through the lens of history, it is difficult to see beyond a world already populated with hundreds of millions living in cities and governed by states with mighty rulers and powerful magnates. Yet this history is radically different from the state of affairs that prevailed in the deep, prehistoric past. As our immediate ancestors climbed the evolutionary ladder, they were progressively more successful in enhancing the number of the newborn who survived to child-bearing age. The increase was imperceptible and subject to severe natural and cultural checks. Death claimed a large percentage of infants and children. The life of adults was fairly short, with little improvement in the average age at death (32–33 years) from the Middle Pleistocene to the Neolithic. A few lived well into their sixties. Women died on average about four years younger than their mates. They lived in small groups in larger mating pools, with marked spatial mobility and fluidity in size and composition. Mortality rates were high and the size of families was small. Fertility was controlled to maintain an exceedingly low rate of population increase.

The relationship between our foraging ancestors and resources is intricate, but the concept of 'carrying capacity' is often used to estimate how many people can be supported over a long period of time. This concept, however, is only useful if we take into consideration the role of human ingenuity in overcoming food shortages, their ability to disperse, and their capacity to regulate their numbers so that they can remain at a safe level below frequent oscillations in the natural yield of resources. Nevertheless, severe, natural fluctuations beyond the social memory of a group may place them at severe risk. Outbreaks of disease or simply stochastic variations can cause occasional depopulation or overpopulation. The intrinsic ability to increase at a fairly rapid rate was instrumental when groups were threatened by extinction. At the same time, cultural checks were necessary to maintain a fairly healthy population. It is likely that *Homo sapiens sapiens* increased at a faster rate than their predecessors and engaged in a variety of social, technological, and cultural innovations by the end of the Pleistocene. This may be in part a result of their cognitive capabilities, but it might have also been a function of regionalization and a free flow of ideas amongst contiguous groups creating a dynamic intellectual environment.

The first steps towards managing plants and animals at the end of the Pleistocene were rapidly followed by a series of steps that ultimately led to agrarian, settled communities and nomadic pastoralists. This marked a new cultural setting, with a new demographic order, characterized by high regional densities which allowed large populations to reside within fairly small areas. These aggregates formed the nucleus of state societies.

The emergence of the state had in turn a major influence on the demographic landscape. In many cases, towns and cities emerged as density spikes with anomalously large populations. Initially only hosting a few hundreds, the early cities soon mushroomed into hundreds of thousands, but with a fairly basic maximum size of 20,000 to 40,000 before the modern megalopolis became commonplace. The states were organizational polities that through time fostered social, ideational, technological, and economic changes that not only delineated the shape of civilization as we know it, but also created an environment for an expansion of world population hitting the 100 million mark by 600 BC. The early state, however, was based on great inequalities. The fundamental basis of state aggrandizement was human labour. The larger the working labour force, the greater the revenues to the governing élite. There was rarely ever a shortage of land. Moreover, various innovations increased productivity. A pronatal ethos, combined with warfare and other means to secure slaves and serfs, placed a heavy burden on women. As the source of offspring, women became an economic commodity. However, the greater need for male labour in intensive agriculture and as fodder for war did not do much to enhance the social status of women.

There were no major improvements in life expectancy in the early civilizations, with an average age at death for adults of 36 years (31–40 years)—in fact, it was not until after 1840 that the average age at death for adults increased gradually towards its modern value in industrial nations. However, growth rates became progressively higher, except for a few interludes due to dramatic natural or cultural checks.

The advent of agriculture introduced new diseases, as people provided a resident host for infectious diseases. Epidemics became more common and virulent. Paradoxically, with greater productivity, only a small percentage have had the privilege of a decent diet and the pleasures of civilization. In the meantime, the cost of high productivity and the impact of billions of people on the habitats of the earth are causing a noticeable strain. The problem is not so much one of numbers but of ecological stewardship and global economy. To wave the threat of 'overpopulation', or continue to reiterate the pro-birth policies encoded in early agrarian state ideologies, is short-sighted (Hern 1990). Nine months after Hitler came to power in 1934, his ruthless suppression of abortion led to a sudden rise of birth rate at 4 points per 1,000 (Pressat 1971:116). Policies that still adhere to a view of having more people as a means of increasing state power and the labour force ignore the economics and politics of the present. The population dilemma lies today in the divergence between the objectives of the state and the family. In addition, there is a legacy of a pronatalist ethos that has victimized women in the past. Ironically, women were valued only as 'mothers'. Women are also caught in the cycle of poverty related to population growth. Greater demands on natural resources lead to environmental degradation, which leads the poor to depend on child labour to maintain a living; this contributes to population growth, which in turn contributes to greater poverty (Dasgupta 1995).

Industrialization benefiting from the colonial possessions not only created an array of desirable consumer goods but also more effective means of increasing agricultural yield. Either in order to improve one's station in life, or to evade punishment or murder, more children were procured to fuel the industrial machine. Most of this increase was not a result of better health conditions, but primarily a consequence of reducing or eliminating cultural population controls. Where health 'improvements' were made, they were mostly in reducing infant mortality. Many women in many Third World countries still die at a tender age as did their grandmothers hundreds of years ago.

In attempting to piece together the demographic past of humanity, archaeologists highlight our modern predicament and lead us to question pet theories and sacrosanct beliefs shaped by our modern historical experiences. We may not be able to make any valid long-term projections, since the trends of demographic change are non-linear or predictable, but we can gauge the role of various forces that shape the demographic landscape. We have never been at the mercy of nature from the day we generated a spark of fire, and our ingenuity as a species has been remarkable. Archaeological insights into our common demographic past provide a corrective to our stereotypical view of the 'nasty, brutish and short' lives of our ancestors and an antidote to our short-sighted view of population dynamics from recent historical contexts.

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Basic palaeodemographic approaches are well presented in the classic work by Acsádi and Nemeskéri (1970). Pressat (1972) and Newell (1989) provide the fundamental principles of formal demographic analysis. Howell (1986) gives a useful review of anthropological demography. Cohen's *Health and the Rise of Civilization* (1989) is a readable, exhaustive survey of the relations between diet, disease and population. *Demographic Archaeology* (Hassan 1981) presents a comprehensive approach to population studies in archaeology with an exposition of palaeodemographic and archaeological methods, as well as explanations of the role of population dynamics in culture change. Swedlund and Armelagos (1976) is an excellent, brief introduction to demographic processes, demographic studies in anthropology, and palaeodemographic studies. The field of demographic anthropology is also reviewed by Howell (1986), who discusses methodological as well as theoretical issues, and presents an overview of population problems in archaeology.

18

COGNITION

Thought, ideas and belief

Steven Mithen and Nigel Spivey

INTRODUCTION

Just as we wish to know how people lived in the past, we also wish to know what they thought, and how they thought. Indeed, it is difficult to address questions of subsistence, trade and social organization without some understanding of the manner in which people in the past viewed their world. While archaeologists have long asked such questions, the late 1980s saw a concerted move towards the development of a 'cognitive archaeology' (Renfrew 1982; Renfrew and Zubrow 1994). This cannot boast the theoretical and field studies which developed from the move towards a 'social archaeology' twenty years previously, but its consequences for the discipline are likely to be as profound. At present, however, cognitive archaeology is a rather disparate body of work, varying markedly in its content and approaches. This is understandable, since trying to infer the nature and contents of, for example, the minds of prehistoric people from the stone tools, broken bones and potsherds of the archaeological record is certainly a daunting, optimistic, and some might say foolhardy task. And even if such inference seems successful, what results might it yield when carried over into a literate era of history—when, arguably, a cognitive record has been in some way directly inscribed or 'scripted'? Undaunted, this chapter sketches the nature of cognitive archaeology for two very different time periods, with very different databases: the Palaeolithic, and classical Greece.

For early prehistory, during which the archaeological record monitors not only cultural but also biological evolution, the major concern of a cognitive archaeology must be with the evolution of the human mind: when did the architecture of the modern mind evolve? This question has to be addressed with the often sparse data from the palaeolithic record, dominated by stone tools and, in the later Palaeolithic, faunal assemblages. For later prehistory, the focus shifts to how cognitive architecture—uniform in its essence across all living people—has led to the development of different concepts and ways of viewing the world. Ideology becomes a central concern: how different ideologies develop and their role in social, economic and political organization (Miller and Tilley 1984). The study of human burial plays a major role in this, partly due to the dominance of the burial record during many periods of later prehistory and its direct connection with past ideology (Hodder 1982; Shanks and Tilley 1982; Thomas 1988). These studies, which must be embraced within a cognitive archaeology, have been termed symbolic and structural archaeology and have formed a major part of the post-processual critique (Hodder 1982, 1990). Another example of relevant research in later prehistory is Bradley's work on the relationship between rock art and the perception of landscape in Britain (Bradley 1991).

Not surprisingly, the character of cognitive archaeology changes significantly when we are dealing with periods for which we have written documents as well as material remains. The significance of written records in changing the nature of cognitive archaeology can be seen in the study of hunter-gatherer rock art. When an ethnohistorical record of the mythology and social organization of a hunter-gatherer group is available, archaeologists are able to make very detailed interpretations of rock art traditions, as for instance in Australia (Haskovec and Sullivan 1989; Morphy 1989) and southern Africa (Lewis-Williams 1982). These show how many of the images in these traditions have complex interpretations and intimate links with ideology and a symbolic construction of the world. However, when similar interpretations are imposed upon prehistoric art, the results are unconvincing, such as the claim that many abstract marks in upper palaeolithic art are 'entoptic' phenomena seen by shamans in a state of trance (Lewis-Williams and Dowson 1988). A cognitive approach to prehistoric art clearly has to take on a different guise, not inferior to that when ethnographic data is available, but simply different.

The roots of cognitive archaeology lie both within and outside the discipline. With respect to the former it arises from the failure of the processual archaeology of the 1970s to address cognitive issues, and indeed its inability to do so due to the constraints of theory and method it imposed upon itself (see Chapter 2). Equally, however, it has arisen from the failure of the post-processual critique: while this pointed to a series of important failings in processual archaeology, such as its lack of concern with individual action, symbols and historical process (Hodder 1985), it failed to provide an alternative that maintained a credible 'scientific' approach, becoming dominated by an unrestrained subjectivity lacking a concern to connect theory with data (for example, Shanks and Tilley 1987). Cognitive archaeology seeks to maintain the scientific credibility of processual archaeology, while addressing issues of cognition and symbolic behaviour as had been raised by the post-processualists.

It is no coincidence that the development of cognitive archaeology has occurred at a time when related disciplines have also become more concerned with cognition. There has been much renewed interest in the issues of language, consciousness, and creativity in psychology and philosophy in recent years, partly stimulated by the development of artificial intelligence (Boden 1990; Corballis 1992; Dennett 1992; Donald 1991). Indeed, it is only in the past two decades that the discipline of cognitive science has arisen (Gardner 1987) and the impact of this is being felt through many disciplines. Cognition is beginning to play a more prominent role in the study of animal behaviour, often with an implicit goal of contributing to our understanding of human cognition (Bryne and Whitten 1988; Cheney and Seyfarth 1990; Griffin 1981, 1982; Humphrey 1976). More recently a distinct sub-discipline of 'evolutionary psychology' has emerged (Barkow *et al.* 1992). This makes explicit reference to the Pleistocene environments within which the human mind evolved. Significant progress on understanding the modern mind is likely to arise from an integration of this 'evolutionary psychology' and 'cognitive archaeology', as has been attempted by Mithen (1996). What is readily apparent, however, is that the emergence of a cognitive archaeology is part of a multidisciplinary trend to address the nature of the human mind, rather than just a particular sub-area of the discipline of archaeology.

THE EVOLUTION OF THE HUMAN MIND: PRE-MODERN HUMANS

Language, intelligence, and consciousness are frequently invoked to differentiate humans from other animal species. None of these is easy to define and each is (arguably) represented in many animal species, particularly primates. In humans, however, these cognitive processes are extraordinarily complex and intertwined: they may be different in kind, rather than degree, to those found in other species.

Before we consider the archaeology, it is important to establish that we should not see the evolution of the human mind as an upwardly progressive process beginning with the proverbial Neanderthal incapable of thought and ending in the supposed cognitive pinnacle of our fine minds of today. There is a great temptation to see the cognition of early hominid species as *inferior* versions of our own. This is a mistaken approach: comparative psychology has demonstrated that intelligence is a multivariate phenomenon. Some bird species, for example, can perform specific cognitive feats which are far beyond the capacity of primates, humans included. Cognition, just as much as physiology, should be seen as fitting an organism for a particular way of life, and, while inter-specific comparisons can be made, value judgements are of limited worth. However, while we should avoid seeing the minds of our hominid ancestors as simply watered-down versions of our own, we can nevertheless assume that an evolutionary pathway exists. Evolution works by building upon existing structures: indeed, some argue that we can see in the modern mind vestiges of the distinctive cognitive processes of our ancestors (for example, Donald 1991).

A second important point is that, when we talk about the evolution of the human mind, it is unclear what this means. There are two schools of thought on this issue. One might be called the 'big bang' school, in that they see the mind as one general-purpose information processor, with intimate connections between all the distinctly human cognitive processes (for example, Piaget 1960). The other might be termed the 'cognitive creep' school: this views the mind as a series of modules, each evolved for a specific task (for example, Cosmides and Tooby 1987), or for there to be different types of intelligences, such as those for language, mathematics and music (Gardner 1983). This views the mind not as a 'general-purpose computer' but as having evolved to solve a specific suite of problems faced by hominids in their evolutionary environments. Others take a mixture of these approaches: Fodor (1983), for example, sees a general-purpose central system, but with a series of 'encapsulated' input or perceptual processes. One implication of modular approaches is that different aspects of the human mind are likely to have evolved at different times. As this chapter describes, the archaeological data from the Palaeolithic appears to provide greater support to the gradual creep rather than big bang theory of cognitive evolution.

The fossil evidence provides limited information concerning the evolution of the human mind. The most useful is that concerning brain enlargement, which has been a continuous process during human evolution (Stringer 1984). Two points should be noted. First, while brain size among mammals is related to body size, the enlargement in the hominid brain outstrips that which can be accounted for by increasing body size alone (Martin 1983). Second, the major phase of brain enlargement occurred early in human evolution: *Homo erectus,* appearing at *c.* 1.8 million years ago (hereafter MYA), had a cranial capacity that was 80 per cent that of modern humans. However, while the fossil record allows us to trace the expansion, and to some extent the structure, of the hominid brain, we need to turn to the archaeological record to speculate upon the character of hominid minds. For our early ancestors this record is dominated by stone tools. Drawing inferences about prehistoric cognition from such material is fraught with difficulties, and few specialists agree about the implications of particular industrial traditions (e.g. Dibble 1989; Gowlett 1984). Some of the most controversial data are the earliest, the lower Pleistocene stone industries from East Africa which first appear at *c.* 2.5 MYA.

Oldowan technology: ape, human or neither?

The most important assemblages of these early stone tools come from Beds I and II at Olduvai Gorge and were termed by Mary Leakey (1971) 'the Oldowan Industry'. It is generally assumed that these artefacts were manufactured by *Homo habilis,* although there is no reason why contemporary australopithecine species may not also have been tool-makers (Susman 1991; and see also Chapter 20). Oldowan artefacts, and those of similar date from Koobi Fora and Shungura (Isaac 1984), are usually simple 'tools' resulting from direct percussion on basalt, quartz and limestone (Fig. 18.1).

A critical issue is whether 'types' are present within the Oldowan, and if they are, how they should be interpreted. Archaeologists use the notion of type to refer to an artefact that has been made to a distinct pattern. The existence of types is often taken to imply the ability to form mental templates which may, in turn, imply abilities to form linguistic categories. Similarly the presence of types has been taken to suggest an ability to share mental concepts between individuals, again implying that language may be present (Chase 1991). Mary Leakey suggested that 'types' did exist within the Oldowan, and used terms such as choppers, discoids and polyhedrons to describe recurring artefact morphologies (Leakey 1971).

However, experimental knapping has challenged this view by showing that the recurring artefact shapes arise due to two principal factors: the shape of the original nodule and the intensity of the flaking (Potts 1988; Toth 1985); much of the variability was also due to the effects of the raw material used (Isaac 1984; Stiles 1991; Toth 1985). The 'types' Leakey identified were a product of archaeological classification rather than intended products of hominid stone knappers. In this light, it has been argued that the cognitive processes implicated by Oldowan artefacts are equivalent to those employed by chimpanzees when they produce tools such as

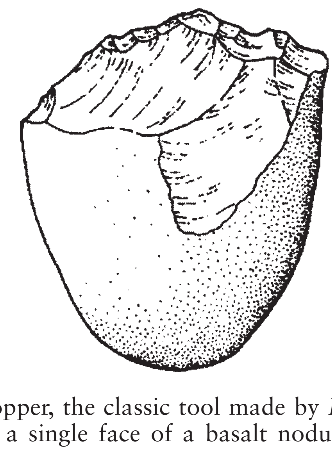

Figure 18.1 Oldowan chopper, the classic tool made by *H. habilis,* produced by removing one or more flakes from a single face of a basalt nodule. Source: S.Mithen 1996.

termite sticks (Wynn and McGrew 1989). However, this extreme position probably underestimates the level of technical skill and consequently the required cognitive processes required to coordinate perception and motor actions in stone knapping (Gowlett 1986).

The artefacts themselves may not be the most informative source of data about hominid cognition. The distribution of artefacts in the early Pleistocene landscapes suggests behaviour and thought which are different from those observed or inferred among modern apes. At many East African sites there is evidence that raw materials were transported substantial distances before they were knapped and discarded (Hay 1976; Isaac 1978, 1984; Leakey 1971). The comparison between experimentally knapped and real lithic assemblages has shown that partially worked cores were also transported around the landscape (Toth 1985). The Olduvai sites are particularly interesting in this respect, since they indicate that different types of raw material were transported over different distances.

Artefact transport over such distances has not been observed in any non-human primate: the furthest chimpanzees appear to transport stone artefacts is 500 metres (Boesch and Boesch 1983). Potts (1988) has argued that much of this artefact transport, particularly of unworked nodules, was to create stone tool caches to use when scavenging carcasses—occasions when ready access to sharp flakes would have been essential to minimize exposure time to competing scavengers such as hyenas. Consequently, while the manufacture of Oldowan tools may have required cognitive processes no different to those possessed by modern apes, the manner in which these tools were used may reflect a different, perhaps more human, type of cognition, indicating that hominids were engaged in considerable planning of subsistence activities involving the anticipation of the future use of tools.

Homo erectus and the Acheulian

At *c.* 1.4 MYA a new artefact form appears in the archaeological record—the handaxe: bifacially worked implements, often pear-shaped in form, often finished by a series of very fine thinning flakes (Fig. 18.2). They form the central element of Acheulian industries found not only in Africa but also in large parts of Europe and Asia, indicating that *Homo erectus* was the first hominid to disperse out of Africa. Though mainly associated with *H. erectus,* they continued to be manufactured and used by archaic *H. sapiens,* such as Neanderthals, down to 40,000 or so years ago.

Adapting the theories of Piaget regarding the mental development of children, Wynn (1989) has argued that the appearance of these bifaces indicates a much more 'human-like' cognition than the Oldowan industries. Piaget identified a series of cognitive stages in children from sensiormotor to pre-operational to operational thought. Wynn suggested that, as Oldowan artefacts display the minimum degree

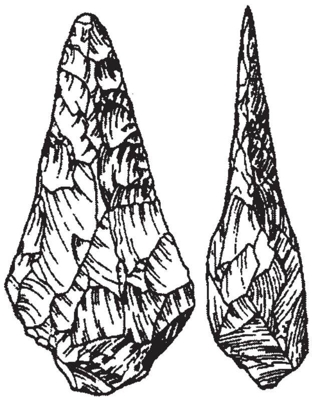

Figure 18.2 Acheulian handaxe. Handaxes first appeared 1.4 million years ago, and up until 100,000 years ago are found very widely in Africa, Asia and Europe. They come in all shapes and sizes, but frequently have a highly symmetrical form, clearly implying the existence of a mental template in the mind of the knapper and requiring considerable planning in their execution. Source: S.Mithen 1996.

of spatial competence, their makers had only reached the cognitive level of preoperational thought, as possessed by young children and apes; by contrast, the symmetry of early bifaces, and the fact that flake removal was often geared to the production of an end product, indicated to him more advanced spatial competence, implying an early stage of operational thought, substantially different to those of apes. He further argued that by 300,000 years ago bifaces display additional spatial concepts which suggest that fully modern operational thought had developed. The most important feature of the later Acheulian bifaces, according to Wynn, is their symmetry in three dimensions; the removal of each flake had to maintain symmetry in all three dimensions, a complex cognitive and motor action task.

Wynn's analysis of bifaces is elegant, and his conclusion that fully modern thought had arisen by 300,000 years ago provocative, but the content and value of this conclusion are highly questionable. His analysis is built on the notion that ontogeny recapitulates phylogeny, which can be held with little confidence (Gould 1977), whilst Piaget's scheme is solely descriptive and does not engage with a Darwinian approach, which is the only paradigm for understanding human evolution. It is also intuitively unconvincing that 300,000 years ago hominid cognition was of the same type as modern humans, implying that the appearance of art, ritual, big game hunting, colonization and rapid culture change, all of which occurred much later in human evolution, had no implications for the evolution of the human mind.

While the use and significance of spatial concepts in the production of bifaces can be questioned, it is certainly the case that such knapping required advanced sensiormotor skills. A biface is often the end product of a long sequence of actions, involving blank production, initial bifacial shaping, thinning and final shaping, processes which may also involve several different types of hammer stone, each appropriate for a specific task. Mithen (1996) believes that such skills reflect a discrete 'technical intelligence' in the mind of *Homo erectus;* others have argued that such skills derive from the same neurological structure that produces language, recognizing analogies between the production of speech and complex stone tools (Corballis 1992; Falk 1980; Holloway 1969). Such claims have been countered, however, since they fail to draw a sufficiently robust connection between inferred tool behaviour and language (Chase 1991; Wynn 1991). Donald (1991) has marshalled substantial evidence to show that sensiormotor skills and language are cognitively independent: for example, people who suffer from aphasia (loss of linguistic capacities) do not appear to have their motor skills impaired.

However, while stone tools may not provide evidence for language, they certainly do not demonstrate that language was absent. Here we must be careful to differentiate language from speech. Fossil evidence suggests that it was only with *Homo sapiens sapiens* that the vocal tract was so developed that a sufficiently wide range of vocalizations was possible to allow spoken language (Lieberman 1989). Yet *Homo erectus* may well have had language in the form of gestures. This has long been thought of as the root for the evolution of spoken language. Donald (1991) has noted that a 'mimetic' capacity—that is, representation via gesture—is maintained in those who suffer cognitive pathologies preventing spoken language, and suggests that this was the principal means of communication for *Homo erectus*.

There is a greater likelihood that types are present within Acheulian industries than among the Oldowan. In southern England, for example, handaxes come in a variety of shapes and sizes and archaeologists have been quick to classify them into types such as 'pointed', 'ovate' and 'ficrons' (for example, Roe 1981). These types certainly fall on a continuum (Dibble 1989), and raw material variability is likely to have played a substantial role in creating morphological variability. There are, however, three types of evidence that hominids within particular societies 'chose' to make bifaces according to an arbitrary (that is, non-functional) design. First, many artefacts show delicate flaking to create a specific morphology: the resulting shape is not just an unintended consequence of the knapping process. This is particularly evident from the rare sites which provide *in situ* knapping debitage, such as Boxgrove and Caddington (Bradley and Sampson 1978; Roberts 1986). Second, many assemblages are very heavily dominated by one specific type (for example, points in the Middle Gravels of the Barnfield Pit at Swanscombe, and ovates in the Upper Loam: Wymer 1968), and it is difficult to understand how these could have formed unless knapping had been geared to such ends. Third, while the same basic biface form is found throughout much of the Old World, there are regional differences that cannot be attributed to raw material availability and functional variation (Wynn and Tierson 1990).

Experimental tool use (Jones 1980; Toth 1985) and microwear studies (Keeley 1980; Keeley and Toth 1981) have suggested that bifaces were general-purpose tools, and consequently these types are unlikely to reflect artefacts made in specific shapes for specific purposes. Similarly, due to the likely absence of symbolic capacities of *H. erectus*, the types cannot be thought of as symbols, for example to identify ethnicity. The most likely explanation is simply that they reflect traditions of artefact manufacture within particular societies, acquired by social learning, as can be the case amongst different groups of chimpanzees (McGrew *et al.* 1979). The imposition of form within such traditions is most appropriately described as 'isochrestic style' (Sackett 1982); that is, the imposition of form without the intention to communicate (Chase 1991).

This presence of such persistent traditions of tool morphology suggests that social learning may have been intense and that *H. erectus* possessed an extremely important cognitive capacity: imitation. This can be seen most clearly in Acheulian assemblages which have handaxes showing remarkable similarities, such as those from the Wolvercote Channel in Oxfordshire (Tyldesley 1986). The presence of imitative capacities among *H. erectus* marks a very important step in cognitive evolution. Monkeys and apes probably have very limited capacities of imitation (Tomasello 1990; Visalberghi and Fragaszy 1990), whereas these are a critically important cognitive skill among modern humans, upon which much of child development and the acquisition of culture are based (Meltzoff 1988; Yando *et al.* 1978). Imitation was probably a means by which juvenile hominids acquired social and ecological knowledge.

In the light of the general-purpose nature of lower palaeolithic stone tools, it is unlikely that the acquisition of technical skills provided a selective pressure itself for the evolution of imitation, but once this capacity had arisen, it appears to have had a considerable influence on technology, leading to entrenched traditions. This would only have happened in those contexts in which social interaction was sufficiently intense to allow imitation of toolmaking to take place: in the industries from forested interglacial environments, such as the Clactonian and Taubachien (Valoch 1984; Wymer 1988), the lack of tool types and limited technical skill probably reflect the low degree of social learning due to small hominid group size and limited social cohesion (Mithen 1994).

H. erectus was the first hominid species to colonize large parts of the Old World, being present in south-west Asia by 1.8 MYA, and with immediate descendants (probably *H. Heidelbergensis*) in Europe after 1 MYA. This reflects the colonization and exploitation of a wide range of environmental zones, and in particular an ability to cope with high latitudes in which seasonality would have been marked and a dependency on animals required (Dennell 1983, and Chapter 20; Gamble 1986;

Turner 1992). The ability to exploit such a diverse set of environmental types may imply a complex suite of cognitive processes to allow the scheduling of behaviour with seasons, the use of fire, cooperative subsistence activity such as the search for frozen carcasses, and a flexible social organization (Dennell 1983; Gamble 1987). However, while such complex behaviour and cognition have been claimed, there is little direct evidence (Villa 1991). There is, for instance, only one kind of special activity site documented for the Middle Pleistocene—butchery sites; there are no known workshop sites, 'base camps', specialized hunting camps, or settlements known to have been restricted to a single season. While fire must have been essential for survival in northern latitudes, and traces are frequently found on Middle Pleistocene sites, there is no known case of organized activities around a fireplace. Reconstructions of substantial structures at Terra Amata have been shown to be false (Villa 1983). Communal hunting is directly implied by just one known site, the elephant and rhinoceros assemblages at La Cotte on the island of Jersey (Scott 1980), which are most likely to derive from a cliff-fall hunting strategy. Unfortunately, most faunal assemblages, such as from Hoxne, Swanscombe and Torralba, are too poorly preserved to allow inference of foraging strategies (Stopp 1988; Villa 1990, 1991).

Although the detail of such strategies cannot be inferred, the simple fact that these early humans were surviving in glacial environments with a limited technological repertoire implies that they relied on a detailed knowledge of their landscape and potential prey. Studies of modern hunter-gatherers, such as the Inuit and the !Kung, demonstrate that these people are superb naturalists. It is most likely that *H. erectus* and all early humans had similar understanding and knowledge of the natural world. Mithen (1996) attributes them with a distinct 'natural history intelligence'.

Levallois technology and the Mousterian

From *c.* 250,000 years ago, many industries become dominated by tools made on flakes, with bifaces becoming a minor component, if present at all; in south-west Europe and the Near East, such assemblages from the Later Pleistocene are often associated with Neanderthals and labelled Mousterian industries. In many of these assemblages the Levallois technique becomes dominant, a knapping method by which large flakes with predetermined size and shape were removed from a core which had been specially prepared. Some have argued that this technique marks a cognitive advance involving planning the development of the core, but this was probably no greater than that involved in biface manufacture—indeed the technique can be seen as a natural development of the process of thinning bifaces.

The issue of type arises once again with the Mousterian. One of the largest classes of Mousterian artefact is the scraper, a retouched flake. In a classic study, Bordes (1961a) developed a complex typology of such scrapers, seventeen different types, which he thought of as representing different conceptual entities for the Neanderthal flint knapper. Since different assemblages were composed of different frequencies of scraper types, he suggested that these were derived from distinct ethnic groups, each with their particular way of manufacturing scrapers (Bordes 1961b), implying that Neanderthals had an essentially modern type of cognition (Dibble 1989). However, recent research has suggested that a very large part of the variability may be attributed to the intensity of resharpening and variability in raw materials (Dibble 1987; Holland and Dibble 1990).

Nevertheless, there are other features of the archaeological record associated with Neanderthals that may suggest additional features of cognition to those possessed by *H. erectus:* most notably, Neanderthals may have practised intentional burial, although there are substantial methodological problems in identifying such burials (Bar Yosef *et al.* 1992; Rak *et al.* 1994). The cognitive implications of intentional burial may involve belief in an afterlife, mythology and symbolic thought, though the lack of clear examples of grave-goods with these burials (Chase and Dibble 1987), unlike those of modern humans, warns against such interpretations. The presence of engraved or painted objects in middle palaeolithic contexts would also substantially advance the case that Neanderthals had the capacity for symbolic thought, and numerous claims have been made (Bednarik 1992; Marshack 1989). However, there are no cases of representational art, and few, if any, of the abstract marks recorded are other than the unintentional products of other activities, such as cutting vegetables on a bone or stone support (Chase and Dibble 1987, 1992). However, it is clear from the archaeological record that Neanderthals and earlier hominids were collecting and using pigments, notably iron and manganese oxide, perhaps for body painting.

There are possible indicators of increasing intellectual sophistication amongst pre-modern humans, and the evidence for the development of rather advanced social intelligence characterized by the ability to create and pursue complex social relationships. Nevertheless, probably the most significant feature of pre-modern hominids is the extraordinary stasis in technological development throughout the lower, middle and early part of the later Pleistocene, particularly in the light of the extraordinary developments that then occurred with the transition to the Upper Palaeolithic *c.* 50,000–35,000 years ago. The widespread distribution of *H. erectus* and archaic *H. sapiens* in diverse environments, from North Wales (Green 1984) to the Cape of southern Africa (Keller 1973), suggests that, just as with any primate (Dunbar 1988), there would have been a considerable degree of variability in social organization. Such variability is likely to have included large groups in environments such as the glacial environments of northern Europe (Gamble 1987; Mithen 1994), and an advanced level of social intelligence would have been necessary for the maintenance of such groups.

In summary, one interpretation of the mind of *H. erectus* and archaic *H. sapiens* is that this consisted of a series of discrete intelligences—those for making tools, interacting with the natural world, and living in complex social groups, and perhaps also for language. But these intelligences do not seem to have interacted together in the characteristic manner of a modern human mind (Mithen 1996; Fig. 18.3).

THE EVOLUTION OF THE MODERN HUMAN MIND: *H. SAPIENS SAPIENS*

H. sapiens sapiens first appears in the archaeological record at *c.* 100,000 BP in southern Africa and the Near East, when Neanderthals and other archaic *H. sapiens* species were widespread in many areas of the world; but by 30,000 BP it appears that *H. sapiens sapiens* was the only surviving hominid species. While there are major controversies with the evidence (Lindley and Clark 1990; Mellars 1989; Mellars and Stringer 1989), the fossil record and studies of mtDNA and nuclear DNA in living populations suggest that *H. sapiens sapiens* may have had one local origin, probably in Africa between 400,000 and 200,000 years ago, and then dispersed throughout the globe to replace archaic populations. The contribution of the archaic populations to the gene pool of modern humans is a matter of contention (Smith 1991).

It is also debatable whether or not the anatomical changes defining biologically modern humans, which included notably altered cranial morphology, also represented a major change in cognition. Against all our expectations from evolutionary theory, it appears that the behaviour of the earliest modern humans (that is, prior to *c.* 50,000 BP) was not substantially different to that of the archaic populations. In the caves of Skhul and Qafzeh in the Near East we have well-preserved specimens of early *H. sapiens sapiens* dating to *c.* 95,000 BP associated with a Mousterian technology dominated by Levalloisian flakes, apparently of precisely the same nature and used for the same tasks as those of the Neanderthals (Bar-Yosef 1989; Shea 1989). A similar lack of behavioural change in spite of anatomical change appears to occur in southern Africa (Klein 1989). Whilst this may be due to failings in the archaeological record, for example in evidence for the exploitation of plant resources differentiating a *H. sapiens sapiens* from a Neanderthal lifestyle, at present we are usually unable to identify any differences in behaviour, and consequently cognition, between the earliest *H. sapiens sapiens* and archaic populations, except in very rare instances. For example, at Katanda in Zaire, bone harpoons have been found which date to 90,000 years ago (Yellen *et al.* 1995), and which are similar to those of the European Upper Palaeolithic.

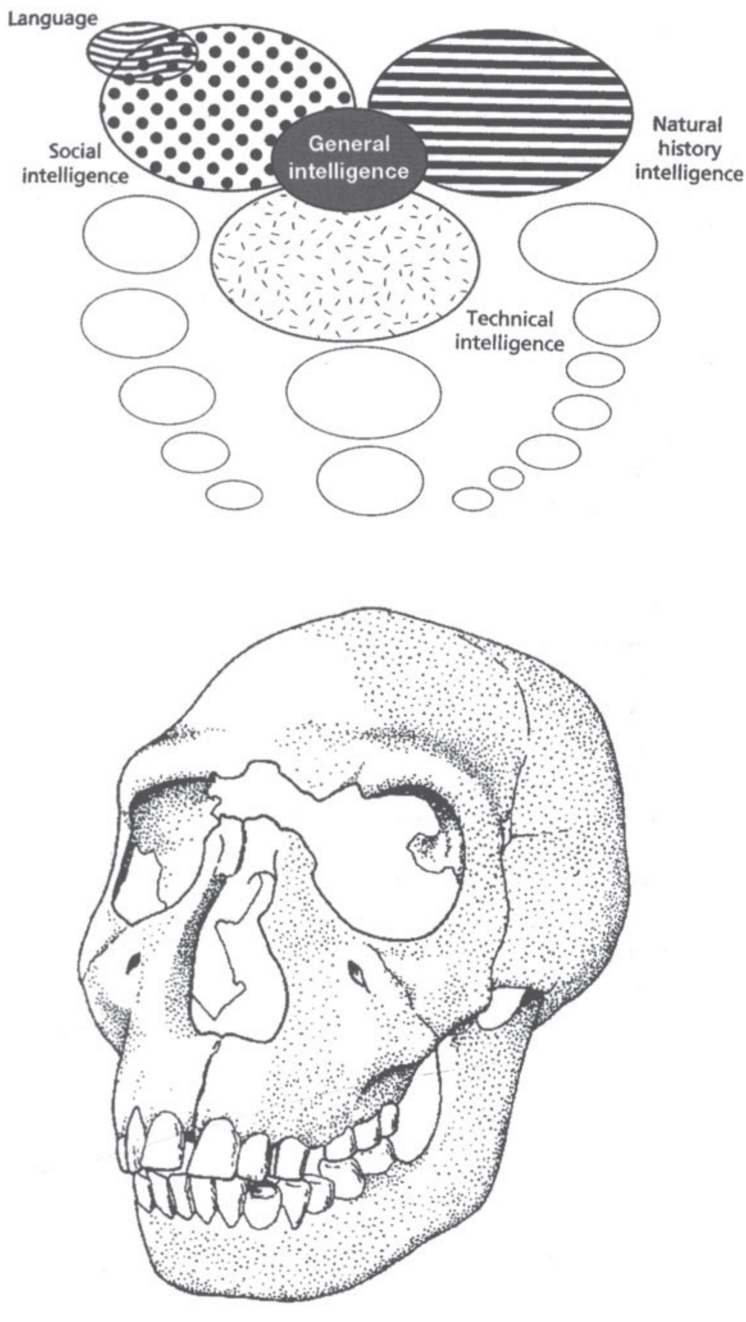

Figure 18.3 Reconstruction of the early human mind. This illustration suggests that early humans had a very different type of cognition from that of modern humans: while they could think in essentially modern ways about making tools (technical intelligence), the natural world (natural history intelligence), and social interaction (social intelligence), they were unable to integrate their ways of thinking and knowledge in these various domains. Although a linguistic capacity may have been present, this was restricted to the social domain, for the communication of social information. The skull depicts that of the *H. erectus* specimen known as Nariokotome boy, dating to 1.6 million years old. (See also Figure 19.6.) Source: S.Mithen 1996.

It is not until *c.* 50,000 BP, the middle/upper palaeolithic transition, that we find widespread changes in the archaeological record that may reflect the appearance of a fully modern cognition: the appearance of new technologies and of symbolic artefacts; increased rates of culture change; and the colonization of arid regions (Mellars 1973, 1989; White 1982). Whether these developments signify a real break in cultural/cognitive evolution, or just a change in the manner in which archaeologists describe and interpret their material, is hotly debated (Lindley and Clark 1990).

The middle/upper palaeolithic transition is most clearly defined in western Europe, where it appears to correlate directly with the replacement of Neanderthals by *H. sapiens sapiens*. At *c.* 40,000 BP a new archaeological 'culture' appears, the Aurignacian, which seems to have developed first in the Near East and then spread westwards across Europe. The Aurignacian is characterized by a concentration of blade technology, a series of distinct artefact types such as carinate scrapers and split bone points, and body ornaments such as beads and bracelets (Bordes 1968; Mellars 1989, 1991). Although no fossil remains have been found with the earliest Aurignacian, it is assumed to have been created by *H. sapiens sapiens*. There appears to have been a period of a few thousand years of overlap in western Europe between Neanderthals and *H. sapiens sapiens,* during which time Mousterian industries take on certain attributes of the Upper Palaeolithic (for example the Chatelperronian and Uluzzian), perhaps reflecting a process of acculturation as Neanderthals attempted to imitate the new technologies (Harrold 1989).

The last Neanderthal fossils date to *c.* 30,000 BP: it appears that Neanderthals were unable to compete with biologically modern humans for resources such as large game. This has been seen as reflecting cognitive differences between the two hominid types (Mellars 1991) allowing modern humans to hunt more efficiently, cope with environmental fluctuations, and attain greater behavioural flexibility. It cannot be doubted that after 35,000 BP biologically modern *Homo* had language, due to the extensive use of visual symbolism in the form of cave art and sculptures (see Davidson 1991), as discussed below. Indeed, some argue that the development of modern language is the root of all the changes that constitute the upper palaeolithic transition (Mellars 1991).

This is a very enticing argument. Certainly we should not doubt that hominids with language will behave very differently, and leave a very different archaeological record, from hominids without language: spoken language not only facilitates communication but also may make fundamental changes in the manner in which individuals think. But perhaps the major change is that language acts to integrate the minds of all individuals into a single network. An analogy with computers is helpful here: the most powerful computers are those which allow parallel processing, the simultaneous execution of a series of related tasks. The presence of language within a hominid community can be thought of as linking minds into one large parallel-processing computer, not only increasing the efficiency with which problems could be solved but also fundamentally changing the types of problems that could be tackled.

The transition to the Upper Palaeolithic is less clearly defined in the Near East and Africa and indeed in regions of Europe away from south-west France. On a global scale, the transition to modern humans and to modern patterns of behaviour presents a complex spatial and temporal mosaic: the apparent correlation between hominid type and culture in south-west France is the exception rather than the rule. This suggests that the developments in this region at *c.* 35,000 BP cannot be explained simply in terms of the arrival of *H. sapiens sapiens,* but must also concern adaptation to the particular glacial environments of the northern latitudes. Indeed, many date the explosion in visual symbolism not to 35,000 but to 20,000 BP, where it is clearly related to changing environmental conditions rather than hominid cognition (Mithen 1990), although this is coming under challenge from new AMS radio-carbon dates of cave paintings (Chauvet *et al.* 1996). In most parts of the world art remains a rare phenomenon during the Palaeolithic, but 'modern' behaviour and thought can be inferred from other types of developments: in particular we see at 50,000 BP, or soon afterwards, the colonization of the final parts of the globe, notably Australasia, Siberia and ultimately the New World. The colonization of such areas with low density, diversity and predictability of resources is likely to have only been possible after fully modern human cognitive capacities had evolved. According to Mithen (1996) this involved the integration of previously isolated intelligences (Fig. 18.4).

The first art and the art of memory

While the rock art of Australia may well date to initial colonization at 55,000 BP, the earliest dated tradition we have at present is the upper palaeolithic art of western Europe starting at *c.* 35,000 BP (Fig. 18.5). This art provides the most eloquent testimony that by this date all elements of a fully modern cognition had evolved (Davidson and Noble 1989): the cave paintings from Lascaux, Altamira, Niaux and the many other decorated caves must surely relate to a mythological world and an ideology that is now lost to us and, in that the animals depicted were those the people hunted, they suggest that the natural world was now viewed in cultural terms—the ice age hunters lived in a culturally created symbolic world.

We can interpret this art in terms of myth and attempt to reconstruct the symbolic world of the hunters (see, for example, Leroi-Gourhan 1968), but without written documents or oral history this is unlikely to be profitable research: the symbolic meanings of the cave paintings are lost to us forever. However, we can

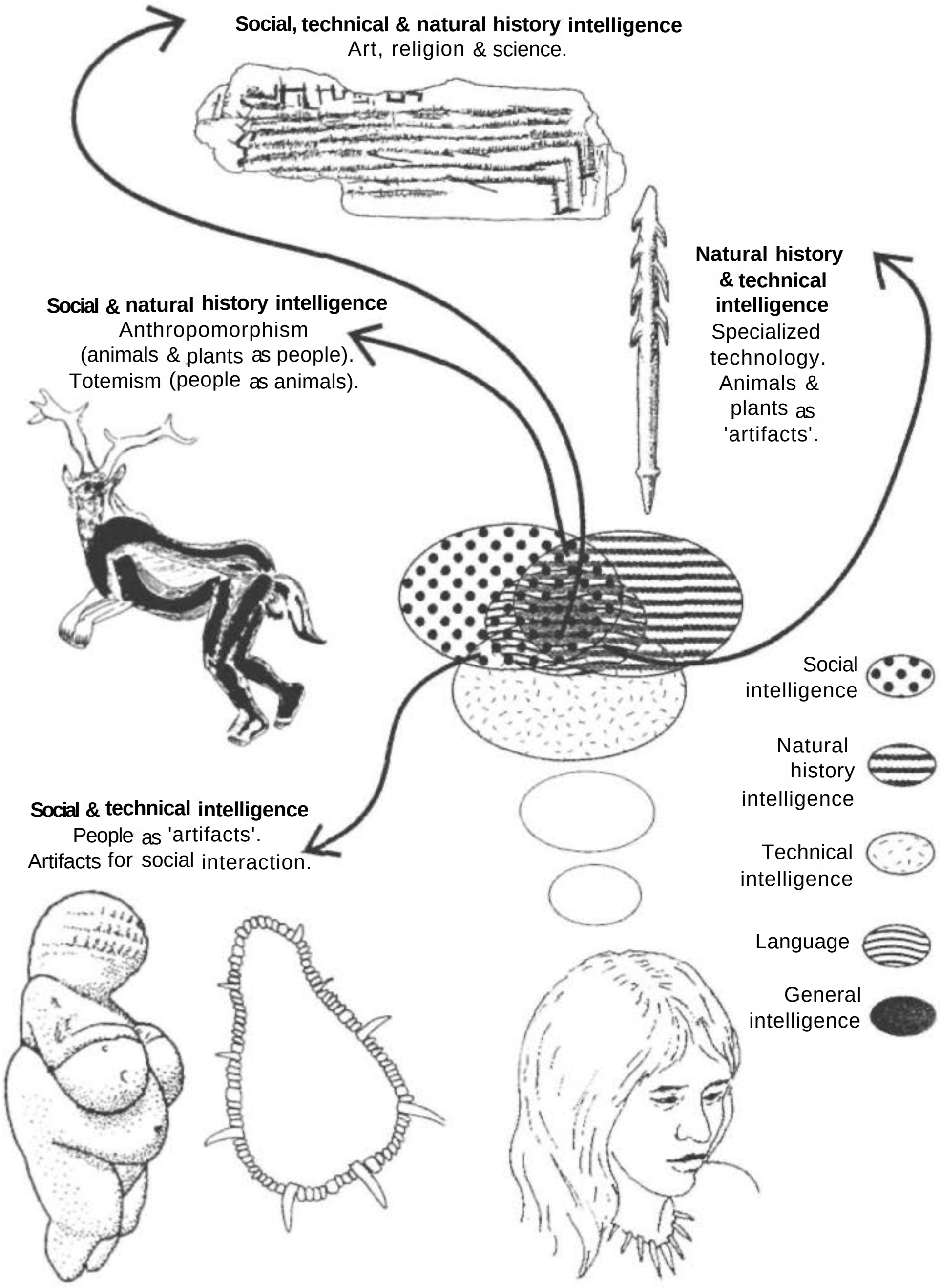

Figure 18.4 The cultural explosion that appears to have begun at *c.* 100,000 and reached a peak *c.* 40,000 years ago is attributed here to a new-found cognitive ability to integrate the multiple intelligences of the early human mind; it resulted in new ways of thinking which lie at the root of art, science and religion in the modern world. Source: S.Mithen 1996.

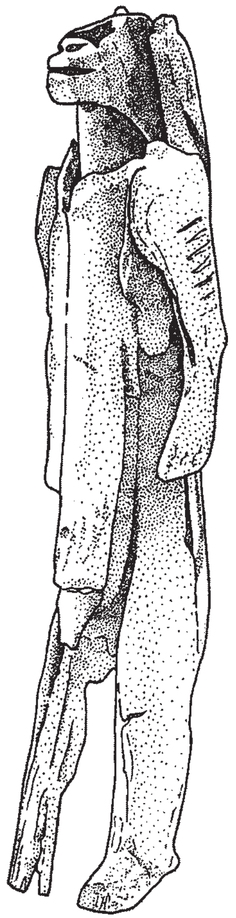

Figure 18.5 The lion/man statue from Hohlenstein-Stadel, southern Germany, *c.* 30– 33,000 years old. Height 28 cm. Source: S.Mithen 1996.

analyse this art from a more functional perspective that views it as a means to store, transmit and recall information. Donald (1991) has coined the term 'external symbolic storage' to refer to this type of material culture which marks a major change in the character of human cognition. The value of such external storage should be immediately familiar to us by our use of libraries, and increasing reliance on electronic storage of information; indeed, some early artefacts may be directly comparable, such as the Taï Plaque with its complex series of incisions (Marshack 1991; Fig. 18.6). The range and complexity of the cognitive tasks we can address by using external information stores are of a radically different order of magnitude than if we can only rely on the information that can be stored in human minds. Palaeolithic

Figure 18.6 Engraved bone plaque from Grotte du Taï, Drôme, France. Length 8.8 cm. Source: S.Mithen 1996, with permission of A.Marshack.

art therefore marks the reversal of the process that began early in prehistory, of ever-increasing demands on human memory and information-processing capacities (Donald 1991).

For many art traditions, the information being stored may be purely symbolic, but in other cases, ecological knowledge may also be stored within the art, and this is likely to be the case for the Upper Palaeolithic. If we examine the imagery of the cave paintings and mobiliary art in detail, we can identify a series of references to the processes by which hunter-gatherers acquire information from their environments, such as by following tracks, inspecting spoor and watching the behaviour of animals, particularly bird life (Mithen 1988a, 1990). These references probably acted as cues to the recall of information from episodic memory (that containing information about past events, rather than more general knowledge which is stored in procedural memory). Hunter-gatherers are always acquiring information and storing it in long-term memory (see Mithen 1990: chapter 3); the problem they face, as with all people, is the recall of relevant information when a particular problem arises. Upper palaeolithic art, with its series of recall cues, is likely to have facilitated such information retrieval, probably at times of substantial change in hunting strategies (Mithen 1988b, 1990).

This approach, as with other functional approaches to the art (Gamble 1982; Jochim 1983) does not deny its aesthetic and symbolic qualities, nor its immense creative achievement (Mithen 1991a), but a study of the creative processes involved in this art is poorly developed. There is a general view that 'creativity' is outside of scientific study, being a mystical process that cannot be explained other than by referring to individual genius. As cognitive archaeology develops, this is likely to change as archaeologists begin to integrate new work in computational psychology, such as that on creativity (Boden 1990), into their theory-building and interpretations.

Rationality, emotion and hunter-gatherer foraging

The study of subsistence has long been a major concern of palaeolithic archaeologists, principally due to the preservation of faunal assemblages that inform about prehistoric hunting strategies, but archaeologists are now beginning to invoke various cognitive processes to replace the behaviourist/functionalist approaches such as those of the Cambridge 'palaeoeconomy' school (Higgs 1975). Such cognitive approaches can be briefly illustrated by considering the subsistence practices of those ice age hunters who created the cave paintings in south-west Europe.

The diversity of game in the faunal assemblages (Delpech 1983; Straus and Clark 1986) makes it clear that these hunters faced choices about which animals to hunt and how they should be exploited: for instance, in many areas and periods there were large migratory herds of reindeer to ambush (Spiess 1979), as well as a range of other large game such as bison, horse and red deer. In addition, there was a range of smaller game. Salmon fishing in the rivers running to the Atlantic may have been particularly productive (Jochim 1983). Individuals and groups of foragers had to make choices between these alternatives, formulate goals, and then plan how these would be attained. Often such planning would have involved acquiring information and developing joint plans with other groups. Moreover, this decision-making would often have taken place under conditions of considerable uncertainty: the hunters were living in environments which had substantial, and to some extent unpredictable, fluctuations in resources across time and space. Consequently, they not only had to make plans, but also contingency plans if the targeted resources were insufficient in number or maybe simply failed to appear.

It was by decision-making in conditions of uncertainty that hunting plans were made and executed, and it was these, in turn, that led to the creation of the large faunal assemblages from cave sites in south-west France. To focus on decision-making, planning, and rationality, however, must not be taken to imply that the cognitive archaeology of prehistoric hunting views people as inhuman information-processing machines: two cognitive features which intuitively appear opposed to rationality would have been central to such decision-making—creativity and emotion. Creativity plays an essential role in planning and decision-making, particularly in conditions of uncertainty when hunters regularly have novel situations bearing similarities to past events but also having unique elements. Consequently, new hunting plans cannot be a simple repeat of those used on previous occasions but require ingenious solutions to novel distributions of resources.

Similarly, we need to view prehistoric hunters as having the full range of human emotions and refer to these in our interpretations of past behaviour. Feelings such as delight, anger, sadness, and so on act as a management system for the control and processing of information. Imagine a prehistoric hunter deciding whether to search for deer in the woodland with other hunters, or to gather molluscs on the seashore. To make a perfectly rational decision, the hunter would need to acquire and process a mass of information about the pros and cons of each resource: the costs, benefits and risks of its exploitation, the reliability of this information, the actions of other hunters and so on. Without any emotion, and with unconstrained rationality, the hunter would starve while acquiring and processing the infinite amount of potentially relevant information, but if we allow him emotion, this quest for perfect rationality will be inhibited and he will choose one course of action rather than another (Mithen 1991b).

In short, as archaeologists adopt a more cognitive approach to prehistoric subsistence by becoming concerned with planning and decision-making, they also achieve a more humanistic vision of the past. A prehistory in which we discuss the role of human creativity and emotion is ultimately more satisfying and appropriate than one in which such cognitive processes—which we know to be essential to our own behaviour—are not invoked. The critical point, however, is that by bringing these into our interpretations we can avoid renouncing a ‘scientific’ approach to the past by drawing on recent work in cognitive science, which has shown how cognitive processes such as creativity and emotion are indeed amenable to scientific study (de Sousa 1987; Oatley and Johnson-Laird 1987).

COGNITIVE ARCHAEOLOGY IN THE AGE OF PLATO?

We now make a quantum jump in chronology, to classical Greece. And immediately we face a serious question of applicability. After all, many modern philosophers would basically agree with A.N.Whitehead’s characterization of the history of Western philosophy as ‘a series of footnotes to Plato’ (Whitehead 1929:153). When the structures of the Lyceum, the school created by Plato’s successor Aristotle, were revealed in Athens early in 1997, the Western press saluted the event as a sort of intellectual home-coming. So there is a problem here for anyone seeking to pursue the ‘archaeology of mind’ (Renfrew 1982) into the ambit of classical Greece. It seems impudent to use the objects of archaeology as a means of understanding cognitive development in a society which gave rise to Plato and the Academy, to Aristotle and the Lyceum. What possible light can archaeological remains shed upon the Greek mind, when the literary record is so generous and (if we accept Whitehead’s dictum) fundamental?

The enduring tradition of Platonic studies can readily delude us that our mentality is hardly foreign from that of a Greek in the fifth century BC: which explains the sort of jocular handbooks of Greek society such as H.D.F.Kitto’s *The Greeks* (first published in 1951; still in print, and popular amongst students), with its engaging air of complete at-homeness with Greek institutions, and its fluent *apologia* for violence, misogyny and economic exploitation in classical Athens. Anyone who shares the Kitto familiarity with the Greek mind will have no problem with the material remains of classical Greece: Kitto salutes classical Greek art and architecture for its 'consuming intellectualism'. (By comparison, the products of Minoan art are nugatory, and the structures of pre-Hellenic Knossos are 'chaotic': Kitto 1951:25–26.)

The investment of rationality in Greek art and architecture is done so regularly that it would be futile to start listing instances: it is easier to recall the incident described by E.R.Dodds, introducing *The Greeks and the Irrational,* where a young man standing in front of the Elgin Marbles confesses that his response to 'this Greek stuff' is killed by its overbearing 'rationality' (Dodds 1951:1; see also Vidal-Naquet 1986:252). Following Nietzsche's basic schism between 'Apolline' rationality and 'Dionysiac' irrationality in the ancient Greeks, Dodds and others have endeavoured to reassure us that the Greeks were less intimidating in their commitment to rationality than we might imagine. The result is not coherent: it seems to put schizophrenia on an almost ethnic scale, whilst it also sets a trap for the would-be archaeologist of mind. Which half of the presumed 'Greek mind' is going to betray itself in the archaeological record: the 'emotional', or the 'rational'? According to some cognitive scientists, the question should never arise (de Sousa 1987).

The extent of the historical problem is nicely illustrated by an anecdote of European antiquarianism. In the Fitzwilliam Museum in Cambridge there is the upper part of a colossal caryatid (Fig. 18.7). Its original Greek site was Eleusis, and the statue was first recorded and identified as Ceres (Demeter) by Sir George Wheeler (Wheeler 1676:428). Another scholar-tourist, Edward Dodwell, reported the statue in 'its full glory, situated in the centre of a threshing-floor', and tells us that the farmers of Eleusis village 'were impressed with a persuasion that their harvests were the effect of her [that is, Demeter's] bounty' (Dodwell 1819, I:583). Previous attempts by French antique-hunters to remove the statue had failed; having been dragged to the port, the statue, according to the locals, had flown back to her proper place. It was E.D.Clarke who eventually got Demeter from Eleusis to Cambridge (via shipwreck off Beachy Head) in return for the gift of a telescope to the Turkish administrators and some bribery involving the village priest (Clarke 1803; Otter 1824:505).

This is a poignant episode, and it raises an important question about the archaeology of mind when applied to museum objects. Our natural response is more or less akin to Clarke's: to imagine that a statue ensures agricultural success is the sign of a 'savage' or 'irrational' mentality. At best, we spare the peasants of Eleusis some romantic sympathy: we may dwell on 'the misty glory which the human imagination sheds around the hard material realities of the food supply' (Frazer 1912:vii). But it is worth pondering the durability of Demeter's cult at Eleusis. The sanctuary and its functions were supposedly ended in AD 396, when Alaric the Goth invaded Greece, so why were Eleusinian farmers still lighting lamps on festival days to the statue of Demeter in AD 1800? Frazer's answer may be predicted: the farmers revere the statue because they have yet to discover

Figure 18.7 Upper part of a colossal caryatid (basket carrier) from Eleusis. Marble, second century AD. Reproduction by permission of the Syndics of the Fitzwilliam Museum, Cambridge.

phosphates; the cult of Demeter is a surrogate for scientific understanding; the magic continues pending the advent of rationality; and so the foundation and development of the sanctuary of Eleusis may be roughly regarded as sustained 'error'.

As Anthony Snodgrass (1984) has pointed out, however, despite our familiarity with Greek sanctuaries as archaeological sites we know surprisingly little about how sanctuaries such as the Athenian Acropolis, Olympia and Delphi actually functioned with regard to their cult practices. The excuse for our ignorance has been given as 'the fact that Greek sanctuaries operated in a way which produced relatively little stratification' (Snodgrass 1984:227), but there is surely more to it than that. Greek temples are taken to be models of control, regulation, order: the 'orders' of Greek temple architecture were reckoned in the eighteenth century to have developed from the huts of savages; the same orders are regarded by some modern architects and their regal mentors as the ultimate signs of reasonable (or 'God-given') design. Turned into town halls (Leeds) or schools (Edinburgh High) or museums (the British), Greek temples become the circumstances of modern rationality. Who would ever believe that the inner sanctum of the Temple of Apollo at Delphi contained an enclosure in which a woman crouched on top of a tripod, inhaled vapours from a crack in the ground, and went into an inspired fit; or (more incredibly) that representatives from Greek city-states took serious political decisions on the basis of such epileptic ravings?

Most archaeological material from sanctuaries is put into museums, and once inside a museum an object is easily stripped of its cult significance. It requires a massive leap of imagination to envisage a sanctuary like Olympia as it properly was, cluttered with statues, dedications and votive offerings. Pausanias picked his way through a jungle of images at Olympia in the second century AD; and a century of German excavations has revealed an Olympia rich with potential information about cult practices. To an early seventh-century BC stratum belong thousands of bronze and terracotta animals; in the sixth and fifth centuries BC, *tropaia*—tithes of booty offered to Zeus by victorious city-states—were popular; and from the mid-fifth century BC, athletic dedications proliferate. Olympia developed into a sanctuary that hosted, according to Pausanias, some seventy different cults.

We fancy ourselves familiar with the Olympic Games, but we remain unsympathetic to the implications of a running track dominated by a temple, and we might have trouble in understanding the images of the Olympic sanctuary if we did not have Pausanias (V.21) telling us, for example, that the statues of Zeus wielding a thunderbolt have a generic name *(Zanes)*, representing the penitence of athletes caught cheating in the Games. All the same, most of the cults mentioned by Pausanias have yet to be identified; hardly surprising, when one of the veteran excavators admits that no one has yet explained the relationship of religious observances and athletic competitions at Olympia (Mallwitz 1988).

This is the problem with the archaeology of mind when applied to classical Greece. It is not a lack of material, stratified or otherwise, but rather a lack of will. There is no reason why the material remains of a classical Greek sanctuary should not be analysed according to the same archaeological and anthropological methods as outlined by Renfrew for the prehistoric site of Phylakopi (Renfrew 1985). Indeed, we ought to be at a great advantage when, for example, the priestly offices at Delphi are filled by characters as divulgative as Plutarch. But Greek rationality is at stake. Greek behaviour at sanctuaries displays features of something we would want to call 'pre-logical thinking', or 'primitive mentality' —or, to risk using their ambivalent own word, *deisidaimonia* ('respect for the gods' or 'superstition') —and as such, certain distinctions we hold dear begin to seem blurred. What is 'Greek' and what is 'barbarian' becomes blurred; what is 'rational' and 'irrational' becomes blurred; and we can no longer be sure of that old logic which equates 'science' with 'civilization'.

The misleading effects of a *mentalité* approach to classical Greece have been exposed by Geoffrey Lloyd (Lloyd 1990). As he shows, drawing the line between ‘science’ and ‘magic’ is not as easy as we think. The historian of science collects the writings of Hippocrates and his followers, and salutes the birth of ‘clinical’ or ‘scientific’ medicine in the fifth century BC; the archaeologist charts the extraordinary growth, from the fifth century BC onwards, in *Asklepeia,* sanctuaries to the healing god Asklepios, from Athens (420 BC) to Rome (293 BC). Some antipathy can be demonstrated between the Hippocratic practitioners of ‘scientific’ medicine and their rivals, the faith-healers: but the archaeology of the Asklepios cult suggests that it cannot be polarized as purely psychosomatic. Stelai at the Asklepeion on the island of Cos (the home of Hippocrates) were said by the first-century AD geographer Strabo (XIV.2.19) to carry records of Hippocratic or ‘clinical’ cures; surviving stelai from other sanctuaries of Asklepios certainly show that the marvels of divine healing could be tempered with proper physiological advice (Edelstein 1945).

Plato’s attitude to the ‘primitive mentality’ of sanctuaries like Delphi is well known. He was perfectly aware of potential hocus-pocus from the mantic quarters of Greek cult practice (*Laws* 908d), but was nevertheless prepared to weave into community life a continuous thread of regular religious observances, in which the *manteis,* or prophets, are fully involved (*Laws* 828b). We do not know how Plato regarded the sort of cult which Clarke found lingering at Eleusis in 1801, but it has been pointed out that the terminology of the Eleusinian Mysteries is metaphorically used in some of Plato’s arguments, and it seems likely that he would not have disparaged the value of a statue entrusted with agricultural fertility.

Few Western philosophers have tackled the problems posed by ‘irrationality’ in the age of Plato, but one exception is Wittgenstein, in his comments on Frazer’s *Golden Bough* (Wittgenstein 1979). It is well known that Wittgenstein was profoundly irritated by some aspects of English culture, and his marginalia to Frazer are often more astringent than necessary (‘Frazer cannot imagine a priest who is not basically an English parson of our times with all his stupidity and feebleness’ — Wittgenstein 1979:5e); but we can accept the principle Wittgenstein is stating, which is that the treatment of magical and religious notions as mistakes or stupidities *(Dummheiten)* may itself be wrong-headed. The identification and isolation of a ‘savage mentality’ as a misunderstanding of the physical world are wrong; Frazer’s readings of ancient and comparative ritual seem cruder than the rituals themselves; and there is one central factor to be reckoned with—more psychological than anthropological—which is that ‘man is a ceremonious animal’ (Wittgenstein 1979:7e).

The implication is that cognitive archaeology is as valid for the age of Plato as it is for the Palaeolithic. In fact, for those trying to understand Greek art and architecture, some process of cognitive archaeology is not only legitimate but also necessary, if anything beyond straight stylistic classification is to be achieved.

Kouroi and 'the Greek Revolution'

The archaeology of mind, as we have seen, has been scarcely pursued beyond the chronological margins of prehistory; yet Colin Renfrew's original rubric for the application of such an archaeology signalled not only the Aegean as an area ripe with possibilities, but also 'early Greek civilization' as offering a particular example of 'symbol systems' in operation (Renfrew 1982:25). According to Renfrew, the free-standing and life-sized male statues known as *kouroi* ('youths': Fig. 18.8) display a stylistic uniformity that allows them to serve as symbols of interaction between the independent city-states (or 'peer polities') of the Aegean during the sixth century BC (see also Renfrew 1986:11–12). Standardized, schematic statues may clearly be valuable as symbols; indeed, their symbolic value is dependent precisely upon their

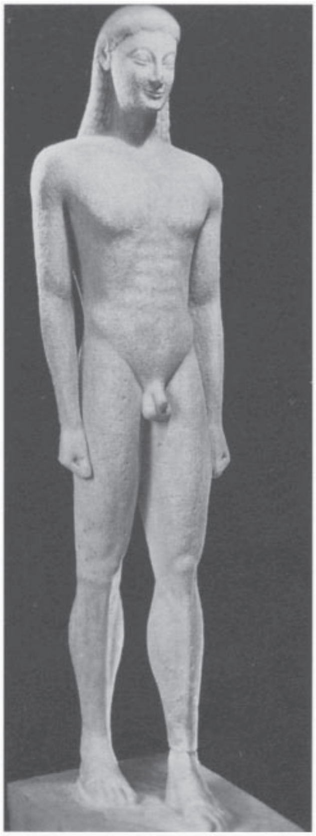

Figure 18.8 Kouros (youth) from Melos. Marble, mid-sixth century BC. © National Archaeological Museum, Athens.

schematic features. If the statues failed to conform to expected schemes, then the shared message implied by the shared style would get lost or confused. So it is easy enough to accept Renfrew's idea that the *kouroi* communicate a common ideology of 'Greekness' amongst the autonomous city-states.

However, what happens when the *kouroi* apparently lose their schematic features? In the stylistic classification of these statues (Richter 1970), the last *kouros* is reckoned to belong to the early fifth century BC; thereafter, free-standing and life-sized male statues no longer show the predictable features which have symbolic value. We arrive at the moment which art historians have dubbed with various terms, all of them dramatic—'emancipation' (Loewy 1907), 'the great awakening' (Gombrich 1972:46–64), 'the Greek Revolution' (Gombrich 1960:99–125; Spivey 1996:17–53)—when Greek artists turned away from schematic forms or 'memory-pictures' (Loewy 1907) and began working from the direct motive of imitating 'nature'.

This leads us to put an important gloss on Renfrew's use of the 'uniformity' of the *kouroi*. The statues have been chronologically ordered: though 'standardized', they can be perceived as changing over time. The earliest are dominated by geometric forms for limbs, muscles and so on; the latest are naturalistic. Regional distinctions are not easy to define because, amongst the artists of the Greek city-states, 'the progression in anatomical knowledge was amazingly uniform' (Richter 1972:4). Indeed, the stylistic evidence may well support what the literary tradition subsequently tells us, that Greek artists were peripatetic and took commissions from whichever city-state was offering. This does not affect Renfrew's point: but the logical result is that, sooner or later, the archaeologist of mind is challenged by a lack of uniformity, obvious patterns, standards or schemata in the material record.

Before tackling the consequences of fading schemata, it is worth pointing out that to credit the Greeks of the fifth century BC with a unique 'awakening' in art-historical terms is not to foist upon them some retrospective judgement. Greek artists knew they were leaving the sleep of 'memory-pictures' or patently schematic forms. That is why one Athenian vase-painter, c. 510 BC, inscribed one of his red-figured pots with a sporting taunt to a fellow-painter, daring him to accomplish the same skills of naturalistic representation (Boardman 1975:33); that is why competitive tenders were invited for the decoration of classical temples and sanctuaries (Boardman 1985:36); that is why anecdotes about illusionistic skills and tricks proliferate about classical artists (Kris and Kurz 1979); and that is why, over a century later, Plato gives this estimate of the Egyptians: 'if you inspect their paintings and reliefs on the spot, you will find that the work often thousand years ago—I mean the expression not loosely but in all precision—is neither better nor worse than that of today; both exhibit an identical artistry' (*Laws* 656d).

For Plato, the predictability of Egyptian art was a virtue, a sign of good legislation. Egyptian artists were, in his eyes, entirely subordinate to the Pharaohs for whom they worked. He exaggerated the point, of course: sculptured figures of the Egyptian Predynastic period (before 3100 BC) are by no means identical with the Late Dynastic period (which is the Egypt Plato knew in the fourth century BC). But it is true that within the iconography of Egyptian 'court art' we can recognize symbols of power which hardly alter over thousands of years, and the style of representation admits amazingly little variation. The Pharaohs of Plato's time, struggling to maintain Egypt's unity against external forces, may have exaggerated this traditionalism. But it is there: a system of symbols entirely suitable for government, based on the concept that Pharaoh was a god and 'the champion of the cosmic order' (Lloyd 1983:288). Thus Pharaoh with the body of a lion; Pharaoh with a bull's tail; Pharaoh with a sun disc over his head—these are hieroglyphs of divine power, messages whose cognitive value was guaranteed for successive millennia by an enduring system of dynastic rule.

The archaeological record of such schematic art readily lends itself to analysis of autocratic ideologies, or amalgamations of secular and religious authority (Larsen 1979:295–390). Lord Curzon's well-known comment on the reliefs of the palaces of the Persian kings at Persepolis—'all the same, and the same again, and yet again' (Curzon 1892, 2:194)—is easily translated into the cognitive implications of those reliefs. The rulers occupying the buildings decorated by the reliefs had vast armies at their command. The repetition of the figures indicates size; the homogeneity of the figures indicates subordination. And since Persepolis was founded by the same Persian kings who sought to extend their rule over Greece in the first half of the fifth century BC, it is tempting to compare art styles at Persepolis with art styles at Athens. Can it be argued that the 'emancipation' from schematic forms at Athens in the fifth century BC pertains to a society free from autocratic rule? Is there then such a thing as an 'archaeology of democracy'?

The cognitive mapping of classical Athens

In the opening chapter of his *History of the Peloponnesian War,* the historian Thucydides makes the following observation on Athens and Sparta as cities. Imagine, he says, that Sparta became a deserted city, and that you went to visit it: you would never guess that Sparta had been a major power—not only in the Peloponnese but in the Aegean ambit generally—because Sparta as a city 'is not regularly planned and contains no temples or monuments of great magnificence, but is simply a collection of villages'. By contrast, the hypothetical visitor to a deserted Athens 'would conjecture from the eye that the city had been twice as powerful as it in fact is'.

This section of Thucydides' history, written towards the end of the fifth century BC, is sometimes called his 'Archaeology', and archaeologists ought to take note of his observation on the potentially misleading remains of Greek cities. It might well be understood as a caution not to proceed with the analysis of power systems from material remains, or even as a deterrent to attempting an archaeology of mind within classical contexts. Alternatively, it could be argued that the absence of extravagant buildings in Sparta properly reflects aspects of Spartan ideology. However Thucydides' point is taken, we are left with the fact that he, an Athenian of the late fifth century BC, is aware of the value of ideological expression in material terms. His literary testimony constitutes one source for our understanding of the genesis and operation of democracy at Athens: but it is not alone. Ancient Athens was 'a city of images' (Bérard 1989): the images are further testimonies. In other words, the archaeologist should be able to assist in the definition of the Athenian democratic ideology.

Considered in terms of urban form, Athens was more than 'a city of images': it was a city rich in what urban planners call 'imageability'. Imageability is defined as 'that quality in a physical object which gives it a high probability of evoking a strong image in any given observer' (Lynch 1960:9). Thucydides was evidently aware that the urban form of Athens was 'imageable' on a grandiose scale; and just as he told his readers that his history would last 'for ever', so some of the monuments of classical Athens survive as potent images of 'order', political maturity, and so on. The Acropolis still rises above modern Athens as a highly visible landmark; and the principal temple upon the Acropolis, the Parthenon, has a recent history of serving as the prototype for modern civic and 'democratic' buildings. The re-contextualization of such images may be useful: for if we can recognize the cognitive processes whereby we connect, say, a particular statue in New York harbour with 'Liberty', then it will help us understand similar processes suggested by the archaeological record of classical Athens.

Athens was an organic city. In the mid-fifth century BC it could be described as 'wheel-shaped' (*trochoeideos:* Herodotus, *Histories* VII.140), and to those tracing the organic development of this 'wheel', it is clear that in a gradual fashion, the city's hub shifted from the Acropolis to the Agora (inadequately translated as 'marketplace': as we shall see, its functions went far beyond those of commercial exchange). The Acropolis as a rock was always prominent topographically; but the cognitive significance of its landmark qualities demonstrably altered over several centuries. In the Bronze Age, the rock was the basis of a Mycenaean palace, massively fortified in the late thirteenth century BC. This was large enough to provide shelter for perhaps several thousand people in times of danger; otherwise, it was royal accommodation, and monumentally dominated an outlying area of nucleated settlements.

The stratification of subsequent development on the Acropolis is notoriously difficult to define, but the Mycenaean palace yielded to a temple, and then a series of temples; the archaeology can be coloured with stories of the seizure of this area first by tyrants, then by invading Persians. But below the Acropolis, at the end of the seventh century BC, we see what was once a cemetery becoming the focus of palpably 'civic' development: a large quadrangle was cleared, rectangular buildings erected on its west side, and further structures—including a fountain-house and a large walled enclosure—were added during the sixth century BC. Between 500 and 100 BC the remaining three sides of the square were filled: and the area is archaeologically recognizable as the centre of the city (Fig. 18.9). Arterial roads converge upon it, and most of the buildings can be assigned their central civic purposes—not only from literary references but also from the finds of several decades of American excavations. Thus, for example, there were small water-clocks for the timing of speeches; allotment machines for impartial selection of members of juries; publicly stamped sets of crockery, for meals served to senators at public expense;

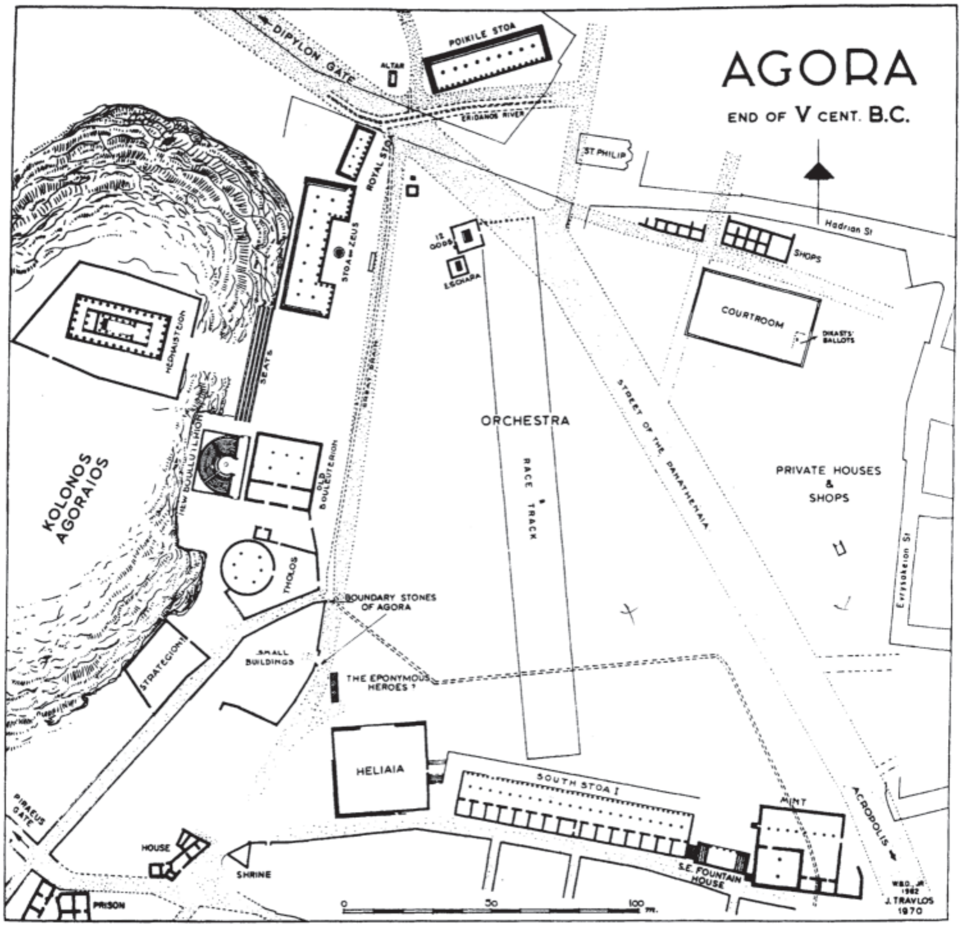

Figure 18.9 The Athenian Agora at the end of the fifth century BC. Source: American School of Classical Studies at Athens: Agora Excavations.

and so on. Even without the assistance of literary testimony, an imaginative archaeologist could recognize the protocols of democracy in these objects.

The development of the Agora was not at the cost of the Acropolis, but the public perception of the Acropolis changed: it was an elevated place, but not occupied by temporal rulers. Our knowledge of the Athenian religious calendar is not profound in its detail, but we do know that festival days punctuated many days of many months of the year: and the impression of civic life dominated by cult observances is precisely what we would get from the classically developed Acropolis. It became an area compact with altars, temples, shrines and places of potential taboo; and the rite of passage involved in entering that area was emphasized by the erection, in the 430s BC, of monumental gateways *(Propylaea)*. It was no longer a place of royal residence: in the sixth century BC the Peisistratid tyrants may have lived up there (although one building along the west side of the Agora has been tentatively identified as a 'palace' of the Peisistratids), but in the fifth century BC the business of government was clearly accommodated around the Agora.

The ideological consequences of this are clear only when comparisons are made. The Persian kings who built Persepolis adhered to the stock design of oriental monarchies: government offices clustered around the king's (divine) presence in a complex of palaces. The Hellenistic dynasts of Pergamon in Asia Minor installed themselves in palaces adjacent to temples on top of a terraced citadel. The Roman emperor Augustus put up a temple to Apollo on Rome's Palatine Hill, and his own house next to it, so that it was not easy to define where the residence of Apollo ended and the residence of Augustus began. Tyrannies, oligarchies, monarchies and dictatorships take the high ground: the level is for democracy, whose institutions are topographically—and typically—more 'accessible'.

The ordering of urban space along preconceived ideas is often described as a Greek 'invention', and ascribed to Hippodamos of Miletus. One part of Athens—or rather, the harbour town which served Athens, the Piraeus—is reckoned to have been planned by Hippodamos, in the mid-fifth century BC; otherwise, the city lacks the sort of orthogonal or zoned layout which is the Hippodameian hallmark. This is to be expected: though some classical minds dreamed of laying out a geometrically ideal city (Aristophanes, *Birds* 905–1009; Plato, *Laws* 705a–e), in practice this tended to be possible only in situations of artificial 'development', as in the case of the Athenian-inspired colony of Thurii in southern Italy planted as a replacement to the ruined Sybaris. There is, in some of the literary records, almost an inverted snobbery about the lack of Egyptian or Near Eastern-style order in the domestic quarters of Athens, so we are bound to look at the details of areas of public activity if we want information about prevailing ideologies.

Here, the concept of 'the Greek Revolution' needs qualification. It is true that art at Athens in the fifth century BC displays, in its best-known museum pieces (the sculptures of the Parthenon, for example), the sort of non-schematic characteristics which excite our admiration. And, as we maintained above, it is also the case that both artists and their public were conscious of innovations in representation—'the shock of the new' is a concept by no means confined to the art of our own era. However, it is important to remember the context in which the 'virtuoso' painters, sculptors and architects of classical Athens worked: an essential conservatism in terms of architectural types; an essential homogeneity in the materials used for building; and the retention, for key junctures of public activity, of patently archaic schemata.

The conservatism of the classical temple 'orders' needs no special illustration, but it is worth explaining the extent of other 'orders'. The most curious of these to modern minds is the Herm. *Hermai*—rectangular shafts decorated with male genitalia and the head of the god Hermes on top—hardly change in their design between the sixth century BC and the second century AD. Hundreds of these images stood in Athens, marking entrances of shrines and private houses, and sometimes doubling as victory monuments. The Agora excavations have yielded many examples (Harrison 1965), some of them bearing signs of the mass vandalism which took place one night in 415 BC in what was interpreted as a plot to overthrow democracy (Thucydides VI.26). These statues were germane to orientation within the city. Their regular features (the erect phallus a symbol of luck; the bearded Hermes, of course, the deity of safe passage) remained unchanged: in every sense of the expression, you knew where you were with the Herms.

Likewise, there is no artistic 'revolution' in the Hekataia, the statues of a triple-headed, triple-bodied goddess regularly placed at crossroads or junctions of three roads. Sculptors engaged to carve such images never attempted to alter their style. Without street names, or even gridded streets, people relied upon schematic forms as landmarks, and it was the very archaistic force of such images that gave them their value as signposts. The entrances to the Agora, too, were marked by 'speaking stones': *perirrhanteria,* or lustral basins, of the sort usually associated with temples, were placed there, implying a pseudo-religious purification procedure before entering the business of public life; and the extent of the Agora area was marked by *horoi,* or boundary-stones. These inscribed stones are found elsewhere in the city: they told you when you were on the margins of an area with special status such as a fountain, a shrine, or a burial area (especially necessary in the Kerameikos quarter of the city, where potters worked close by a large cemetery), and the formula of the inscription invests the stone itself with semiotic duties. *Horos eimi tes agoras:* 'I am the boundary of the Agora', declares the stone. It is, like the lustral basins, a feature of near-sacred demarcation.

The survival of archaic images within their city furnished the Athenians with perhaps the most distinctive feature of their political culture: a powerful sense of the past, expressed in an accumulation of commemorative images. Students of Greek art are inclined to underestimate this: faced with the theory that the Parthenon Frieze (carved *c.* 440 BC) commemorated a victory over the Persians at Marathon in 490

BC (Spivey 1996:123–51), it is the time-lag of fifty years that seems incredible. But the distance between Athenian citizens and their heroic past was kept short by regular cognitive association of the city with its fixed images.

The best example of this association is provided by a well-known statue group called 'The Tyrannicides', commemorating the murder of Hipparchus, one of the sons of the tyrant Peisistratos, in 510 BC, by two men called Harmodius and Aristogeiton. A hero cult developed, centred around their statue in the Agora; only Roman copies of this have survived (Fig. 18.10), together with a series of iconographic references. The statue may have been placed in the Agora originally

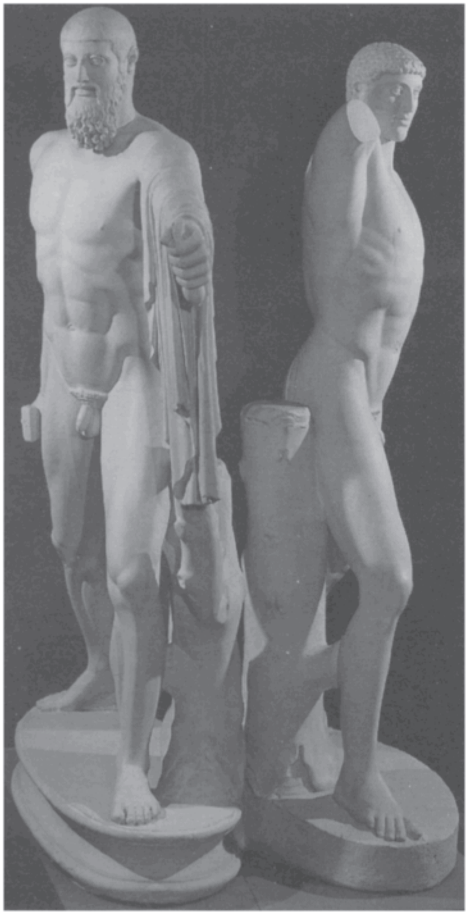

Figure 18.10 'The Tyrannicides', Harmodius and Aristogeiton; cast of a Roman marble copy of a bronze group originally set up in Athens *c.* 470 BC. Source: Museum of Classical Archaeology, Cambridge.

because the assassination itself had, according to the historians, taken place at one of the shrines there, but subsequently it was simply part of the general architecture of democracy in that area of the city. Its message was essentially a testament to the democratic ideology of classical Athens: the power *(kratia)* of the people *(demos)* to rid themselves of autocrats.

Classical scholars have long debated the meaning of Athenian 'democracy'. But as far as popular perception goes, the images and memorials of fifth-century Athens provide enduring models for modern liberal constitutions. The idea that classical Greek art is owed to a democratic constitution is as old as J.J.Winckelmann (Winckelmann 1764:I.4.130–33). Sir Alfred Zimmern refined and reaffirmed the point: 'we owe the Parthenon sculptures not merely to the genius of Phidias but also to the genius of the social system which knew how to make use of him' (Zimmern 1922:368). Yet very little has been done, beyond easy assertions of environmental determinism, to study the cognitive connections between ideology and material remains in fifth-century Athens. Isaiah Berlin, a self-styled 'historian of ideas', is issuing a challenge to archaeologists when he asks: 'how much do we know about Athens—the *mentalité,* or the ways of life, in the days of Socrates or Plato or Xenophon? We scarcely know what Athens looked like—did it look like Beirut or a Zulu kraal?' (Jahanbegloo 1992:26). As we have seen, the picture of classical Athens is not quite so unfocused that the city cannot be distinguished from a Zulu kraal, but Berlin has identified a genuine problem. It is not that the Greeks failed to rationalize their art and architecture, but simply an accident of survival that their treatises on such matters are no longer available for us to consult. We have the opportunity to pick up their material remains—their theories 'reified', in effect — and attempt to reconstruct the thinking behind them.

CONCLUSION

It was the anthropologist Franz Boas who stressed that the mind of early man could never be described as 'primitive' in the sense of being underdeveloped or unsophisticated, either rationally or emotionally (Boas [1927] 1955). And it is another anthropologist, Ellen Dissanyake, who has argued for a constant in human development: that art is central to human evolutionary adaptation, and therefore that *Homo aestheticus* is a precursor of *Homo sapiens sapiens* (Dissanyake 1992). In this chapter we have yoked together two fields of archaeological study that are usually kept apart, but which indeed share, or ought to share, these anthropological premisses. The mental equipment of those who peopled the Upper Palaeolithic was basically the same as that belonging to the inhabitants of classical Athens. To draw up some sort of absolute progress chart of cognitive 'development' is therefore a misguided enterprise. We should rather be trying to assess historically what cognitive skills were required in a given social situation. We do not need to be structuralists as such (that is, to believe that there are innate human aptitudes for recognizing 'structures' or principles in language, myth, symbols and so on), but we should accept the existence of 'cognitive universals': patterns of thinking common to all who possess the human mind. Archaeologists have been slow to appreciate the possibilities of approaching the material record in search of those cognitive patterns. The caricature of modern tradition is the excavator who, coming across some strange and apparently unidentifiable structure or object, shrugs it off as 'ritual' and has no more to do with it. There are, as we have tried to indicate here, good reasons for adopting a more positive attitude.

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There has been a massive surge of interest in the evolution of human cognition during the last decade, with contributions coming from archaeologists, anthropologists, psychologists and philosophers; one work that has tried to integrate material from these disciplines is Mithen (1996). R.Byrne, *The Thinking Ape* (Oxford: Oxford University Press, 1995), provides an excellent review of the chimpanzee mind and its implications for the early stages of human cognitive evolution. Three very useful collections of papers which are dominated by studies of early cognition are P.Mellars and K.Gibson, *Modelling the Early Human Mind* (Cambridge: McDonald Institute, 1996), J.Maynard-Smith, *The Evolution of Social Behaviour: Patterns Among Primates and Man* (London: Proceedings of the British Academy, 1996), and T.Ingold and K.Gibson, *Tools, Language and Cognition in Human Evolution* (Cambridge: Cambridge University Press, 1993). *Gossip, Grooming and the Evolution of Language* by R.Dunbar (London: Faber, 1996) provides a provocative theory for the evolution of language and includes a useful summary for changes in the dimensions of the human brain during evolution. Studies of early stone tools which focus on their cognitive implications include Wynn (1989).

For classical Greece, some consideration of 'Hellenization' is essential before turning to the archaeological themes discussed here: F.M.Turner, *The Greek Heritage in Victorian Britain* (Yale: Yale University Press, 1981), is a good introduction to the study of classical paradigms in Western culture, and see also M.Bernal, *Black Athena* (London: Free Association Press, 1987). J.G.Frazer's *The Golden Bough* and his *Commentary on Pausanias* (London: Macmillan, 1898) remain highly useful; for a review of Frazer's current standing, see P.Burke (1986) 'Strengths and weaknesses of the history of *mentalités*', *Journal of the History of European Ideas* 7:439–51. On the aesthetic consequences of the Greek belief in animated art, see Spivey (1995). For the archaeology of Athenian democracy, see Camp (1986) on the American excavations of the Agora, and for the planning of classical Greek cities see W.Hoepfner and E.-L. Schwandner, *Haus und Stadt im Klassischen Griechenland* (Munich: Deutsche Kunstverlag, 1986), and W.Schuller (ed.), *Demokratie und Architektur* (Munich: Deutsche Kunstverlag, 1989).

Part III

WRITING ARCHAEOLOGICAL HISTORY

19

HUMAN EVOLUTION

Andrew T.Chamberlain

INTRODUCTION

Humans, like all other biological species, have an evolutionary history. The evidence for human evolution is found in the fossil and archaeological records and in the detailed similarities between modern humans and their closest relatives among living animals, the primates. The fossil record consists of the mineralized remains of bones and teeth with occasional preservation of the outlines of soft tissues, such as fossilized footprints. Fossils provide most of our information about the earlier, extinct species of humans which preceded the 'anatomically modern' humans that make up the world's population today. The emergence of uniquely human characteristics, such as upright posture, bipedal locomotion, increase in brain size and specialization of the hand, can be investigated by studying these fossils and identifying the changes that have occurred in human skeletal anatomy. Dating of the fossil record establishes the sequence and rate at which these evolutionary changes have occurred.

Although there are many palaeontological sites that have yielded human fossils, most of these sites have produced only fragmentary remains of one or a few individuals. The fossil record for the earliest humans is still surprisingly incomplete compared with the record for other groups of terrestrial mammals. The earliest humans occupied habitats and had a mode of life similar to primates, and like modern monkeys and apes the early humans would have made up only a small proportion of the animal species occupying their environment: in the modern East African savannah ecosystem, for example, primates constitute less than one per cent of the large mammal biomass production.

Humans share many anatomical, physiological, and behavioural similarities with prosimians, monkeys and apes, and these animals are classified together in the order Primates. Biological classification is hierarchical, reflecting the fact that the similarities between animal species define a nested pattern of affinity: similar species are grouped into a genus (plural = genera), similar genera into a family, and so on. This hierarchy is the result of the divergence, or 'cladogenesis', of lineages which occurs when new species are formed. After divergence, the separate lineages of descendants can no longer exchange genetic material, and the combined influence of differential selection pressure and genetic drift will eventually ensure that the species acquire differences in appearance and behaviour.

Modern humans are classified as the species *sapiens* in the genus *Homo*. It is impossible to observe directly the behaviour and genetic structure of early humans, but their fossilized remains differ in appearance (morphology) from modern humans to such an extent that they are classified in different species and sometimes in different genera from ourselves. Palaeontologists recognize and define fossil species by applying the principle of uniformitarianism. The members of a species are individually variable in their appearance, and yet there are usually morphological discontinuities ('gaps') that separate the members of one species from those of another. Palaeontologists make the quite reasonable assumption that fossil species should show approximately the same amount of variation as modern species, and therefore they do not as a rule classify very different fossils in the same species, nor do they create new species solely to account for small differences that are more plausibly interpreted as within-species variation. Of course, with only bones and teeth to work on, it is quite possible that the palaeontologist will not be able to recognize species that were identical in their skeletal anatomy while differing in non-fossilizable features such as coat colour, chromosome number or reproductive behaviour. There is therefore a tendency to underestimate the number of species that are represented by fossils (Foley 1991; Groves 1989; Tattersall 1986), but this practice is preferable to inventing species solely on the basis of minor individual differences.

At present there are about ten separate species recognized in the human fossil record, most of which are are grouped into two genera, *Australopithecus* and *Homo*. Some palaeontologists place the 'robust' australopithecines in a separate genus called *Paranthropus,* and recently an early australopithecine species has been placed in the distinct genus *Ardipithecus* (see p. 774). There has been considerable discussion about the distinction between *Australopithecus* and *Homo* but, as a general rule, species of *Australopithecus* differ from members of the genus *Homo* in having teeth that are large and brains that are small in relation to these animals' overall body size. There has also been debate about the defining features of the family Hominidae, into which *Australopithecus* and *Homo* are grouped. Although the earliest forms of *Australopithecus* were adapted to bipedalism, they were quite primitive in their cranial structure, and are difficult to distinguish from some fossils of Miocene apes. It is therefore convenient to adopt an evolutionary definition of the Hominidae as the group containing all taxa (that is, species and genera) that are more closely related to *Homo sapiens* than to any other living primate. In other words this is the clade that includes all descendants of the lineage that diverged from the African apes in the late Miocene about eight million years ago (Fig. 19.1). The late divergence of the African apes and humans, which is responsible for their close genetic similarity, has led some authors to group *Australopithecus* and *Homo* into the subfamily Homininae. These same authors use the term Hominidae for the group containing both humans and African apes, but in this chapter the expressions 'hominid' and 'humans' refer exclusively to the clade whose sole living representative is *Homo sapiens*.

PRIMATES AND HUMANS TODAY

Primates are a group of mammals that diverged from other mammalian orders in the early Tertiary era, after the demise of the dinosaurs at about *c.* 65 million years ago. Living non-human primates are confined to the tropical and subtropical areas of the world, and since many species prefer arboreal habitats, most primates are further restricted to forest and woodland biomes. The living primates are classified into a primitive group called the prosimians and a more derived group that includes the monkeys of South and Central America (the New World monkeys or platyrrhine primates) and the apes and monkeys of Africa and Asia (the catarrhine primates). Most of the prosimian primates are small, solitary nocturnal animals with an insectivorous diet, such as the bush-babies in Africa and the lorises and tarsiers in Asia, but on the island of Madagascar the prosimians diversified and include larger-bodied diurnal and social species. A much more primitive group of animals that is sometimes included within the primates, the Plesiadapiformes, became extinct and are known only from fossils dating to the early part of the Tertiary.

Primates are adapted to live and find their food in the three-dimensional world of the tropical forests. Their senses of vision and touch are more developed than their hearing and smell, and all primates have forward-facing eyes and the ability to grasp objects between the thumb and the rest of the hand. Unlike other arboreal animals such as squirrels, primates cling to supports by grasping with hands and feet rather than using claws. In fact, primate claws have evolved into nails that protect the sensitive touch pads on the tips of the fingers and toes. The inner surfaces of the hands and feet of primates are covered in ridged 'friction skin' (dermatoglyphs, or finger and palm prints) that enhances the grip and provides extra sensitivity when assessing the texture and resilience of touched objects. When travelling quadrupedally, primates support more of their body weight on the hind limbs than the forelimbs, and they usually contact the ground with the soles of their feet (plantigrade

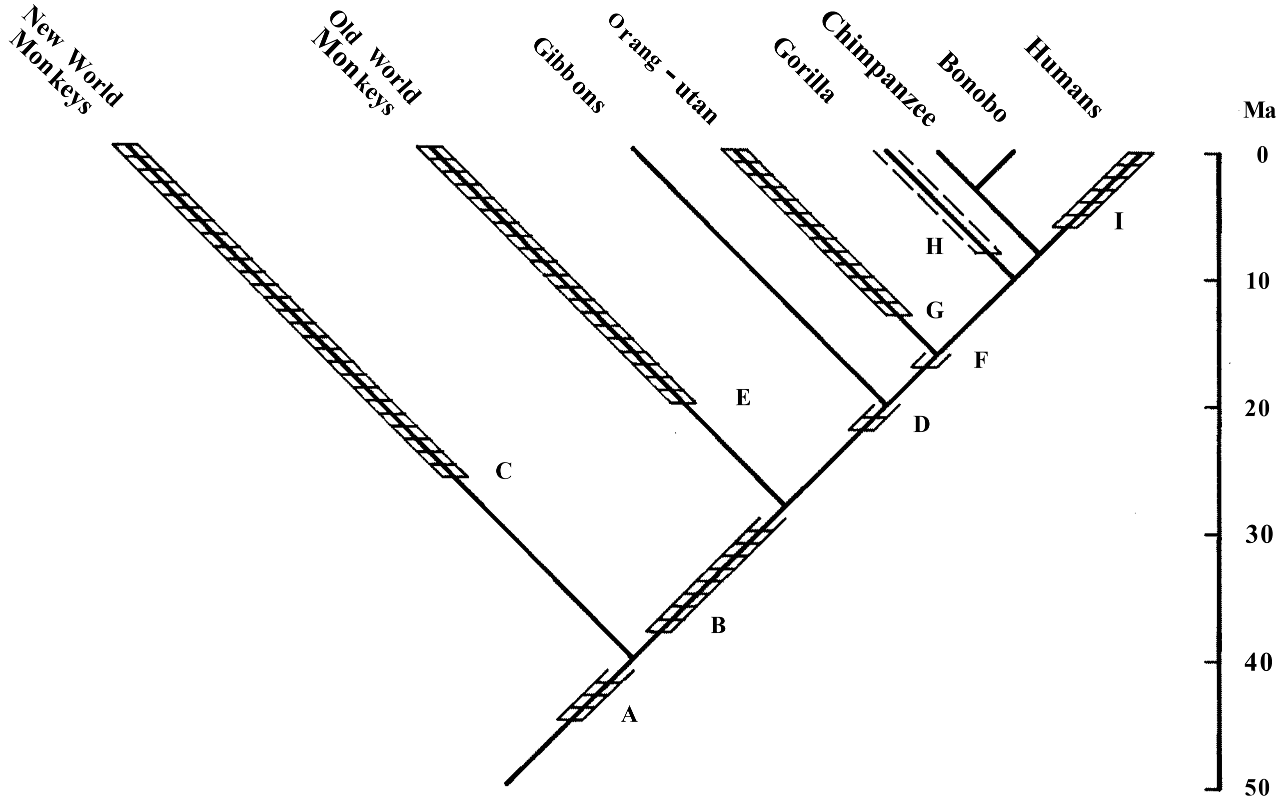

Figure 19.1 Phylogenetic tree for living anthropoid primates, based on the branching sequence established from biomolecular and morphological evidence. The hatched regions indicate the extent of the fossil record for each of the groups of living primates. Fossil evidence for the first appearance of these lineages is as follows: A. Anthropoids *(Algeripithecus, Eosimias)*; B. Catarrhines *(Aegyptopithecus, Propliopithecus)*; C. Platyrrhines *(Branizella, Tremacebus, Dolichocebus)*; D. Hominoids *(Proconsul)*; E. Cercopithecoids *(Victoriapithecus)*; F. Great Apes *(Afropithecus)*; G. Pongines *(Sivapithecus)*; H. ?Gorillines *(Samburu Hills)*; I. Hominids *(Australopithecus)*. Dates in millions of years ago (Ma). Source: A.T. Chamberlain.

locomotion) rather than just their toes (digitigrade locomotion). When they cease moving they often adopt a more upright posture that frees the hands for manipulative tasks.

Primate diets are comprised of fruits (including seeds and nuts); other plant items such as foliage, flowers, twigs and resins; and animal prey (mainly insects and other invertebrates, although some primates also pursue and eat small vertebrates). The larger-bodied primates tend to consume a greater proportion of food items with low nutritional value, while the smallest primates tend to include a more substantial amount of insects in their diet. Dietary specialization is reflected in the structure of the teeth and jaws. Fruit-eating primates have large strong front teeth for penetrating the hard outer layers of fruits and seeds, and enlarged premolars that serve to maximize the available grinding surfaces in the mouth. Leaf-eating primates have small front teeth and develop sharp cutting ridges on their chewing teeth. These primates also have large and elaborate digestive tracts that encourage the fermentation of structural carbohydrates that would otherwise be difficult to digest. Insectivorous primates have relatively tall, pointed-cusped, teeth that serve to hold and crush their insect prey. Unlike other insectivorous mammals, primates capture insects by grasping them in one or both hands, an action which requires precise hand-eye coordination.

Primate social groups are stable, cooperative structures in which the members recognize each other individually and can distinguish each other's kinship relationships. Compared with most other mammals, the social bonds between individuals in a primate group are strong, and movement of animals between groups is relatively uncommon. Social interactions in a group are strongly influenced by the pattern of dominance relations among individuals. The facility for individual recognition leads to the development in some primate species of sophisticated social behaviour, including the formation of coalitions and friendships and the occurrence of deliberate social manipulation and deception. Group sizes range from solitary, through monogamous pairs with dependent offspring, to large groups with multiple breeding males. In most primate species the males, on maturing, leave the group in which they were born, with the result that closely related females form the core of the social group. Chimpanzees are exceptional in that females transfer out of their natal group, and related males form the affiliative core of the group.

Compared with other mammals of similar body size, primates have relatively long gestation periods and usually give birth to one or at most two offspring at a time. Young infants are highly dependent on parental care and are carried by their parents for the first few months of life. Growth to sexual maturity is slow and lifespans are often relatively long, providing enhanced opportunities for social learning. Immature primates copy or are passively guided, rather than instructed, by other group members in their acquisition of survival skills, unlike human societies in which teaching is universal.

The Hominoidea is the taxonomic group containing the apes and humans. The hominoids comprise relatively few species today, but were much more diverse in both numbers of species and geographic range during the Miocene epoch. Hominoids are predominantly frugivorous, having broad incisor and molar teeth, and are adapted to climbing and suspensory patterns of movement in the trees. Their forelimbs are relatively long and the shoulder and wrist joints have enhanced mobility, permitting the hand to grasp supports that have different orientations and heights above the head. In this way they contrast with the monkeys, which are more strictly quadrupedal in locomotion. The gibbons, also known as the lesser apes, are small-bodied hominoids that have a specialized mode of arboreal locomotion—'brachiation', or arm-swinging. They are classified in two genera: *Hylobates* and *Symphalangus*. The living great apes comprise the Asian orang-utan *(Pongo pygmaeus)* and the African apes, which include three species: the gorilla *(Gorilla gorilla),* chimpanzee *(Pan troglodytes)* and bonobo or 'pygmy' chimpanzee *(Pan paniscus)*. The African apes are closely related both genetically and morphologically to modern humans, and the chimpanzees in particular are often used as structural and behavioural models for early hominids.

LOOKING AT THE PAST

Fossils and dating

The word fossil means 'something dug up from the ground', but in palaeontology it has a more restricted meaning: the petrified remains of an organism. Fossil fuels do not qualify as fossils in the strict sense because they are not identifiable at the organismal level, and bodies preserved in bogs or in frozen ground are tanned or mummified rather than fossilized. The expression 'sub-fossil' is sometimes used to denote the remains of organisms that have commenced but not completed the process of fossilization. During fossilization the soft tissues of the animal are usually lost through decay, while the hard parts of the skeleton are altered by 'diagenesis', the combined effect of temperature, pressure and chemical reactions in the ground. Diagenesis, which is also responsible for the conversion of soft unconsolidated sediments into hard rocks, modifies skeletal tissues through recrystallization, permineralization and replacement. The mineral crystals originally present in living calcified tissues (which include shells, antlers, bones and teeth) are unstable under the changing conditions of burial, and these minerals tend to recrystallize. In some burial environments the original mineral in the skeleton is dissolved away and replaced by new mineral growth, while porous media such as spongy bone or plant tissues can be partially replaced or impregnated by new minerals (permineralization). 'Trace fossils' are the fossilized remains of animal behaviour such as tracks, burrows and coprolites. Some of the earliest hominid remains, the human footprints discovered at Laetoli in Tanzania, are trace fossils.

The following circumstances provide ideal conditions for fossilization: (1) *rapid burial,* which reduces damage caused by carnivores, by abrasion during water transport, and by the exposure to the sun and wind; (2) *lacustrine or marine environments,* in which continuous sedimentation occurs, reducing the likelihood of reworking of sediments and erosion of fossil-bearing layers; the fine-grained embedding matrix provided by lake sediments also reduces the oxygen content and preserves fine surface detail on the fossil; (3) *slightly alkaline ground water,* such as occurs in calcareous deposits, gives the best preservation of bone and teeth (acid water tends to dissolve the mineral component of the skeleton).

Fossils can be dated in the same way as archaeological finds: either by direct dating or indirectly by determining the time of deposition of the sediments in which they are buried. Absolute dating methods monitor the progression of physical or chemical processes that are slow and regular in time, and are not influenced by the conditions of burial (see Chapter 5). Radio-carbon dating is applicable to the youngest parts of the fossil record, but is effectively limited to organic samples or biogenic carbonates that date to less than 50 ka (50,000 years ago). Potassium-argon dating is suitable for volcanic sediments from 50 ka to many millions of years old. Uranium series dating can be applied to chemically precipitated calcium carbonates and is therefore useful for dating limestones, travertines and stalagmitic deposits in caves. This method conveniently overlaps the radio-carbon and potassium-argon ranges and is suitable for samples up to about 500 ka. Fission-track dating, electron spin resonance (ESR), thermoluminescence (TL) and optically stimulated luminescence (OSL) are different procedures for measuring the accumulated energy from radioactive decay that is stored in crystalline materials; these methods can be applied to lithic artefacts, sediment grains and bones and teeth.

Other important approaches to dating are the methods that allow correlations to be established between the stratigraphies of different fossil sites. When sediments and volcanic rocks are deposited they acquire a magnetization as small magnetic particles in the rock align themselves with the earth's magnetic field. The polarity of the earth's field has reversed many times during the last 10 million years, with the most recent change occurring at about 700 ka. Knowledge of the direction of magnetization of a sample helps to limit the range of possible dates assigned to it. A more finely subdivided chronostratigraphy is provided by the deep ocean oxygen isotope record, which tracks the variation in the ratio of the stable isotopes ^{18}O and ^{16}O in fossil microfauna in deep sea sediments. During periods of cold climate (such as glacials) more precipitated water, and hence more of the lighter isotope ^{16}O, is locked up in glaciers and polar ice caps, thereby raising the marine concentration of ^{18}O. In some parts of the world volcanic eruptions are sufficiently large to spread thin ash layers over very large areas. Individual ash layers can be identified in a sedimentary sequence by their unique chemical composition or 'fingerprint'. A sample of the ash layer is analysed, and the amounts of different major and trace elements provide the signature of a particular volcanic eruption, which can be correlated between the different sites at which it was deposited. The patterns of evolutionary change in lineages of animals are the basis of biostratigraphic dating, which has been used, for example, to date Middle Pleistocene sites in Europe (van Kolfschoten 1990).

Molecular evidence

The phylogenetic relationships and evolutionary histories of organisms can be determined from the analysis of large complex biomolecules: proteins and DNA. Proteins form a major and diverse component of living tissue, being used as structural materials, as transporting molecules (such as haemoglobin, an oxygen-carrying molecule) and as enzymes that act as highly efficient catalysts in biochemical processes. Proteins are large, chain-like, molecules built up out of sub-units called amino acids. There are twenty different amino acids and they can be linked together in any combination, the precise order or sequence being specified by the organism's DNA. The sequence of amino acids determines the protein's physical properties and chemical activity.

The DNA molecule is an even larger double-chain molecule. The longitudinal strands of the double-chain are made from alternating phosphate and sugar sub-units, and the strands are connected between their sugar sub-units by cross-linked pairs of bases. Each cross-link consists of one of two possible pairs of bases, adenine with cytosine or guanine with thymine, but these pairs can be orientated either way round, so there are four possible arrangements at each cross-link position in the DNA molecule. The sequence of base pairs along the DNA molecule determines the amino acid sequence of the organism's proteins, with successive groups of three DNA base-pairs coding for one particular amino acid in a protein molecule. Other parts of the DNA sequence control the growth and development of the organism, and the activities within the organism's cells. As with proteins, the number of possible combinations of DNA base pairs is virtually limitless, but the DNA molecule has a further property. The double-chained molecule can be separated into two single chains by splitting the cross-linked base pairs, and then each chain can serve as a template for the synthesis of a new copy of the opposite chain. Thus DNA not only carries the information that determines protein structure but also can replicate itself, an action that is essential in reproduction when copies of DNA are passed between generations.

Although each individual has a unique DNA sequence, members of a single species are quite similar in their DNA. The most variable parts of the DNA molecule are the sequences of 'junk' DNA which do not appear to code for structural proteins. Sequence differences of about 0.1 per cent are found between human individuals in these parts of the genome, allowing individuals to be 'fingerprinted' by determining their unique base-pair sequences. Differences between individuals belonging to separate but closely related species, for example between a chimpanzee and a human, average just a few per cent in the variable parts of the DNA molecule. The measurement of sequence differences between species provides a way of reconstructing the evolutionary pathways by which they have diverged from a common ancestral species. After two lineages become separated, the DNA (and protein) sequences of the species tend to diverge, as random genetic mutations accumulate in the lineages with each successive generation. Most of the DNA from cell nuclei is non-coding, so most of the mutations that occur in the DNA will neither benefit nor disadvantage the organism and will therefore be passed on to succeeding generations. The rate of this 'neutral' evolution of DNA depends on the properties of the organism, such as efficiency of DNA repair during replication and average generation length, rather than on external factors that could be influenced by the environment. Therefore the differences that accumulate between the DNA molecules of a pair of species are roughly proportional to the length of time that has elapsed since the species diverged from their common ancestor.

Protein and DNA comparisons have been used to construct a well-corroborated sequence of branching among the main groups of living higher primates (Fig. 19.1). The branching pattern can be converted into a 'molecular clock' for determining the time of individual branching events by calibrating at least one speciation event using reliably dated fossil evidence. The molecular phylogeny for the primates has been calibrated at two points, by the fossil evidence for the emergence of the cercopithecoid (Old World Monkey) lineage at 25–35 MYA (million years ago), and by a date for the origin of the lineage leading to the orang-utan, which diverged from the African ape and human lineage before 13 MYA but probably not earlier than 17 MYA. One prediction of this molecular clock is that humans diverged from the African apes in the late Miocene, less than 10 MYA and perhaps as recently as 7 MYA.

Genetic investigations have also been made of living human populations, using a range of different gene frequency and DNA sequence data (Cavalli-Sforza *et al.* 1994; Richards *et al.* 1996; Stoneking 1993). The evidence from these studies suggests that modern humans had a single place of origin, most probably in Africa and around 100–150 thousand years ago, rather than evolving from the regional variants of earlier Pleistocene hominids found in Africa, Europe and Asia.

EARLY PRIMATES

Primates originated in the early Tertiary era at a time when other mammalian orders were rapidly diversifying following the extinction of the dinosaurs at the end of the Cretaceous. During the earliest part of the Tertiary, the Palaeocene (66–55 MYA), the Atlantic Ocean was beginning to widen (Fig. 19.2). North America and Europe were still sufficiently close to permit terrestrial animals to move between these continents, but South America, Africa and India were island continents separated by deep seas from Eurasia and North America. The earliest primates were small, structurally generalized and probably insectivorous and nocturnal animals, and it is exceedingly difficult to distinguish their fossils from those of other contemporary small mammals. One group of 'quasi-primates' that was present in North America and Europe from the early Palaeocene is the Plesiadapiforms (Rose 1994). These animals were very common and diverse, with many species and genera classified into up to six families, and they comprise up to 40 per cent of the mammal species at some North American fossil sites. Their teeth are sharp cusped, indicating a largely insectivorous diet, but they lack virtually all the structural features that define later primates such as forward-facing eyes, increased brain size, an ossified post-orbital bar on the skull, grasping foot, and nails rather than claws on the digits. It is possible that modern primates originated from within this group, but one family of Plesiadapiforms, the Paromomyids, has been shown to be related to colugos ('flying lemurs') rather than to true primates, and the relevance of Plesiadapiforms in early primate evolution is uncertain (Cartmill 1992).

By the end of the Palaeocene most of the Plesiadapiforms had become extinct, and the first true primates had begun to appear. Until recently little was known about early Tertiary primates in Africa. The teeth of the fossil primate *Altiatlasius,* found at Adrar Mgorn in Morocco and dating to the late Palaeocene, suggest that it may be an early representative of the omomyids, one of the major groups of Eocene primates (Rose 1994).

The Eocene (55–36 MYA) was a time of global warming, when the tropical climatic conditions favourable to modern forms of primates became widespread in the northern hemisphere. The early Eocene mammalian faunas of Europe and North America were similar to each other, but continental drift during the Eocene led to a widening of the North Atlantic, which increasingly restricted faunal exchange between the continents. The main primate groups of the Eocene, the adapids and the omomyids, were equivalent in their structure and adaptations to modern prosimians. The adapids resembled modern lemurs, though with longer body and tail (Fig. 19.3), and they were heavier and had longer snouts than the omomyids, which more closely resemble modern tarsiers and galagos.

There is considerable debate about whether the first fossil representatives of the Anthropoid primates (monkeys and apes) evolved in Africa or in Asia during the

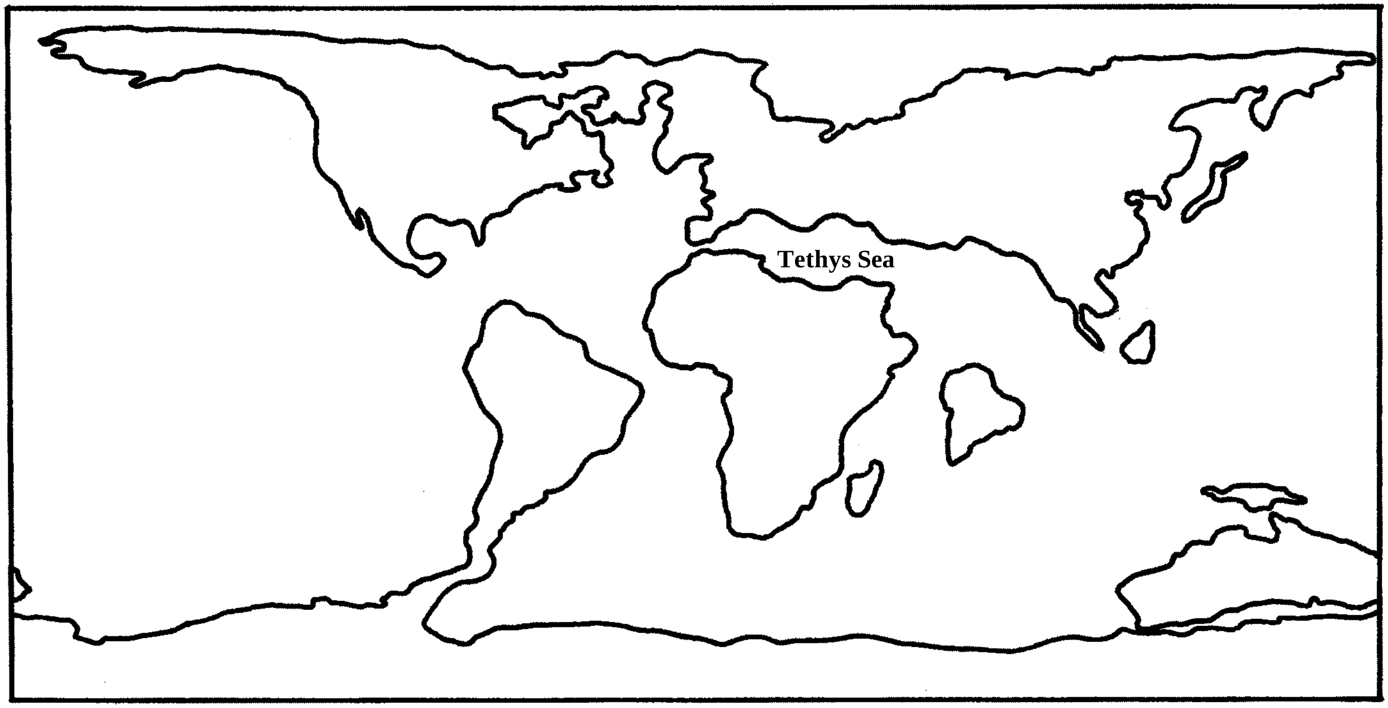

Figure 19.2 Position of the continents at the beginning of the Tertiary, approximately 60 million years ago. South America, Africa and India were separated by a continuous seaway from Eurasia and North America. Source: Smith *et al.* 1981.

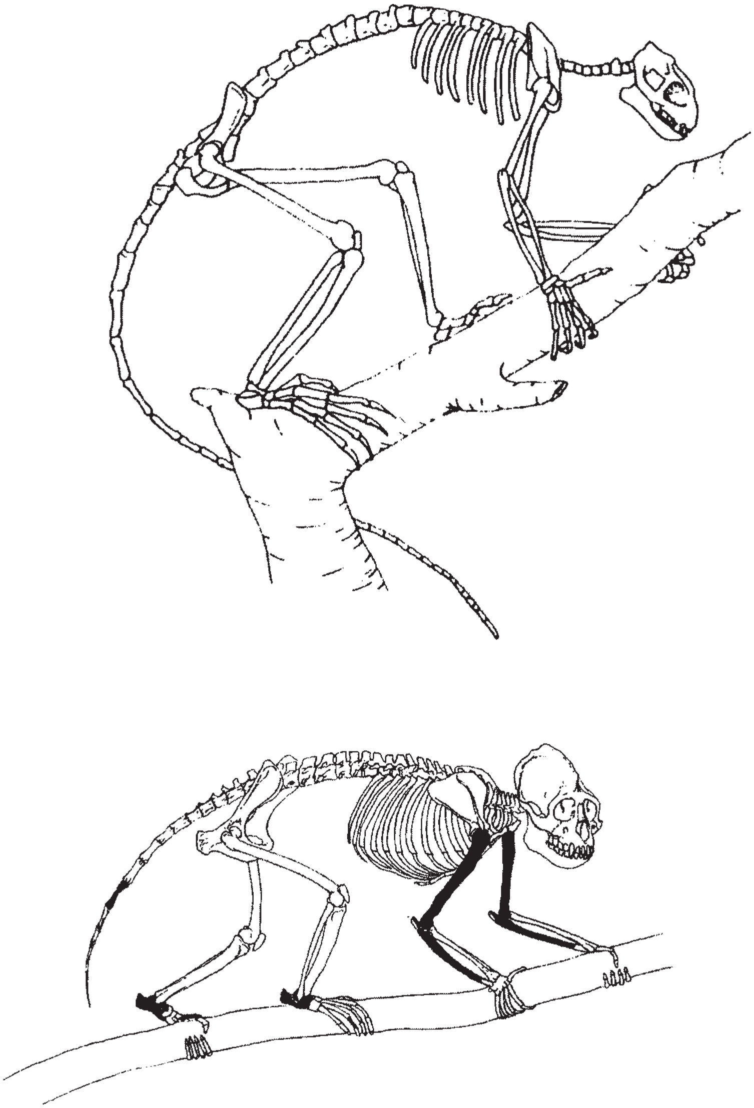

Figure 19.3 Reconstructions of the skeletons of a middle Eocene adapid (*Smilodectes*, above) and an early Oligocene propliopithecid (*Aegyptopithecus*, below). Source: Fleagle 1988.

early part of the Eocene. At Glib Zegdou in Algeria, the fossil teeth of an Early or Middle Eocene (about 45 MYA) primate called *Algeripithecus* have been discovered (Godinot and Mahboubi 1992). This primate, though much smaller than living African monkeys, resembles later African fossils such as the Oligocene monkey *Aegyptopithecus* in the detailed shape of its teeth. Of similar age is a primitive anthropoid called *Eosimias,* recovered from Late Middle Eocene deposits in Shanxi, China (Beard *et al.* 1996). Anthropoid primate fossils have also been found in Late Eocene deposits in Burma and Thailand at sites dating to about 40 MYA. The fossils are *Pondaungia* and *Amphipithecus* from Burma, and *Siamopithecus* from Krabi in Thailand (Chaimanee *et al.* 1997). Compared to adapids and omomyids, the early anthropoids had deeper jaws and more rounded cusps to their cheek teeth (buno-donty), indicating that they were incorporating a larger proportion of hard foods in their diet.

In the Oligocene (36–25 MYA), plate tectonic movements brought the continents into approximately their present-day arrangement, although North and South America were still separated by a deep-water seaway. Rapid global cooling in the early part of the Oligocene may have been triggered by changes in ocean currents and increased polar glaciation following the separation of the continents of South America and Australia from Antarctica. Nearly all primates became extinct in Europe and North America at this time, leaving the tropical latitudes of Africa, Asia and South America as centres of primate evolution.

In Africa, an extensive and diverse early Oligocene fossil primate fauna has been found at the Fayum in Egypt, a site that has been dated by palaeomagnetic methods to 36–33 MYA (Simons 1995). This site has produced fossils of two prosimian species, two groups of ancestral catarrhine primates (the parapithecids and the propliopithecids), and the oligopithecids, which are primitive anthropoids (Simons and Rasmussen 1994). The Fayum parapithecid species belong to the genera *Apidium, Parapithecus, Qatrania* and *Simonsius,* and range in body size from 300 to 3,000 g. The teeth of these primates show that they were predominantly frugivorous. The propliopithecids, which include the genera *Propliopithecus* and *Aegyptopithecus,* were larger in body size and had teeth that more closely resembled those of the Miocene apes, although their skeletons were adapted for arboreal quadrupedal locomotion as in other monkeys, rather than climbing and suspension as in modern apes (Fig. 19.3). The oligopithecids, which include the genera *Catopithecus, Oligopithecus* and *Proteopithecus,* have the same dental formula as Old World monkeys and apes, but in other respects their teeth resemble those of the Eocene adapids. They are therefore viewed as primitive ancestral anthropoids.

The earliest fossil primates in South America date to the late Oligocene (MacFadden 1990). It is not yet known whether these Oligocene primates migrated from North America or from Africa: either route would have required rafting across extensive bodies of water, since South America was still isolated from the other continents at this time (Fig. 19.4). But the global cooling which reached its greatest extent in the middle of the Oligocene also lowered sea levels, reducing the length of the water crossing and perhaps creating a series of island stepping stones in the shallower areas of the equatorial Atlantic Ocean. The Oligocene primates *Branizella* from Bolivia and *Tremacebus* and *Dolichocebus* from Argentina resemble

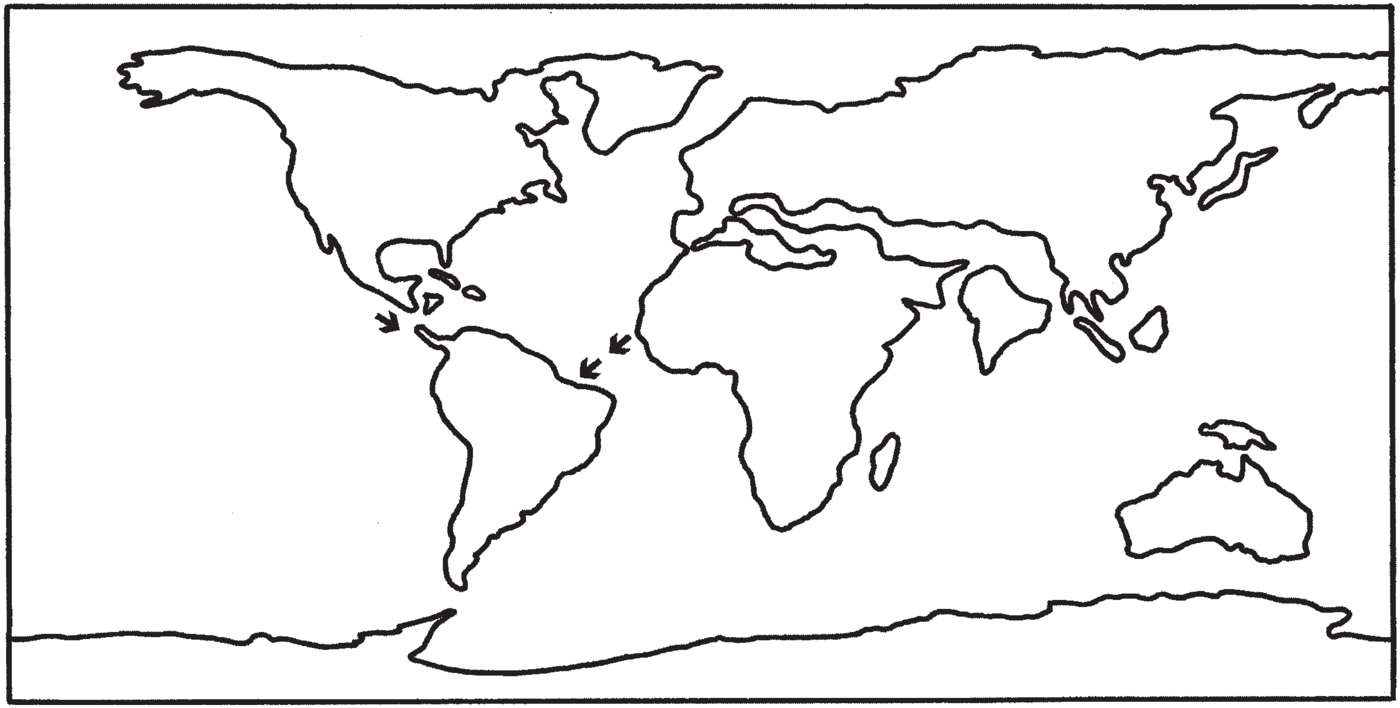

Figure 19.4 Position of the continents at the beginning of the Oligocene, approximately 35 million years ago. Arrows indicate possible routes by which anthropoid primates colonized South America. Source: Smith *et al.* 1981.

the early anthropoids of the Fayum in Africa, which is the only other continent with fossil anthropoids at this period. Subsequently the Oligocene primates evolved into the diverse spectrum of New World primates that now occupy the forested regions of South and Central America.

EVOLUTION OF APES

A large time interval separates the early Oligocene anthropoids of the Fayum and the next oldest catarrhine primates, which are found in the Early Miocene (25–16 MYA) in East Africa. At some point during this interval, the apes (Hominoidea) diverged from the other catarrhine primates (Fig. 19.5). The apes differ from the catarrhine monkeys in having expanded skulls, broader incisors and molars, reduced differences between the premolars, deeper jaws, an absent tail and a series of modifications of the limb bones. The forelimb shows increased flexibility at the shoulder, elbow and wrist joints, while the hindlimb has increased hip and ankle mobility. These are adaptations for the wider range of climbing and suspensory postures that are used by apes.

In the Early Miocene, the global climate was warmer than in the preceding Oligocene, and the expanding forests of Africa were populated by an abundant and

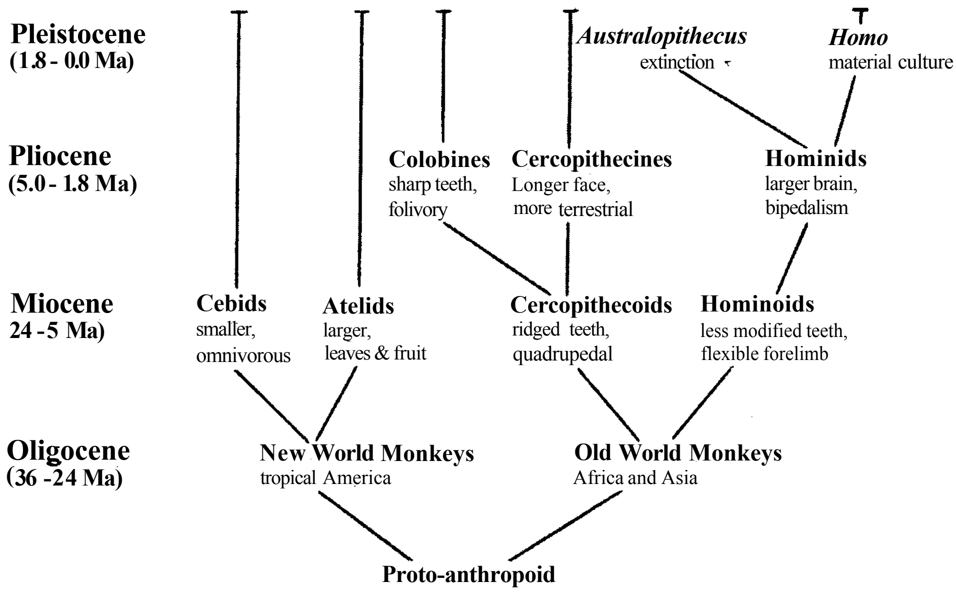

Figure 19.5 Divergence of anthropoid primates from the Oligocene to the present day, with an indication of the major morphological adaptations in each lineage; dates in millions of years ago (Ma). Source: A.T.Chamberlain.

diverse range of primitive apes. In the Middle Miocene (16–11 MYA), the African/Arabian continental plate made contact with Eurasia, closing the Tethys Sea (whose remnants form the present day Mediterranean and Caspian Seas) and allowing the northward emigration of African land mammals into Eurasia. The changes in ocean circulation, together with continuing uplift of the Himalayan mountains, led to cooler and drier conditions prevailing in Africa in the Middle Miocene, although true grassland habitats did not predominate in the East African landscape until the late Miocene (11–5 MYA).

The early Miocene fossil sites of East Africa are associated with volcanic lavas and tuffs that erupted from volcanoes along the developing rift valley system. The volcanic layers allow the fossils to be dated radiometrically to between 22 and 16 MYA. Although today this region has a semi-arid climate, in the Early Miocene there was a continuous moist tropical forest extending right across East Africa to the Indian Ocean coast. Fossils of up to six species of ape have been found at a single site, showing that the apes were much more diverse than in present-day Africa. The early Miocene apes probably occupied some of the niches which were subsequently exploited by monkeys, which have come to far outnumber the apes in present-day Africa. The large-bodied (>15 kg) early Miocene apes belong to the genera *Proconsul, Rangwapithecus* and *Afropithecus,* while a series of smaller-sized (<10 kg) apes belong to the genera *Micropithecus, Nyanzapithecus, Simiolus* and *Turkanapithecus*. These taxa had predominantly frugivorous diets, with the exception of *Rangwapithecus* and *Nyanzapithecus,* which were specialized folivores.

During the Middle Miocene, most of the early Miocene ape genera disappear in Africa, but they are replaced at sites such as Fort Ternan, Maboko and Ngorora by a new genus, *Kenyapithecus*. Unlike the early Miocene apes, this genus had robust jaws and thick enamel on its teeth, indicating a dietary shift towards harder foodstuffs. *Kenyapithecus,* which was once classified together with *Ramapithecus* as a hominid (thick enamel is a characteristic of early hominids), was thought to be adapted to open country habitats, but palaeoenvironmental studies of Fort Ternan, a *Kenyapithecus* locality dating to 14 MYA, show that closed forest or woodland was present at this site. *Kenyapithecus* is now thought to be an early representative of the lineage leading to great apes and humans. Closed humid forests also characterized the palaeoenvironment at Berg Aukas in Namibia, where a fossil jaw of the middle Miocene hominoid *Otavipithecus* has recently been recovered (Conroy *et al.* 1993).

Although primates are virtually absent from Europe and Asia in the Early Miocene, a diverse range of catarrhine primates occupied these continents in the Middle and Late Miocene. Several distinct taxonomic families of apes have been identified in the Eurasian Miocene fossil record. The dryopithecids were large (20–40 kg) frugivorous apes, including *Dryopithecus* from Europe and *Lufengpithecus* from China. A partial skeleton of *Dryopithecus laietanus* found at Can Llobateres in Spain shows that the species was adapted to below-branch arboreal locomotion similar to that seen in the present-day orang-utan (Moyà-Solà and Köhler 1996). The pongids (which include the modern orang-utan *Pongo pygmaeus*) are represented by the fossil genera *Sivapithecus* and *Gigantopithecus*. The pongids are all large apes, with body weights ranging from about 40 kg in small species of *Sivapithecus* to as much as 300 kg in the appropriately named *Gigantopithecus*. *Oreopithecus,* which is represented only by a single species from sites in northern Italy, was a large folivorous catarrhine primate that is currently placed in the Hominoidea in its own family, the oreopithecids. *Graecopithecus (=Ouranopithecus),* represented by late Miocene fossils from northern Greece, shows some close similarities to the living African apes, and this genus may therefore be a close relative of the hominids (De Bonis and Koufos 1994). Two additional genera from China, *Dionysopithecus* and *Platydontopithecus,* are unlike the other Eurasian apes and may be representatives of the proconsulids, a family containing mainly early Miocene African taxa.

Fossil remains from Pakistan and Turkey of the hominoid genus *Sivapithecus* have teeth with relatively thick enamel, and their skulls show several similarities to the modern orang-utan with which they are grouped in the family Pongidae. The genus *Ramapithecus,* once thought to be an ancestral hominid, is now also included within the genus *Sivapithecus*.

EARLY HOMINIDS: *AUSTRALOPITHECUS*

Two lines of evidence support an African origin for hominids. First, the primates that are most closely related to hominids are the chimpanzee, bonobo and gorilla, which are endemic to Africa. Among living primates closely related genera and species tend to occupy adjacent geographical areas, and this implies that the divergence of the African ape and hominid lineages may have occurred in Africa. Second, all hominid fossils that have been found outside Africa are no earlier than the terminal Pliocene (1.8 MYA), whereas fossils assigned to the extinct hominid genus *Australopithecus* are present in East Africa from about 6 MYA (Table 19.1).

The oldest fossil hominid yet discovered is a lower jaw from Lothagam in Kenya. This fossil was found in sedimentary deposits between volcanic layers with radiometric dates of 3.8 and 8.5 MYA: faunal correlations between Lothagam and other dated fossil sites show that the jaw is about 5.6 MYA, and is thus late Miocene in age. In contrast with the sparse late Miocene fossil record, there are many Pliocene fossil sites in Africa, and at least a dozen of these have yielded early hominids from the time interval between 6 and 3 MYA (Table 19.1). Several of these fossils have been attributed to *Australopithecus afarensis,* a species that is best known from the samples recovered at Laetoli in Tanzania and Hadar in Ethiopia. The fossil limb bones from Hadar and the fossilized hominid footprints at Laetoli provide clear

Table 19.1 The earliest fossil evidence for hominids in Africa; dates in millions of years ago (MYA)

Date (MYA)	*Site*	*Specimen*	*Taxonomic attribution*
3.0–3.4	Bahr el Ghazal, Chad	KT 12/H1 mandible	*Australopithecus bahrelghazali*
3.2	Hadar, Ethiopia	AL 288–1 'Lucy' skeleton	*Australopithecus afarensis*
3.4	Omo, Ethiopia	Omo 20–1886 tooth	*Australopithecus*
3.6	Laetoli, Tanzania	LH 4 mandible	*Australopithecus afarensis*
3.9	Allia Bay, Kenya	ER 20432 mandible fragment	*Australopithecus anamensis*
<4.0	Maka, Ethiopia	MAK VP 1.1 femur	*Australopithecus afarensis*
4.0	Belohdelie, Ethiopia	BEL VP 1.1 cranial fragments	*Australopithecus afarensis*
4.0–4.2	Fejej, Ethiopia	FJ 4 SB 1,2 teeth	*Australopithecus afarensis*
4.1	Kanapoi, Kenya	KP 29281 mandible	*Australopithecus anamensis*
>4.2	Chemeron, Kenya	BC 1745 humerus	*Australopithecus*
4.4	Aramis, Ethiopia	ARA-VP-1/129 mandible	*Ardipithecus ramidus*
4.9	Tabarin, Kenya	TH 13150 mandible	*Australopithecus*
5.6	Lothagam, Kenya	LT 329 mandible	*Australopithecus*

evidence of bipedalism in *Australopithecus afarensis,* although this species also retained some anatomical adaptations for arboreal locomotion, including relatively long arms and curved foot bones. A small sample of early Pliocene fossils has been attributed to newly discovered species of australopithecine, including *Australopithecus anamensis* (Leakey *et al.* 1995), *Australopithecus bahrelghazali* (Brunet *et al.* 1995) and *Ardipithecus ramidus* (White *et al.* 1994).

The immediate ancestors of hominids were large-bodied hominoids that were adapted for climbing and suspending themselves below arboreal supports. Among the living hominoids, the adults usually move quadrupedally when on the ground, but they also occasionally adopt bipedal postures. Chimpanzee infants learn to walk bipedally before they walk quadrupedally, but in doing so they need to grasp supports with their hands in order to maintain their balance (Doran 1992). Amongst primates, true bipedalism is unique to hominids and a large number of separate anatomical and physiological modifications is implicated in the change from habitual quadrupedal to bipedal locomotion. This implies that bipedalism must have provided considerable advantages in energy saving or in enhanced reproductive success for the earliest hominids.

When a bipedal animal is walking, it consumes less energy than a quadruped of the same body size—although this advantage is reversed at higher speeds. Long-distance bipedal walking might have provided scavenging opportunities (from being able to follow herds of migrating animals), or alternatively it could have enhanced the ability of early hominids to provision sedentary individuals who were caring for dependent infants. However, the degree of sexual dimorphism in early hominids (see p. 776) is inconsistent with the monogamous group structure required if provisioning is to be a successful evolutionary strategy. It is more probable that early hominids foraged in large groups, exploiting low density or scattered resources in grassland habitats. Under these circumstances, the adoption of an upright bipedal posture can assist thermoregulation in equatorial latitudes by reducing the heat load from incident solar radiation in the middle of the day. Further advantages in reducing thermal stress would have been provided by the higher wind speeds and lower air temperature and humidity away from the ground surface, particularly if the early hominids, like modern humans, had little body hair. A naked skin allows for more efficient heat dissipation, particularly when supplied with abundant sweat glands (Wheeler 1992).

Traditionally, the species of *Australopithecus* have been categorized as 'gracile' or 'robust', a distinction that originated in the recognition of significant differences in tooth size between fossils of *A. africanus* and *A. robustus* from South Africa. The distinction, though convenient, is misleading for several reasons. First, all australopithecine species have robust jaws and cheek teeth that are relatively large compared with those of other primates of similar body size (McHenry 1984). Second, although they possessed large jaws and had skulls that were reinforced against the stresses generated by their powerful chewing muscles, australopithecine species had small 'petite' bodies (McHenry 1991) and were substantially lighter in weight than modern chimpanzees (Table 19.2). Finally, the distinction describes a temporal trend rather than a taxonomic classification—the 'gracile' species *A. afarensis* and *A. africanus* are early forms, whereas *A. aethiopicus, A. boizei* and *A. robustus* (the 'robust' australopithecines) evolved more recently and were contemporaneous with the earliest forms of the genus *Homo* (Table 19.3). Some researchers place the 'robust' australopithecine species in the genus *Paranthropus,* reflecting the likelihood that they form a monophyletic group (Strait *et al.* 1997). However, the phylogeny of the australopithecines as a whole is unclear, and in many publications both the robust and the gracile forms are classified together in the genus *Australopithecus*.

Fossils of *Australopithecus* were first discovered in the 1920s, 1930s and 1940s in breccias at the sites of former limestone caves in the Transvaal Province of South Africa. The remains of *A. africanus* were found at Taung, Sterkfontein and Makapansgat, and those of *A. robustus* at Kromdraai and Swartkrans. Recent excavations

Table 19.2 Estimated body weights of *Australopithecus*, Chimpanzee *(Pan troglodytes)* and humans

Species	*Female weight*	*Male weight*	*Species average*	*Dimorphism (M/F)*
A. afarensis	29	45	37	1.55
A. africanus	30	41	35	1.37
A. boisei	34	49	41	1.44
A. robustus	32	40	36	1.25
Pan troglodytes	40	54	47	1.35
Homo sapiens	53	65	59	1.23

Note: All weights are in kg. The estimated body weights of fossil species are based on hindlimb joint dimensions, using modern human regression formulae for predicting weight from joint size (McHenry 1992).

Table 19.3 First and last appearances of hominid species*

Taxon	*First appearance (MYA)*	*Last appearance (MYA)*	*Maximum geographical range*
A. anamensis	4.1	3.9	E. Africa
A. afarensis	4.2	2.8	E. Africa
A. africanus	3.1	2.3	S. Africa
A. aethiopicus	2.6	2.3	E. Africa
A. boisei	2.3	1.4	E. Africa
A. robustus	1.9	1.2	S. Africa
H. rudolfensis	2.4	1.8	E. Africa
H. habilis	1.9	1.6	E. Africa
H. erectus/ H. ergaster	1.75	0.1	Africa, Asia
H. heidelbergensis	0.7	0.1	Africa, Asia, Europe
H. neanderthalensis	0.25	0.035	Asia, Europe
H. sapiens	0.1	—	World-wide

Note: *Dates for hominid species known only from a single locality (*A. bahrelghazali* and *A. ramidus*) are given in Table 19.1.

at Swartkrans and Sterkfontein have added to the large collections of over a thousand hominid fossils recovered from these sites, and in 1992 a cave site at Gladysvale, 10 kilometres east of the Sterkfontein valley, yielded hominid teeth that may represent *A. africanus*. In East Africa fossils of *A. boisei* were first discovered at Olduvai Gorge, Tanzania, in 1959, with subsequent identifications of the same species at Peninj in Tanzania, Omo in Ethiopia and at Chesowanja, Koobi Fora and West Turkana in Kenya. *A. aethiopicus* is an earlier and in some respects more primitive species of robust australopithecine that predates *A. boisei* in East Africa (Walker *et al.* 1986).

The early species *A. afarensis* and *A. africanus* were relatively small-brained hominids, with a primitive (ape-like) pattern of cranial cresting and a prominent (prognathic) face with large projecting incisor teeth. Although they were clearly adapted for upright posture and bipedal locomotion, these species retained the upwards-directed shoulder joints, relatively long forelimbs, curved hand and foot bones, and mobile ankle joints characteristic of an arboreal ancestry. The large samples of fossils available from sites such as Hadar in Ethiopia and Sterkfontein in South Africa show that there were substantial differences in size between adult individuals belonging to *A. afarensis* and *A. africanus*. These differences are interpreted as sexual dimorphism, and the estimated sex differences in body weight of the fossil species are a little higher than in modern chimpanzees (Table 19.2), though somewhat less than is found in the strongly dimorphic apes the gorilla and orang-utan.

In *A. boisei* and *A. robustus* the jaws, cheek teeth, and chewing muscles were massively developed and the face was elongated in a vertical rather than a forward direction. The incisor and canine teeth of these species were reduced in size, suggesting a dietary shift in favour of food resources that required less preparation with the anterior teeth, while the increased dimensions of their premolar and molar teeth maximized the surfaces available for grinding hard food items. Reconstructions of the diet of *Australopithecus* have relied on analogy with other savannah-dwelling animals and with modern human hunter-gatherers living in tropical environments. One popular comparison is with the gelada baboon *(Theropithecus),* which evolved reduced anterior and enlarged cheek teeth as an adaptation to seasonal dependence on grass seeds and plant rhizomes. Others have suggested that early hominids exploited a carnivorous diet, acquired through scavenging or hunting. These hypotheses have been tested through recent studies of tooth microwear, and trace element and stable isotope analyses of hominid fossils. Microscopic images of the wearing surfaces of hominid teeth reveal pits and scratches caused by abrasive particles in the diet. The microwear seen on the teeth of *Australopithecus* resembles that observed on the teeth of frugivorous primates such as mandrills, chimps and orang-utans. Of course, these studies cannot determine whether the hominid diet also included food items which produce little abrasive wear. Measurement of the levels of strontium and stable carbon isotopes in fossils of *Australopithecus robustus* suggests that this species did not consume an exclusively herbivorous diet: some animal tissues must have been ingested as a significant component of the diet of *A. robustus*.

EARLY HOMINIDS: ORIGINS OF *HOMO*

Global shifts in climate and vegetation, associated with the onset of polar glaciation at about 2.5 MYA, led to evolutionary changes in the terrestrial faunas of sub-Saharan Africa (Vrba 1995). Grassland habitats expanded at the expense of forests as temperatures and rainfall were reduced, and dramatic extinctions of forest-adapted mammalian species occurred. At East African hominid sites, the palynological record shows a shift from closed canopy to open woodland conditions at this time, and it is possible that these environmental changes led to the extinction of earlier forms of *Australopithecus*. The earlier hominids were replaced by species earliest representatives of the genus *Homo*.

Homo is distinguished from *Australopithecus* by two principal features: the relative enlargement of the brain, and a progressive reduction in the size and anterior projection of the jaws and teeth (Tobias 1991). Hominid fossils from several sites in eastern and southern Africa have been attributed to *Homo habilis* and to the related species *Homo rudolfensis*. *Homo habilis* was defined in 1964 after fossils of a large-brained hominid were discovered at Olduvai Gorge, Tanzania, dating to between 1.85 and 1.6 MYA. The type specimen, OH 7, is a juvenile cranium with part of the lower jaw together with a few hand bones. The brain volume of OH 7 is 674 cm^3, well above the maximum of the range of cranial capacity in *Australopithecus*. The sample of *Homo habilis* fossils from Olduvai Gorge also includes a partial skeleton, OH 62, which was discovered in 1986.

A series of fossils, including the relatively complete cranium ER 1470 from Koobi Fora in Kenya, dating to 1.9–1.8 MYA, has been assigned to the species *Homo rudolfensis* (Wood 1992). At Chemeron in Kenya, a cranial fragment discovered in 1967 and now dated to 2.4 MYA has been proposed as the earliest known specimen of *Homo* (Hill *et al.* 1992). Of similar age are a mandible of *Homo rudolfensis,* recovered from deposits dated biostratigraphically to approximately 2.4 MYA at Uraha in Malawi (Schrenk *et al.* 1993), and a fossil jaw of *Homo* from deposits dated to 2.33 MYA at Hadar in Ethiopia (Kimbel *et al.* 1996). Early forms of *Homo* have also been found at Sterkfontein and Swartkrans in South Africa (Table 19.4).

The fossil sites that have yielded skeletal remains of *Homo habilis* and *H. rudolfensis* have also produced evidence of stone tool manufacture or use. The earliest dated stone tools have been found at Gona, Hadar, and Omo in Ethiopia, and at Lokalalei on the west shore of Lake Turkana in Kenya. At Gona, cores and flakes of Oldowan type were found *in situ* in sediments dated to between 2.5 and 2.6 MYA (Semaw *et al.* 1997). At a nearby site in Hadar, Ethiopia, similar stone tools have been dated to 2.3 MYA (Kimbel *et al.* 1996). Small quartzite artefacts have been excavated from deposits dated to between 2.3 and 2.4 MYA at Omo, Ethiopia. At Lokalalei the artefacts, which were recovered from sediments dated to 2.3 MYA, consisted of many crude cores made on lava cobbles together with a few flakes (Kibunjia 1994). The artefacts found at these sites show a similar degree of flaking skill to that seen at the younger Oldowan sites in Olduvai Gorge, but the cores are less reduced and the flakes are unretouched. Although it is likely that *Homo habilis* and *H. rudolfensis* were tool users, studies of fossil hand bones have shown that *Australopithecus* possessed similar anatomical features and may have

Table 19.4 Fossil crania and mandibles allocated to species of early *Homo*

Species and fossil sites	*Cranial remains*	*Mandibular remains*
Homo habilis		
Olduvai, Tanzania	OH 6, 7, 13, 14, 16, 24, 52, 62	OH 7, 13, 37, 62
Koobi Fora, Kenya	ER 1478, 1805, 1813, 3735	ER 1501, 1502, 1805
Homo rudolfensis		
Koobi Fora, Kenya	ER 1470, 1590, 3732, 3735, 3891	ER 819, 1482, 1483, 1801, 1802
Uraha, Malawi	—	UH 501
Homo (indeterminate species)		
Chemeron, Kenya	BC 1	....
Koobi Fora, Kenya	ER 164, 807, 1593, 7330	ER 1506, 1811, 3734, 3950
Hadar, Ethiopia	AL 666-1	—
Omo, Ethiopia	L 894-1	Omo 75-14, Omo 222-2744
Sterkfontein, S. Africa	Sts 19, Stw 53, SE 255, SE 1508, 1579, 1937, 2396	
Swartkrans, S. Africa	SK 23, 847, SKW 3114	SK 45

been capable of holding objects with the same degree of precision as *Homo*. The fossil remains of 'robust' species *of Australopithecus* are frequently found at the same sites as *Homo habilis,* and it is therefore not possible to exclude *Australopithecus* as a potential maker or user of stone tools.

Average cranial capacity of *Homo habilis* (640 cm^3) is substantially greater than that of *Australopithecus* (species averages range from 410 cm^3 in *A. afarensis* to 530 cm^3 in *A. robustus*), and the increase in brain size is not accounted for by the small differences in body size between *Australopithecus* and early *Homo*. In hominids, the shape of the brain conforms closely to the inner surface of the cranial vault, because the cranial bones are literally moulded over the surface of the brain as it expands rapidly during the early years of post-natal growth. The shape and size of the brain of a fossil skull can be reconstructed by taking latex impressions of the endocranial cavity (in a few hominid skulls a natural endocast is formed during fossilization by sediments hardening inside the cranial cavity). Studies of endocasts show that the brain of *Homo habilis* was enlarged mainly in the frontal and parietal lobes of the cerebral hemispheres. Some details of the left frontal lobe in *Homo habilis* suggest strong development of Broca's area, a region of the brain involved in speech production in modern humans. The other important region of the brain involved in language comprehension is Wernicke's area, partly located on the inferior parietal lobule. The parietal region is another well-developed part of the brain in *Homo habilis* (Tobias 1987).

HOMO ERECTUS

Whilst *Homo habilis* and *Homo rudolfensis* retained many similarities with *Australopithecus, Homo erectus* more closely resembles *Homo sapiens* in some parts of its skeletal anatomy. In 1984 a skeleton of *Homo erectus* was found at Nariokotome on the west shore of Lake Turkana in Kenya, a site dated to 1.6 MYA (Walker and Leakey 1993). The skeleton, which has been given the specimen number WT 15000, is the most complete early hominid ever found (Fig. 19.6). Although the skeleton is not fully grown (dental development indicates an age of about 12 years), it belonged to an individual whose stature was between 1.6 and 1.7 metres, weighed about 55 kilograms and had limb proportions within the modern human

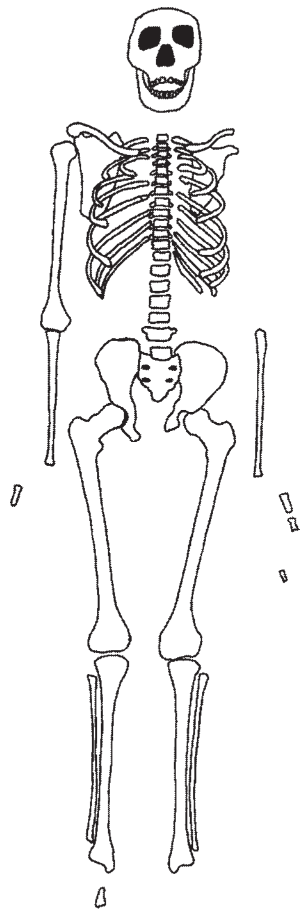

Figure 19.6 Homo erectus skeleton from Nariokotome, West Turkana, Kenya. (After Walker and Leakey 1993.) Source: A.T.Chamberlain. (See also Figure 18.3.)

range of variation. The cranial capacity of WT 15000 (900 cm^3) is greater than *Homo habilis*, although the increase may be explained in part by the greater body size of *Homo erectus*.

Homo erectus is the hominid that dominates the Lower and early Middle Pleistocene, first appearing in Africa and Asia at about 1.8 MYA and possibly persisting in East Asia to as recent a date as 50 Ka (Swisher *et al.* 1996). The first fossils of *Homo erectus* were found at Trinil, Java, in the 1890s by Eugene Dubois, a Dutch palaeontologist. Dubois coined the species name *'erectus'* because the leg bones showed evidence of upright posture and bipedal locomotion. Subsequent finds in the 1920s at Zhoukoudian, China, and at other sites in Java confirmed the widespread occurrence of the species in Asia (Table 19.5). Although the Indonesian and Chinese fossils were originally placed in the separate genera *Meganthropus*, *Pithecanthropus* and *Sinanthropus*, the close similarities between the fossils from the Asian sites and their clear affinities with other species of *Homo* allow them all to be assigned to the single species *Homo erectus*.

Table 19.5 Dates for *Homo erectus* and *Homo ergaster* sites in Africa and Asia in millions of years ago (MYA)

Africa		*Asia*	
Site	*Date (MYA)*	*Site*	*Date (MYA)*
Algeria		*China*	
Tighenif	0.6	Chenjiawo	0.65
Ethiopia		Gongwangling	0.75–1.0
Konso Gardula	1.4–1.5	Hexian	0.15–0.20
Melka Kunture	1.0	Longgupo	2.0–1.8
Kenya		Yuanmou	0.5–0.6
Koobi Fora	1.6–1.8	Yunxian	?0.3–0.5
Lainyamok	0.7	Zhoukoudian	0.23–0.50
West Turkana	1.6	*Georgia*	
South Africa		Dmanisi	?1.6
Swartkrans	1.0–1.5	*Israel*	
Tanzania		Ubeidiya	1.4
Olduvai Gorge	0.7–1.2	*Java*	
		Modjokerto	1.8
		Ngandong	0.03
		Trinil	1.0
		Sambungmachan	0.04
		Sangiran	1.66
		Vietnam	
		Lang Trang	0.4–0.5

Homo erectus fossils have been found at sites in eastern, northern and southern Africa. The species first appears in the lower part of the KBS member at Koobi Fora, Kenya, dated to just over 1.75 MYA. *Homo erectus* replaces and does not overlap in time with earlier species of *Homo* at Koobi Fora, but the species *Australopithecus boisei* survives alongside *Homo erectus* in East Africa until about 1.4 MYA. In north-western Africa, several Middle Pleistocene hominid sites have been found along the coastline of Algeria and northern Morocco. The earliest of these sites, Tighenif in Algeria (formerly known as Ternifine), dates to about 0.6 MYA. The specimens from Tighenif comprise mandibles, teeth and a parietal bone, and they show close similarities to the Asian *Homo erectus* fossils. In South Africa, the mandible SK15 from Member 2 at Swartkrans, tentatively dated to between 1.0 and 1.5 MYA, may represent the first arrival *of Homo erectus* in that region.

Morphological differences between early African *Homo erectus* and later Asian examples of the species have led some to argue for the separation of the early African material as a distinct species, *Homo ergaster*. Whether these differences are important enough to merit taxonomic segregation is an unresolved issue (Turner and Chamberlain 1989). The type specimen of *Homo ergaster* is a lower jaw ER 992 from Koobi Fora, Kenya. Bernard Wood has placed this specimen together with the crania ER 3733, ER 3883 and the skeleton WT 15000 in *Homo ergaster* on the grounds that the crania have primitive features that are lost in Asian *Homo erectus* (Wood 1991).

The main distinguishing characteristics of *Homo erectus* are confined to the cranium. The lower jaw, teeth and postcranial bones of *Homo erectus* are well differentiated from those of *Homo habilis* and *Homo rudolfensis,* but there is considerable overlap in these skeletal parts between *Homo erectus* and later forms of *Homo* (see pp. 783–88). The skull of *Homo erectus* shows several distinctive features, including a long, low braincase with maximum width located across the temporal bones and a sharply angled occipital bone at the back of the skull. The prominent browridge forms a straight bar of bone above the eye sockets, and there is noticeable thickening of the skull vault bones along the midline (metopic and sagittal keeling), as well as on the occipital bone and at the lower posterior corner of the parietal bone (occipital and angular torus). Cranial capacities range from 800 to 1,250 cm^3, but values above 1,100 cm^3 are only found in *Homo erectus* in the Middle Pleistocene specimens from Ngandong and Zhoukoudian.

Homo erectus has often been associated with the Acheulian stone tool industry, a lithic technology typified by its substantial proportion of large bifaces. However, the earliest fossils of *Homo erectus* in Africa predate the first appearance of Acheulian tools by several hundred thousand years, and Acheulian tools first appear in Europe in association with archaic forms of *Homo sapiens* at about 0.5 MYA. At *Homo erectus* sites in eastern Asia, Acheulian artefacts are absent, and instead there is evidence for simpler core and flake technologies being used at Sangiran in Java (Sémah *et al.* 1992) and at Zhoukoudian in China (Zhang 1985).

Localized distributions of baked sediments and burnt stones at some lower palaeolithic sites have been interpreted as human control and use of fire. The earliest such evidence was found at Chesowanja, Kenya, where pieces of baked clay were found in association with faunal remains and Oldowan stone tools in sediments dated to 1.4 MYA. Similar finds have been made at Lower Pleistocene sites including Koobi Fora, Kenya, and at Gadeb (Locality 8E) and the Middle Awash river valley in Ethiopia. It is difficult to prove that these occurrences represent deliberate controlled use of fire, and, in the absence of evidence for hearths, alternative explanations such as natural bush fires or volcanic activity cannot be excluded (James 1989).

Absolute dating of *Homo erectus* fossils has shown that the species had a timespan of well over one million years. The species was eventually replaced in Africa and Asia by 'archaic' forms of *Homo sapiens* after 0.5 MYA. *Homo erectus* has been cited as an example of 'evolutionary stasis' (Rightmire 1990). According to the 'punctuated equilibrium' model, evolutionary change can be episodic, with rapid changes appearing during the initial formation of a new species but the species then undergoing few changes until a subsequent speciation event occurs. Early *Homo erectus* fossils from Lower Pleistocene sites in Africa have been compared with later specimens to determine whether features such as tooth size and cranial capacity change with time. A moderate increase in cranial capacity does seem to characterize the younger fossils, most of which are from Asia, but others have argued that this reflects a taxonomic difference between the earlier forms attributable to *H. ergaster* and the later and predominantly Asian fossils which represent *H. erectus*.

Fossil evidence for hominid occupation of Europe is sporadic until the early part of the Middle Pleistocene, and there is no clear evidence for the presence of *Homo erectus* in Europe. Although archaeological evidence hints at possible Lower Pleistocene migration of hominids to Europe, the earliest securely dated fossil hominids in Europe have been found in deposits dating to 780 Ka at the site of Atapuerca in Spain (Carbonell *et al.* 1995; see also Chapter 20). Although the Atapuerca hominids cannot be distinguished with certainty from *Homo erectus,* they have been allocated provisionally to *Homo heidelbergensis,* a species of 'archaic' *Homo sapiens*. A hominid cranium of similar age was found in 1994 at Ceprano in Italy (Ascenzi *et al.* 1996). The cranium has advanced traits that are not characteristic of *H. erectus,* and like the Atapuerca sample it most probably represents an early form of *H. heidelbergensis*.

'ARCHAIC' *HOMO SAPIENS*

Homo heidelbergensis

The category 'archaic' *Homo sapiens* was formerly used to refer to Middle and Upper Pleistocene fossils of the genus *Homo* that had developed the cranial capacity of *Homo sapiens* while retaining primitive features such as thick cranial bones, large faces and jaws and robust limb bones. In some taxonomic schemes these fossils were classified under several different subspecies of *Homo sapiens* such as *Homo sapiens neanderthalensis* and *Homo sapiens rhodesiensis*. In zoology, a subspecies refers to a discrete, morphologically distinct variety that occupies a limited geographical region within the total range of the species. Modern human variation is geographically continuous (clinal) and there are therefore no discrete subspecies of living humans. With the exception of Neanderthals (classified here as a distinct species *Homo neanderthalensis*), the Middle Pleistocene sample of 'archaic' *Homo sapiens* from Africa, Asia and Europe also forms a homogeneous group that does not exhibit well-defined geographical variation. These hominids, which are clearly distinct from modern humans, are therefore placed in the species *Homo heidelbergensis* (named after the lower jaw from Mauer, near Heidelberg), rather than as subspecies of modern humans.

Homo heidelbergensis is distinguished by its combination of primitive characters retained from a *Homo erectus*-like ancestor and advanced characters that are shared with the Upper Pleistocene species *Homo neanderthalensis* and *Homo sapiens*. *Homo heidelbergensis* is therefore an appropriate ancestor for the hominids of the Upper Pleistocene. Cranial capacity in *Homo heidelbergensis* ranges from 1,000 cm^3 to 1,400 cm^3. Brain enlargement, especially in the parietal and occipital areas, led to increased cranial height, increased parietal bone curvature and a less sharply angled occipital bone. There is some reduction in skull robustness, although larger specimens retain strong brow ridges and thick cranial vault bones. The face is less projecting than in earlier forms of *Homo* and there are the beginnings of the development of a chin at the front of the lower jaw.

The fossil remains of *Homo heidelbergensis* are known from a large number of sites in Africa, Europe and Asia (Table 19.6). Many of these sites have only been dated approximately, but they show that *Homo heidelbergensis* first appeared in Africa and Europe at about 0.5 MYA (the Atapuerca and Ceprano finds suggest a possible earlier appearance in southern Europe). The earliest dates for *Homo heidelbergensis* in Asia are a little later in time, consistent with the late survival of *Homo erectus* in China (Grün *et al.* 1997) and in Indonesia (Swisher *et al.* 1996). Some authors have argued that the Middle Pleistocene crania from China are intermediate between Asian *Homo erectus* and modern Chinese (Li and Etler 1992). In Europe, the fossil hominids from the later part of the Middle Pleistocene begin to show features that are typical of *Homo neanderthalensis*. The occipital bones of the crania from Swanscombe in England and Biache in France closely resemble those of Upper Pleistocene specimens of *Homo neanderthalensis*.

Fossils of *Homo heidelbergensis* are associated at some sites with Acheulian tools and at other sites with core/flake industries. At Bilzingsleben in Germany, fragments of hominid skull bones and teeth have been found on a lower palaeolithic

Table 19.6 Middle Pleistocene fossils attributed to *Homo heidelbergensis;* dates in millions of years ago (MYA)

Country	*Site*	*Date (MYA)*
Africa		
Ethiopia	Bodo	0.6
	Omo Kibish 2	?0.1
Kenya	Baringo	0.3–0.5
	Eliye Springs	?0.1–0.2
Libya	Haua Fteah	0.1–0.15
Morocco	Jebel Irhoud	?0.1–0.2
	Rabat	0.15–0.2
	Sale	0.4
	Sidi Abderrhaman	0.3–0.4
	Thomas	0.3–0.4
S. Africa	Cave of Hearths	?0.2–0.4
	Elandsfontein	?
	Florisbad	?0.1–0.15
	Saldanha	0.2–0.3
Tanzania	Ndutu	0.2–0.4
	Ngaloba	0.1–0.15
Zambia	Kabwe	0.1–0.2
Asia		
China	Dali	0.2–0.25
	Jinniu Shan	0.3
	Maba	0.1–0.2
India	Narmada	?0.2
Europe		
Azerbaijan	Azykh	?0.3–0.4
France	Arago	0.4
Germany	Bilzingsleben	0.4
	Mauer	0.5
	Steinheim	0.2–0.25
Greece	Apidima	?0.2–0.3
	Petralona	0.25
Hungary	Verteszollos	0.2
Italy	Castel de Guido	?0.3
	Cava Pompi	?0.4
	Ceprano	0.7
Spain	Atapuerca (Dolina)	0.8
United Kingdom	Boxgrove	0.5

occupation site dating to about 0.35 MYA. The hominid remains have been likened to *Homo erectus* (Mania *et al.* 1994), but recent discoveries show that they lack some diagnostic *H. erectus* features and they are classified here as *Homo heidelbergensis.* In an excavated area of more than 1,000 m^2, accumulations of stone and animal bones were revealed at Bilzingsleben as well as hearths and areas where stone and bone tools were manufactured or used. The stone tools are mainly cobble hammer stones and small retouched flakes of chert, while large scrapers, cleavers and picks were fashioned from flakes of elephant long bones.

Homo neanderthalensis

The Neanderthals *(Homo neanderthalensis)* occupied western Asia and most of Europe from before 130 ka to 35 ka. This period includes the end of the last interglacial and most of the last (Würm, Weichselian or Devensian) glaciation, and was therefore a time of environmental extremes in the northern hemisphere. The earliest fossils to be attributed to *Homo neanderthalensis* are from later Middle Pleistocene sites in western Europe dated from about 0.25 MYA (Table 19.7; see also Fig. 19.7) and it is possible that the species originated from or is closely related to *Homo heidelbergensis*.

Distinctive traits of *Homo neanderthalensis* are found in the skull and the limb bones. The brain, which is often larger than in modern humans, has small frontal lobes but is expanded particularly in the occipital region, giving a spherical appearance to the rear of the skull. The face is vertically elongated and the middle of the face is dominated by the large nose and prominent upper jaw, which are set in front of swept-back cheek bones. The limbs have relatively short distal segments (forearms and lower legs), but the bodies of the Neanderthals were powerfully built with large joints and prominent muscle markings on the bones. Body weights and stature have been estimated as averaging 65 kg and 169 cm in males, 50 kg and 160 cm in females. Neanderthals also have long, thin, pubic bones at the front of the pelvis. This feature is related to the different orientation of their pelvis, with the hip joints facing more sideways and less forwards than in modern human skeletons (Rak and Arensburg 1987).

Table 19.7 Middle Pleistocene fossils attributed to *Homo neanderthalensis;* dates in millions of years ago (MYA)

Country	*Site*	*Date (MYA)*
Britain	Pontnewydd	0.2
	Swanscombe	0.4
France	Biache	0.1-0.2
	Fontechevade	0.1-0.2
	La Chaise	0.1-0.15
	Lazaret	0.1-0.2
	Montmaurin	0.1-0.2
Germany	Ehringsdorf	0.2
	Reilingen	?0.2-0.4
Italy	Saccopastore	0.12
Spain	Atapuerca (Sima)	0.12-0.3

O-isotope Stage	Magnetic Polarity	Geological Stage	Date (ka)	Principal Hominid Sites
1		Holocene (Flandrian)	0 - 12	
2		Late Weichselian	12 - 24	
3		Middle Weichselian	24 - 59	1st appearance of modern humans in Europe
4		(Middle Devensian)	59 - 71	
5		Early Weichselian	71 - 120	Grotta Guattari, La Chaise
5e		Eemian (Ipswichian)	120 - 128	Bourgeois-Delauney, Saccopastore
6		)	128 - 186	Biache, Fontechevade, Lazaret
7		) Saalian (Wolstonian)	186 - 245	Ehringsdorf, Petralona, Pontnewydd, Steinheim, Verteszollos
8		)	245 - 303	
9		)	303 - 339	
10		) Holsteinian (Hoxnian)	339 - 362	
11		)	362 - 423	Arago, Bilzingsleben, Swanscombe
12		Elsterian (Anglian)	423 - 478	
13		)	478 - 524	Boxgrove, Mauer
14		)	524 - 565	
15		)	565 - 620	
16		) Cromerian Complex	620 - 659	
17		)	659 - 689	
18		)	689 - 726	
19		)	726 - 736	
20		)	736 - 763	
21		)	763 - 790	Atapuerca (Dolina)
22		) Bavelian/Menapian	790 - 810	
23		)	810 - 890	
24		)	890 - 920	
25		)	920 - 960	

Figure 19.7 Oxygen isotope stages, European glacials and interglacials and absolute dates from 960,000 years ago (ka) to the present day. Shaded intervals (odd-numbered oxygen isotape stages) represent warm periods. The chronological positions of some of the main early hominid sites in Europe are also shown. Source: A.T.Chamberlain.

The fossil evidence for *Homo neanderthalensis* is more complete than the record for earlier hominid species, partly because the more recent fossils are generally better preserved but also because some skeletons of *Homo neanderthalensis* were deposited through deliberate burial. The remains of *Homo neanderthalensis* are often associated with Mousterian tools, but the distribution of Mousterian artefacts extends well beyond the known range of Neanderthal fossils, and in western Asia Mousterian is associated with early fossils of *Homo sapiens*. Late Neanderthal remains at the French sites of St Césaire (dated to 36,000 years ago) and Arcy-sur-Cure (dated to 34,000 years ago) are associated with early upper Palaeolithic (Chatelperonian) rather than Mousterian artefacts (Hublin *et al.* 1996; Mercier *et al.* 1991).

The distribution of pathological changes in Neanderthal skeletons provides some insights into their behaviour. Injuries to the skeleton (fractures) were common, and their distribution suggests that they were acquired during subsistence activities such as resource procurement rather than as a result of inter-personal violence. Arthritis is also common, supporting the contention that Neanderthal skeletons were habitually subjected to high physical stress. The anterior teeth often show advanced wear. By analogy with modern hunter-gatherers, the teeth were probably used in non-dietary activities such as bark-stripping, sharpening or retouching tools, and gripping objects while they were being worked.

While the origins of *Homo neanderthalensis* are obscure, their abrupt disappearance from the fossil record in western Europe at 34,000 years ago is suggestive of replacement rather than absorption or hybridization with *Homo sapiens*. In central and eastern Europe, the earliest *Homo sapiens* fossils appear at about 36,000 years ago and are indirectly associated with the appearance of Aurignacian stone tools. These earliest modern humans in Europe retain some archaic features, but do not show any evidence of having inherited uniquely Neanderthal features of the skull or limb bones. Similarly, temporal trends towards modern human morphology are not seen within *Homo neanderthalensis*. The earlier Neanderthals of south-western Asia are more generalized in their skeletal anatomy, with the later 'classic' Neanderthals of western Europe showing increased projection of the middle of the face and the development of more marked features of the postcranial skeleton.

ORIGINS OF MODERN HUMANS

The origin of anatomically modern humans is of great interest because, in investigating the most recent stages of human evolution, the fossil evidence for the origins of *Homo sapiens* can be integrated with genetic and morphological studies of variation among different populations of living humans. Two divergent paradigms that synthesize this evidence in opposing ways have emerged in the last decade (Brauer and Smith 1992; Mellars and Stringer 1989; Trinkaus 1989).

One paradigm views the regional or racial differences among present-day human populations as originating in the pre-existing Lower or Middle Pleistocene populations of *Homo erectus* and *Homo heidelbergensis* that occupied the same regions. According to this 'regional continuity' paradigm, the evolutionary changes that led to the emergence of modern *Homo sapiens* occurred at different rates in different regions of the world, leading to variation in the times of appearance of the first modern humans in the fossil record. The importance of gene flow (the spread of advantageous genes among and between populations) is emphasized as a mechanism for maintaining the cohesion of the species during the gradual transition from archaic to modern forms.

In contrast, the 'replacement' or 'out of Africa' paradigm emphasizes the genetic and morphological homogeneity of modern *Homo sapiens*. The close similarities between modern human populations are explained as a consequence of their descent from one main population that originated recently in a single region of the world, most probably Africa or south-western Asia. This population (in effect, a new species) then migrated outwards, replacing pre-existing populations of archaic hominids with little or no significant assimilation or hybridization. Geographical differences among present-day *Homo sapiens* populations are presumed to have originated after the arrival of the migrating populations in their final regions. Contrasting predictions of the two models are given in Table 19.8.

Table 19.8 Predictions of the 'Regional Continuity' and 'Out of Africa' models

	Predictions of the Regional Continuity (multi-origin) model	*Predictions of the Out of Africa (single origin) model*
1	Present-day geographic patterns were established in the Middle Pleistocene.	Present-day patterns were only established at the end of the Pleistocene.
2	Large differences between modern populations, especially peripheral groups.	Small differences between modern populations.
3	Morphological characters of modern regional populations are found in Middle Pleistocene fossils in each region.	Modern regional characters only characterize Middle Pleistocene fossils in the centre of origin (i.e. in Africa)
4	Transitional or intermediate fossils are found in all major regions.	Transitional fossils are only found in Africa.
5	There is no consistent geographic sequence to the appearance of modern *Homo sapiens*.	The appearance of modern *Homo sapiens* occurs in the sequence (a) Africa, (b) south-west Asia, (c) other regions.

Anatomical evidence

All living humans belong to a single species, 'anatomically modern' *Homo sapiens*. The species can be defined by unique features of its skeleton: *Homo sapiens* possesses a short, high, cranial vault with a domed frontal bone and arched parietals. The skull and jaws lack prominent reinforcing structures such as brow ridges or mandibular tori, although there is a prominent bony chin. The nasal region is not projecting. The posteranial bones are more gracile than in other species of *Homo,* and skeletal development and maturation are extended compared with other hominids.

The oldest examples of *Homo sapiens* are from sites in Africa and south-western Asia. Hominid remains from the African sites have modern-looking, lightly constructed limb bones but still retain some archaic features in the skull, such as moderately prominent brow ridges and large teeth and jaws. In South Africa, the cave sites at Border Cave, Die Kelders and Klasies River Mouth were occupied by early *Homo sapiens* between 120,000 and 50,000 years ago. In eastern and northwestern Africa, early modern *Homo sapiens* are also present from about 100,000 years ago. In Ethiopia, the Omo Kibish 1 skeleton is dated to between 130,000 and 100,000 years ago, and at Dar es Soltan in Morocco, *Homo sapiens* remains dating to between 50,000 and 70,000 years ago have been found. Early *Homo sapiens* sites in south-western Asia include Qafzeh and Skhul, both dated to between 80,000 and 100,000 years ago. The hominid skeletons from these sites have gracile limb bones and modern pelvises, contrasting with Neanderthal remains from the adjacent sites of Kebara and Tabun. The cranial remains from Qafzeh and Skhul have well-developed brow ridges and projecting jaws, but they lack the midfacial and nasal projection that is characteristic of Neanderthals.

The period between 60,000 and 30,000 years ago witnessed the rapid spread (or emergence?) of *Homo sapiens* across Asia and Australasia. Early appearances in Asia occur at Niah Cave in Borneo, perhaps as old as 40,000 years ago, and *Homo sapiens* fossils from Lake Mungo in Australia have been dated to between 35,000 and 45,000 years ago; much earlier archaeological evidence for hominid occupation of northern Australia, dating to before 100,000 years ago, has recently been reported by Fullagar *et al.* (1996). In China, the sites of Liujiang and Zhoukoudian (Upper Cave) date to between 15,000 and 20,000 years ago. In Europe, the first evidence of anatomically modern *Homo sapiens* is dated to about 35,000 years ago and is associated with the appearance of Aurignacian stone tools. The first European *Homo sapiens* are sometimes referred to as Cro-Magnons, after the hominid fossils recovered from the rock shelter of Cro-Magnon, near Les Eyzies in France.

During the coldest phase of the last ice age, there was a lowering of global sea levels by up to 130 metres. Land connections emerged between Asia and America in the shallow seaway between the Chukot Peninsula at the eastern tip of Asia and the westernmost part of Alaska. The lowest sea levels occurred at about 20,000 years

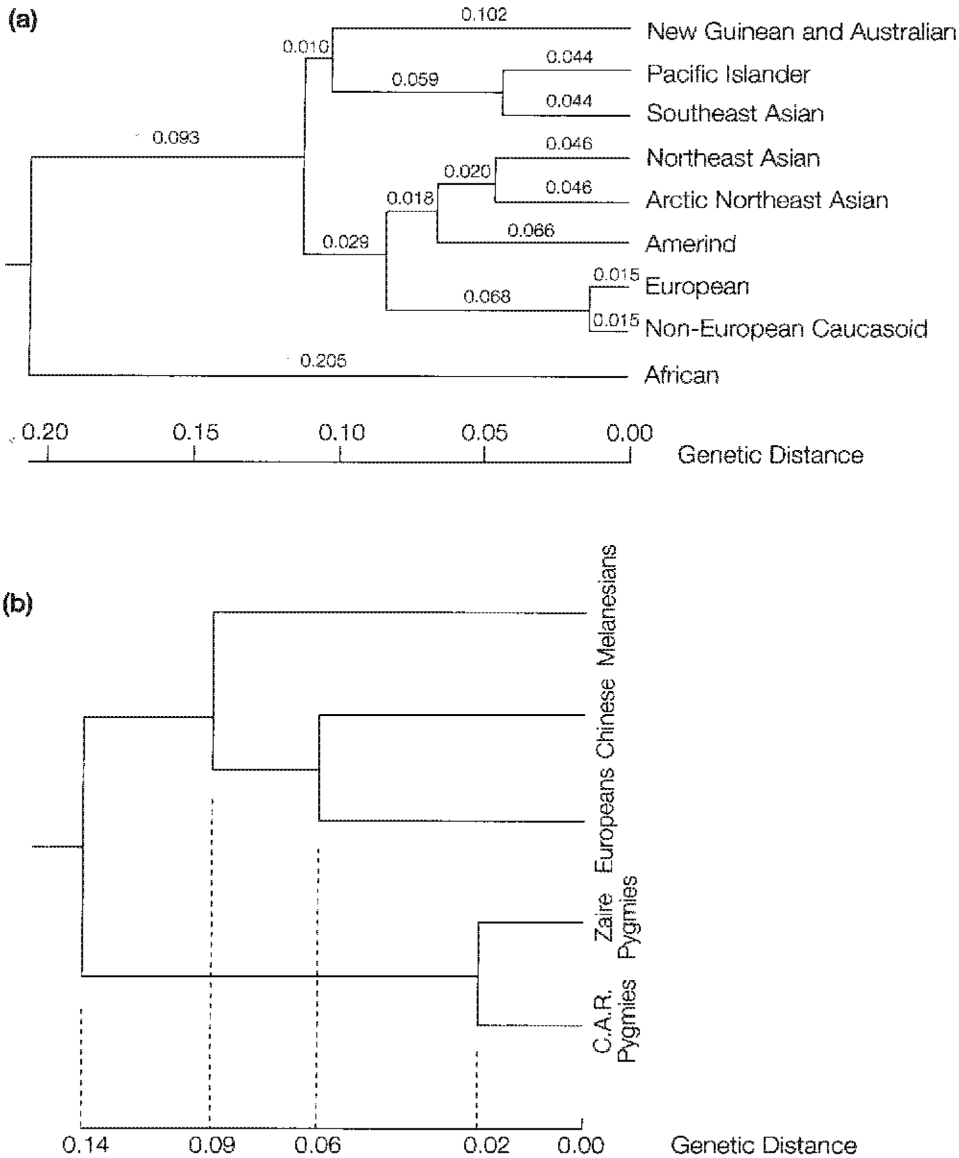

Figure 19.8 (a) Genetic tree constructed from summary genetic distances between living modern human populations; the genetic distances (in F_{ST} units) are calculated from the incidence of classical genetic markers including blood groups, cell surface antigens and protein polymorphisms, (b) Genetic tree constructed from population comparisons of 80 nuclear DNA polymorphic markers. Approximate genetic distances (Nei's distances) are shown for the principal divergence events. Source: L.L.Cavalli-Sforza *et al.* 1994.

ago, and it is possible that *Homo sapiens,* known to be present in North Asia, crossed for the first time into Alaska. Migration into the rest of the North American landmass would have had to overcome potential obstacles presented by the extensive terrestrial ice sheets that covered North America. At the end of the last ice age, global warming and glacial recession at about 11,000 years ago led to rapid expansion of *Homo sapiens* into the rest of continental America.

Biomolecular and genetic evidence

Genetic investigations of living populations of *Homo sapiens* using a range of different gene frequency and nucleotide sequence data offer strong support for the hypothesis that modern humans had an African origin. Most studies confirm that genetic diversity is greatest in Africa, and that genetic distances between African and non-African populations are large. Figure 19.8(a) represents the sequence of divergence of living populations as given by genetic distances based on a large number of classical genetic markers, and Figure 19.8(b) shows the divergence based on analysis of variable regions of nuclear DNA. Both sources of evidence show that after a primary split between African and non-African populations, a more recent subdivision occurred between Australasian and North Asian/Caucasoid (European) groups. These trees show modern Caucasoids as being most closely related to North Asians, but other evidence suggests that Caucasoid populations may have originated from an admixture of Asian and African populations.

The time of origin of human genetic material can be estimated by measuring the divergence between populations with known migration dates (in order to do this, the assumption must also be made that the relevant part of the genome is changing at a constant evolutionary rate). For example, divergence within groups that populated Papua New Guinea must have occurred after the first human colonization of the region, which took place about 60,000 years ago. When the calculated rate of evolution in mitochondrial DNA among New Guineans is applied to other populations of *Homo sapiens,* it gives a best estimate of 130,000 years ago (with 95 per cent confidence intervals of 60–420,000 years ago) for the origin of modern human mitochondrial DNA. This result implies that it is unlikely that modern humans originated from more than one of the Middle Pleistocene hominid populations, since the latter would have diverged much earlier than 400,000 years ago.

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HUNTER-GATHERER SOCIETIES

Robin Dennell

INTRODUCTION

One consequence of the voyages of Columbus and subsequent navigators was that Europeans increasingly encountered hunter-gatherers in Africa, the Americas and, later, Australia. This contact prompted a number of questions: Who were they? Where had they come from? Were they descended from Adam, or had they been created separately? Did they have souls? Why didn't they practise agriculture? Had Europeans once been hunter-gatherers? And what, if anything, could Europeans learn by observing these peoples? Before the nineteenth century, these questions were not answered by direct, historical and archaeological evidence, but by speculations and conjecture. Whereas Hobbes (1651) memorably dismissed their lives as 'solitary, poor, nasty, brutish and short' because they lacked both the restraints and comforts of civilization, Rousseau (1722) idealized them as living in uncorrupted innocence. Increasingly, throughout the eighteenth century, contemporary hunter-gatherers were seen as representing a 'primitive' stage of human development, and one that Europeans had long escaped by developing first agriculture, and later, metallurgy, writing and civilization. Unsurprisingly, these views sat comfortably with suggestions that European 'Caucasians' —a term first coined in the 1780s— were more advanced than 'inferior' races, notably Negroids and Australian Aborigines, many of whom also happened to be hunter-gatherers. Notions of the racial, economic and social inferiority of non-European hunter-gatherers were also highly compatible with European involvement in slavery, and the establishment of European colonial settlements in hunter-gatherer territories.

If contemporary hunter-gatherers were supposed to be 'primitive' peoples whose development lagged far behind that of Europeans, where had they come from? How long had they been like that? And how ancient was hunting and gathering as a way of life? Answers to those questions became clearer by the mid-nineteenth century once two conditions had been met. The first was the recognition by antiquarians that chipped and flaked stone implements from various parts of Europe had been made deliberately and were not thunderbolts or the result of chance geological flaking. Moreover, some of these artefacts were similar to stone tools used by hunter-gatherers in various parts of the world, and could therefore have been used by Europeans when they too were hunters. By the 1830s, for example, Sven Nilsson felt able to describe the material culture of 'the primitive inhabitants of Scandinavia' in terms of analogies between the stone tools found in Scandinavia and those still used by natives in places such as Tierra del Fuego.

The discovery of the Palaeolithic—or the Old Stone Age—grew out of the fusion of this 'comparative ethnography' with the discovery of unambiguous stone tools in secure geological contexts. In 1796, Frere had cautiously suggested that some stone tools from Hoxne—now a well-known lower palaeolithic site in Suffolk, England— may have been older than the earth; that is, more than the 6,000 years of the Biblical chronology (see Chapter 1; Fig. 1.6). Excavations in caves by the likes of Esper in Germany, Schmerling in Belgium, MacEnery in southern England, Tournal and de Saussure in France, had produced evidence, that in hindsight seems unambiguous, of stone tools in ancient deposits, and associated with the remains of extinct animals. This evidence was often dismissed, however, and often by the excavators themselves, on the grounds that either the stone tools might have been introduced from later levels, or that the deposits in which they were found were not demonstrably ancient (see Daniel 1964:42). The year 1859 is often quoted as the turning point in the acceptance of human antiquity, not least because it coincided with the publication of Darwin's *Origin of Species,* which did so much to foster the idea of gradual evolution over immense periods of time.

Eighteen fifty-nine was also the end of an era in that it marked the death of Brunel, arguably the greatest Victorian civil engineer: we should remember that the Railway Age not only shrank the world by making it so much easier for geologists, antiquarians and millions of others to travel, but also created much of the evidence of human antiquity by its insatiable demands for gravel ballast, and by the cutting of innumerable geological sections during the construction of railway lines. Thus in 1859, three eminent Victorian geologists—Falconer, Prestwich and Evans—went by train to inspect the evidence of an obscure French customs official, Boucher de Perthes, who had collected large numbers of stone tools from gravel pits along the river Somme in northern France, and claimed they were ancient, and associated with the remains of extinct animals. (These tools are now known as Abbevillian and Acheulian, after the localities where they were found, and the Acheulian in particular is still used to describe lower palaeolithic assemblages from large areas of Europe, Africa, the Near East and India.) Prestwich and his colleagues confirmed his evidence, as well as that collected by the vicar William Pengelly, who had found stone tools beneath a stalagmitic layer in Kent's Cavern in south-west England that are now recognized as middle palaeolithic, and 40–100,000 years old. Thereafter, geology became the foundation of palaeolithic studies in its ability to demonstrate and calibrate human antiquity.

PALAEOLITHIC STUDIES 1859–1959

Once human antiquity had been convincingly demonstrated to most critics' satisfaction, the subsequent century was largely taken up with mapping this antiquity in space and time. By 1914 a recognizable picture of human antiquity had emerged by painstaking stratigraphic observations in excavations and sections. Geologists were also aided by the discovery that the earth's climate had often been considerably colder than today during the time-span of human evolution. Evidence of reindeer, woolly rhinoceros and mammoth from south-western France, for example, or of glaciers that had once covered much of Scandinavia and the British Isles, indicated the existence of at least one 'Ice Age' during the Palaeolithic. Animal remains from cave and riverine deposits were particularly important in showing the prevailing type of climate, and this in turn helped distinguish between 'warm' and 'cold' phases of the remote past, and so allowed geologists to develop a chronological framework by recognizing, for example, an 'Age of Reindeer' and an 'Age of Hippopotamus'. (As we shall see later, faunal remains from palaeolithic sites are used very differently today.)

Nineteenth-century palaeolithic archaeologists relied heavily on notions of evolution and progress as inherent features of the past: if man had evolved like any other animal, so he had also 'progressed' from a 'lower' to a 'higher' level of existence, and such developments would be reflected in the type of tools that were made. Stone tools could therefore be assigned an approximate relative age by their inferred 'crudeness' or 'sophistication'. Again, analogies with known hunter-gatherers continued to be crucial. Stone tools found in Europe that resembled those made by peoples deemed to be very primitive—notably the Tasmanian and Tierra del Fuegean aborigines—were regarded as very ancient, whilst those resembling the artefacts used by more 'advanced' peoples, such as the Eskimo, were regarded as much younger.

In general, cave sites provided most evidence for what is now seen as the Middle and Upper Palaeolithic in Europe, and river deposits were the main source for the Lower. Much of the key nineteenth-century work occurred in France, from which many of the terms still in use were derived. One key piece of work was by two wealthy amateurs, Lartet and Christy, who excavated several cave sites in southwest France that were occupied by people who often hunted reindeer when the climate was considerably colder than today. (These sites, such as Aurignac, Cro-Magnon, and Les Eyzies, are now recognized as Upper Palaeolithic, dating to 30–15,000 BC.) Following the pioneering work of Boucher de Perthes on riverine deposits, others showed that the Acheulian and Abbevillian could be divided into a number of types, defined in terms of skill of manufacture, and thus their relative antiquity. By the 1870s, de Mortillet, one of the most eminent archaeological publicists of the time, could declare in the Paris Exhibition of 1867 the triumphal statement of 'le Loi du Progrès de l'Humanité, le Loi du Développement Similaire, et l'Haute Antiquité de l'Homme' as demonstrated proofs from palaeolithic archaeology.

If the initial demonstration of human antiquity was achieved by British scholars, its study was thereafter dominated by the French until well into the post-war period. The most exciting discoveries probably took place in the ten years or so before the First World War. Particular landmarks were the excavations at the caves of La Ferrassie and La Chapelle-aux-Saints in south-west France, which produced complete skeletons of Neanderthals, and their artefacts, now recognized as Mousterian, after the nearby cave of Le Moustier. Similar and equally important discoveries were also made at the cave of Krapina, Croatia, even though their importance was overshadowed by the French discoveries. It was these that under-pinned most subsequent debate, and the public perception of Neanderthals as stocky, stooped and primitive (see Chapter 19).

The discovery of palaeolithic cave art was probably one of the most dramatic discoveries of the late nineteenth century. Engraved and decorated objects had been discovered earlier, but were totally eclipsed by the discovery of painted murals of bison, reindeer and mammoth in the caves of northern Spain, the Pyrenees and south-western France. Despite much initial scepticism that representational art could be so ancient, the evidence was accepted by 1914. A key figure here was the Abbé Breuil, whose meticulous copies and records, often made under the most uncomfortable of conditions, firmly established the authenticity, range and skills of palaeolithic artists through a series of detailed monographs. Breuil probably contributed more to the study of the Palaeolithic than anyone else this century. His 1912 paper on the Upper Palaeolithic replaced de Mortillet's earlier and simpler scheme with a sequence for the upper palaeolithic cultures of south-west France that set the agenda for most subsequent studies. In a major study of the Lower Palaeolithic (Breuil and Kozlowski 1931) he recognized eleven stages of the Acheulian in terms of stratigraphy and typology, and this scheme pervaded similar studies elsewhere in Europe and throughout Africa and India.

If the French dominated studies of palaeolithic archaeology, its climatic and geological framework was established by German scholars. By the 1880s, they had also recognized that the Ice Age had been interspersed by warmer 'interglacial' periods when the climate was more like today. In 1909, two German geologists, Penck and Bruckner, published their *Die Alpen im Eiszeitalter* (The Alps in the Ice Ages), in which they argued that there had been four major glaciations during the

Pleistocene (the most recent geological period and the one in which humans evolved). Each was named after a local river of southern Germany, and, conveniently for generations of students, Penck and Bruckner established the practice of naming the oldest glaciation in a region with a name beginning with a letter near the start of the alphabet. Consequently, in terms of decreasing age, the four major Alpine glaciations that occurred during the Palaeolithic were known as Günz, Mindel, Riss and Würm.

Penck and Bruckner's work provided palaeolithic archaeologists with a series of pegs on which to hang their palaeolithic cultures. For example, most of the lower palaeolithic Acheulian was later dated to the Mindel-Riss interglacial, the Mousterian to the early part of the last (Würm) glaciation, and the Upper Palaeolithic to its latter part. It was also so influential on Pleistocene geology for the next sixty years that it deserves further attention. After the 1914–18 war, researchers in other areas found evidence of four major glaciations, in areas formerly glaciated, and four 'pluvials'—or cool, wet episodes—in regions nearer the equator. Consequently, a 'Grand Synthesis' of regional glaciations and pluvials was established, each with four cold events, named in alphabetical order. Common to many of these schemes was the assumption that first, the early Pleistocene had been pre-glacial; second, that glaciations had tended to be short; and third, that each began and ended gradually. By implication, our ancestors had not had to contend with hostile climates until comparatively late in their evolution, and even then, glaciations had been relatively short, and with a very gradual transition to and from interglacial conditions. As noted below, a very different picture has emerged since the 1970s.

Although prehistoric archaeology first developed in western Europe in the first half of the nineteenth century, it soon ceased to be a monopoly of those areas. The first monograph on the vertebrate palaeontology of India appeared as early as 1845, and the antiquity of the Palaeolithic there was recognized as early as the 1860s. In many areas, palaeolithic investigations were developed within a few years of colonial rule, particularly by the French and British. The 'Golden Age' of colonial archaeology was probably during the 1920s and 1930s, when the foundations of stone age studies were firmly established over much of Africa, India, south-east Asia and the Near East (see Dennell 1990). The major exception was Australia, where little significant archaeological work occurred until its Pleistocene record was discovered in the 1960s.

In Africa and Asia, the Palaeolithic was investigated by Europeans, inheriting and developing a framework that had been developed in Europe. Given that archaeological cultures were seen as equivalent to geological ages, this was not surprising, as a culture found in Europe should be expected in Africa or Asia, just as the Miocene is. Thus the Aurignacian was recognized in areas as remote as East Africa, whereas it is now seen as local to Europe only. The recognition that archaeological cultures were not universal stages of development, but discrete, localized entities, soon encouraged the development of local terminologies, albeit often within the broader framework of the Lower, Middle and Upper Palaeolithic that stemmed from European discoveries. Even this framework has now largely disappeared in areas where it was formerly prevalent, such as Africa and India, where an Early, Middle and Late Stone Age (abbreviated as the ESA, MSA, and LSA respectively) are seen as more appropriate.

There has always been a fundamental difference between the study of the Palaeolithic and Mesolithic in Europe and the Near East, and their counterparts in the Americas, Africa and Australasia. In Europe, the Palaeolithic ended some 10,000 years ago at the end of the last ice age, and the Mesolithic was followed by the Neolithic by 5,000 years ago over much of Europe. That is to say, hunting and gathering largely disappeared as a dominant lifestyle in Europe thousands of years ago, and so for Europeans it is very much 'ancient history', and removed from them by two or three thousand years of written history and often by as much again of non-literate agrarian history. (The same is even more true, of course, of the Near East.) In other areas, Europeans confronted hunters and gatherers directly, and the Stone Age in Australasia, and much of Africa, Amazonia and North America often effectively ended with their arrival. In those situations, hunters and gatherers were very much in the present, and could be studied directly, not just in terms of their material culture but also in terms of their kinship systems, language, religious attitudes and ideology. Ethnography and social anthropology were thus integrated with prehistoric archaeology in those areas to a much greater extent than in Europe.

PALAEOLITHIC STUDIES FROM THE 1960s

Palaeolithic studies changed profoundly during and after the 1960s. The main reasons usually quoted are the refinement of dating techniques, and the development of new ones; a comparable revolution in studies of past climatic change; and major changes in the ways that archaeologists approached the past. Other factors were also involved: cheaper air travel in the 1970s made overseas fieldwork more practical, and international conferences more accessible; conversely, higher labour costs increasingly meant that archaeologists had to excavate smaller areas in much greater detail.

Two dating techniques—carbon-14 and potassium-argon (K/A) —did much to free palaeolithic archaeologists from the need to focus primarily upon chronology. Neither was an invention of the 1960s: radio-carbon dating, for example, had been used since Libby's pioneering work in the 1940s, and K/A dating since the 1930s. However, these were initially of use respectively on very young (under 10,000 years) and very old (over 10 million years) materials. As they improved, so radio-carbon could be used reliably on materials as old as 30–50,000 years ago, and K/A on volcanic deposits under a million years old. As a result, both the earliest and latest parts of human evolution and stone age societies could be dated, even though there remained an uncomfortable gap between 50,000 and 500,000 years that is only now being plugged. 'Guesstimates' could now be replaced by realistic, verifiable estimates. One immediate reward was that the time-span of human evolution was considerably enlarged: even in the 1940s, authorities such as Louis Leakey and Arthur Keith believed that the whole of human evolution had been crammed into the last million years, whereas thirty years later we find it easy to accept that the first toolmaking hominids lived over 2 million years ago, and the earliest bipedal hominids were walking upright some 2 million years before that (see Chapter 19). A second gain lay in the type of deposits that could now be dated. As seen earlier, riverine deposits and caves had been the main sources of evidence, simply because they contained sufficiently long geological records to allow the construction of local sequences. Open-air sites usually preserved better evidence of *in situ* activities, but were often impossible to date before the refinement of C14 and K/A. Dating techniques have since been considerably enhanced by the development of other methods, such as palaeomagnetism, thermoluminescence (TL), optical saturation luminescence (OSL), electron-spin resonance (ESR), uranium-thorium (U-Th) and other isotopic techniques (Aitken 1990; and see Chapter 5).

Radio-carbon dating in particular had an immense effect in internationalizing studies of ancient hunter-gatherers. A good example is Australia, the stone age archaeology of which had been largely ignored on the grounds that the aborigines were 'an unchanging people, living in an unchanging environment', and therefore unworthy of study. This prejudice was reinforced by the belief that Australia was not colonized until the postglacial conditions in the last 10,000 years. Due to radio-carbon dating, it now has a Pleistocene past extending back at least 60,000 years (Roberts, Jones and Smith 1994) —that is to say, it was colonized by sea when Neanderthals were still living in south-west France. Likewise, we now know that Melanesian islands 200 miles offshore were colonized some 30,000 years ago (Allen *et al.* 1989); and that the Americas had been colonized by 10,000, and perhaps 30,000 years ago. All this proves more than that something is 'older' than something else: it means that each region can now establish its own prehistory, independent of discoveries and prejudices of other regions.

Perhaps the profoundest impact of radio-carbon and other dating techniques upon the study of prehistoric hunter-gatherers has been in the way that stone tools and animal remains associated with stone tools can be studied. As noted earlier, typological studies of stone tools were initially vital for building chronological frameworks. These efforts were often supplemented by the analysis of animal remains to show the prevailing climatic conditions, and/or the approximate age of a deposit by the type of animal. The advent of absolute dating techniques over the last thirty years has largely (but by no means entirely) freed archaeologists from the need to concentrate on chronology, and enabled them to look instead at other questions such as: how were tools made and used?; why were they discarded?; how long did they last?; which members of a group might have made and used them? Or what types of animals were hunted, or scavenged?; which parts of the carcass were preferred?; at what time of year were they killed?; was meat shared? (if so, amongst whom, and by whom?); and how was it used? (eaten fresh, stored?); were skins used, or only the meat and bone?

A revolution of comparable magnitude to that brought about by radio-carbon occurred through isotopic studies of deep-sea sediments. Put briefly, minute marine organisms called foramifera have shells of calcium carbonate (the building-stuff of chalk), compiled from sea-water and carbon-dioxide. As these creatures live, they absorb the prevailing isotopic composition of the water around them, which in turn depends on the prevailing salinity, itself dependent upon the amount of freshwater locked up on the earth's surface as ice and snow. The isotopic composition of these creatures thus gives an indirect account of the prevailing climate. When these creatures die, their remains fall from whatever depth of water they inhabited when alive to the sea bed. Ocean floor sediments thus contain a record of the earth's climate, and moreover it is generally a record that is far more continuous and undisturbed than any sequence on land (Imbrie and Imbrie 1979).

Analyses of these sediments have shown a radically different view of climatic change during human evolution from that developed on land by Penck and Bruckner, and their successors (Fig. 19.7). The 'Magic Four' glaciations of the Pleistocene have now been replaced by at least twenty over the last 2.5 million years; these often began and ended abruptly, and glaciations probably dominated 90 per cent of the last 2 million years. However, substantial problems still exist in relating this new, global picture to the older, regional sequences derived from the classic fourfold glacial model. Many key sites between 50,000 and 500,000 years old are still dated by reference to the old chronological framework, now known to be obsolete, because they are too old to be dated by C14 and too young for K/A. These problems will eventually be resolved through the development of new dating techniques, but anomalies are likely to remain for many years to come.

The 1960s also marked the eclipse of the French domination of palaeolithic studies by American ideas (Villa 1991). As part and parcel of the New Archaeology, palaeolithic archaeologists shifted their focus from the development of cultures and their components through time to the behaviour of individual groups, and the interrelationships of their technology, social organization and environment. This in turn fostered a more closely integrated, interdisciplinary approach. In British circles, this approach grew out of the Cambridge palaeoeconomic approach developed by Graham Clark in the 1950s (Clark 1952), and Eric Higgs in the 1970s (Higgs 1975).

American developments were always more deeply rooted in anthropology than in Europe, and owed much to the galvanizing influence of Lewis Binford in forcing attention away from descriptions of archaeological cultures to analyses of how their components interacted with each other and the environment (see, for example: Binford 1983; Binford and Binford 1966).

CURRENT SOURCES AND APPROACHES

In the 1990s, archaeologists investigating prehistoric and especially Pleistocene hunter-gatherers have an enormous array of techniques (potentially) at their disposal. The dating of a site or deposit can often be delegated to a laboratory; the prevailing climate is often known in far greater detail than could be imagined a few decades ago; and improved techniques for retrieving and recording material from excavations have greatly increased the quantity and quality of data. How then are hunter-gatherers studied, and what are the main sources of evidence?

Whereas most earlier work on stone tools focused attention on a small number of distinctive types (or '*type fossiles*') that were chronologically significant, the emphasis now is on the total assemblage, including the parts that may have been waste, or the by-products of making and re-using stone tools. Assemblages are often categorized into percentages of each type to facilitate comparison with others. The French, in particular, brought this approach to a high level of refinement through the work of François Bordes and his successors, and have often used recurrent patterns to designate regional subvariations or subperiods of archaeological cultures. However, this approach is not without problems: the type of stone used, and modifications to stone tools before they were discarded have to be considered, and it is rarely appropriate to very early stone technologies as few tools were of a standard shape, or to areas such as Australia, where hunter-gatherers survived with very few formal tool types (Dibble and Rolland 1992).

Other researchers have stressed more the context in which assemblages were used, modified and discarded. American researchers have been particularly active in this respect, due in no small part to the work by Lewis Binford, who did much to focus attention on studying assemblages in terms of seasonal need, planning depth, raw material availability, and cultural framework. One approach he and others have used is to relate stone tool assemblages to the types of large mammal remains associated with them, on the grounds that much of the tool-kit used by hunters would have been used for obtaining and processing meat, as well as other parts of the carcass. Another major development in stone tool studies is through use-wear— the traces of wear caused by a tool being used for a specific task. This line of research was pioneered in Russia by Semenov (1964), and by Lawrence Keeley (1980) in the USA. This has produced some major surprises in that often the perceived function of a stone tool as a 'knife' or 'scraper', for example, is not confirmed by its use-wear. Often, stone flakes categorized as 'waste' were in fact used as tools. This brings into question the extent to which our perceptions of hunter-gatherer tool-form and tool-use are conditioned by our own western, twentieth-century perceptions. As a result, archaeologists are now more wary about describing stone tools in terms of function ('handaxe', 'scraper', and so on) until the use is confirmed independently, and meanwhile prefer to describe stone tools in terms of their shape, and how they were flaked.

In well-preserved and carefully excavated sites, it is sometimes possible to refit pieces of flaked stone. Although tedious to do, these studies can help elucidate whether stone tools were made or merely modified on a site, which parts of a site were used for stone-working, and even the numbers of people who may have been involved (see, for example, Cahen and Keeley 1980; de Loecker 1994). They can also provide valuable information on the amount of post-depositional disturbance that took place after the material was discarded (Villa 1983).

As with stone tools, large mammal remains are no longer used just for establishing a chronological framework. Information is now usually compiled on not only which types of, and how many, animals are present, but which anatomical elements are most often preserved, which parts were removed, the age at which an animal died, and how animal skeletons were broken and/or cut during and after the dismemberment of a carcass.

Although 'off-the-peg' analogies are clearly inappropriate, ethnographic studies can show us a great deal about hunter-gatherer behaviour, even if much of it is cautionary. For example, they provide a reminder of how impoverished our evidence is for hunting and gathering—a few stone tools, some bones and, if lucky, a few scraps of plant debris. Only rarely—as in waterlogged sites—is the organic component of their material culture preserved in the way of nets, traps, canoes, spears, bows, arrows, baskets and skins. Evidence of plant foods is likewise similarly impoverished. Ethnographic studies also indicate the complexities of hunter-gatherer life in terms of decisions and customs over who does what, and how choices are made and implemented. Study of the 'structure' of their decision-making, and means of effecting these decisions in terms of the social organization and technology, can also help in the generation of hypotheses about the types of archaeological residues that may be predicted from different types of activities and circumstances. In the same way, we can learn an immense amount from primatologists about the way apes behave (McGrew 1992), but without turning early hominids into just another type of chimpanzee.

CONCEPTUAL AND METHODOLOGICAL PROBLEMS

The term 'hunter-gatherer' is often used to describe the subsistence of our predecessors from the time when they first learnt to make stone tools (and thereby left an archaeological record) some 2.5 million years ago to the advent of agriculture in the last few thousand years. This time-span presents three major difficulties to those studying the prehistory of subsistence.

Problems of definition: hunting and gathering as a way of life

Gathering, the less contentious of these two terms, implies the collection but not cultivation of plant foods. As plant foods are rarely directly evidenced before the end of the last ice age their role is often more assumed than demonstrated. 'Hunting' is more problematic, as it implies the deliberate, premeditated, killing of animals, as opposed to the scavenging of carcasses of animals that died naturally or were killed by other predators. In behavioural terms, the two are very different, and require very different skills. Archaeologically, however, they are hard to tell apart from the scraps of bone and teeth that occasionally survive in undisturbed archaeological contexts. In the very remote past, scavenging may well have been more important than hunting, and one current major debate is whether 'hunting' is a comparatively recent phenomenon in our evolutionary history (see, for example, Binford 1989).

A related problem concerns the relative importance of meat to plant foods in the hunter-gatherer (or scavenger-gatherer) diet, and the time spent obtaining them. Large brains require high intakes of protein, and our teeth and digestive system are those of an omnivore. Meat is often assumed to have been more important than plant foods in early hominid diet, not least because the remains of large mammals survive much better archaeologically than those of plants. The image of 'Man the Hunter' as deeply rooted in human evolution has also been powerful, partly due to a male bias (thankfully less evident these days) amongst ethnographers in documenting the activities of contemporary hunters, who also tended to be male. It came as a major surprise in the 1960s to learn that the !Kung Bushmen of the Kalahari obtain 90 per cent of their food from plants, even though their hunting was regarded as a high-status (and usually male) activity (Lee 1979). Many ethnographically documented societies are better categorized as gatherer-hunters than hunter-gatherers, and the same may well hold true of the past. In global terms, the importance of meat to human diet generally decreases towards the equator, and diets composed overwhelmingly of meat tend to be located in Arctic regions. The 'hunting' of large mammals as the main means of procuring food may have been not only a comparatively recent phenomenon, but one confined to cold areas where plant productivity is low.

Additionally, the hunting and/or scavenging of large mammals and the gathering of plant foods were not the only options open to early hominids for acquiring food. This applies especially to the acquisition of animal protein. In accounts of human evolution, *carnivory,* or meat-eating, has been emphasized far more than *faunivory*, the eating of animal protein (McGrew 1992:209). However, large herbivores are not the only source of animal protein: small mammals such as rodents, birds, eggs, reptiles and even insects (such as termites) may also have been eaten by early hominids, not least because none is especially dangerous to catch or likely to be scavenged. Unpalatable though it might be to envisage our earliest ancestors eating mice, lizards, frogs, tortoises, eggs and insects, those may have been more commonly eaten than large mammals. We should not assume early hominids ignored them merely because prehistorians have done so.

How does the archaeological record for prehistoric subsistence relate to the fossil hominid record?

The answer to this question has to be: very tenuously indeed for the most part. First, it is often unclear which type of hominid created the archaeological record: this point applies particularly to the earliest African evidence prior to 1.5 million years ago, but also to the last glaciation in Europe and south-west Asia before 30,000 years ago, as both Neanderthals and anatomically modern humans may have been responsible (see Chapter 19).

Second, even if we know which type of hominid did create the archaeological record, its evolutionary relationship to us is usually unclear and/or contentious. We cannot therefore assume an unbroken thread that somehow links us to those hominids living 50,000, 500,000 or 2 million years ago. The prehistory of hominid subsistence is not one of 'progress' from simple to complex, from primitive to advanced, from crude to sophisticated, or from 'less' to 'more' human. These views were inherent in nineteenth-century accounts, and still haunt many present studies, but human behaviour 2 million years ago—or even 100,000 years ago—was not just a 'simpler' and more 'primitive' version of what is seen today: it was fundamentally different because it was performed by creatures that are now extinct and might not even be directly ancestral to us. Hominid behaviour prior to *Homo sapiens sapiens* has to be studied in its own right, and not as something that becomes inexorably and inevitably more 'human' through time, or, for that matter, less chimpanzee-like. Even after 30,000 years ago, when *H. sapiens sapiens* became the only type of hominid in the world, the diversity of human cultures evidenced today and in the recent past should warn us against simple generalizations. Similarly, enough is now known of the diversity of chimpanzee behaviour to caution us against generalizing about the ape-like 'pre-human' condition.

Third, the behaviour of extinct hominid species probably changed through time: the behaviour of *Homo erectus,* for example, is unlikely to have been static over a million years (especially if it colonized two new continents in that time), even if its anatomy may have been remarkably constant. For that reason alone, it is not especially useful to structure discussions of palaeolithic subsistence in terms of a particular type of hominid.

How does the archaeological record for palaeolithic subsistence relate to artefactually defined periods?

Again, the answer has to be: very weakly indeed. The main units of the Palaeolithic (Lower, Middle and Upper) were initially defined for chronological purposes by the presence of handaxes, prepared cores and blades respectively. None of these helps define human or hominid diets and subsistence strategies, however useful they may have been at the time. The Lower Palaeolithic covers at least 2 million years, from the hominids of the late Pliocene of Africa to those living in Africa, and over much of Asia and Europe some 250,000 years ago. The Middle Palaeolithic has no clear beginning and an extremely contentious end around 35,000 years ago, and those who study the subsistence of the last glaciation would do well to avoid being dragged into palaeontological arguments over whether or not Neanderthals became extinct. The Upper Palaeolithic is little more uniform than the preceding Middle and Lower Palaeolithic once the widespread use of blade tools has been noted. An additional limitation of terms such as Middle and Upper Palaeolithic is that they are very local, and inapplicable outside Europe, the Near East and North Africa.

For these reasons, syntheses of palaeolithic subsistence should attempt to be independent of both the fossil taxa identified by physical anthropologists, and the chronological units initially devised by those who studied stone tools. Such syntheses also need to take account of the major gaps and weaknesses of the archaeological record. Here, four major units are tentatively identified.

The first is one of *tool-assisted omnivory*. This term is intended to summarize the evidence for the earliest hominids, prior to about 1.5 million years ago, and possibly confined to Africa. The second, between 0.5 and 1.5 million years ago, is what this writer would summarize as *'The Big Unknown'* (not unlike Glynn Isaac's famous 'Muddle in the Middle'), as its main concerns are when (and even if) hominids left Africa, and when and how they colonized Asia and Europe. The third is evidenced by at least 500,000 years ago, and can be described as *hunting for immediate consumption*. In the last 25,000 years or so, *hunting with the option of deferred consumption* appears to be the most useful way of summarizing the main developments in Europe at least, where the best evidence obtains.

TOOL-ASSISTED OMNIVORY

As described in Chapter 19, the earliest known hominids, from *c.* 4.5 million years ago, are derived from the Rift Valley in East Africa and later from various cave systems in South Africa (Fig. 20.1). The oldest stone tools are those around 2.5 million years old from the Kadar Gona, Ethiopia (Semaw *et al.* 1997). Slightly younger ones have been found at Koobi Fora, but the best known ones are those from Olduvai Gorge, where they were found associated with both *Homo habilis* and *Australopithecus boisei*. It has usually been argued that *habilis* was the only tool-maker, but recent discoveries of hand bones at Swartkrans Cave in southern Africa suggest that *Paranthropus* (including *A. boisei*) may also have made stone tools (Susman 1987, 1988). This would not be surprising, as chimpanzees can both make and use tools made from wood, leaves and occasionally stone (McGrew 1992), and orang-utans (Wright 1972) and some monkeys (Westergaard and Suomi 1995) can also flake stone. If, as seems reasonable, chimps and humans have inherited these skills from a common background, then tool-making may well pre-date both humans and chimpanzees, and thus be older than when they diverged over 6 million years ago (Westergaard and Suomi 1995). What we may be detecting after 2.5 million years is the onset of localized artefact discard, rather than the advent of stone tool-making.

Investigations into the subsistence of late Pliocene hominids share many features with a courtroom drama. The ‘victims’ were numerous dead animals, represented either as individual carcasses (such as the elephant at DKI, Olduvai, or the hippo at the Hippo-Artefact Site, Koobi Fora) or, more commonly, as a few bones and teeth of several animals. *H. habilis* has been the usual ‘suspect’: ‘Nutcracker Man’ or *A. boisei* was readily dismissed as, at most, a feeble-minded and largely vegetarian bystander because of its small brain and large chewing teeth. The stone tools found in the same context as the animal bones were seen as incriminating evidence that *habilis* had killed and butchered the animals in its quest for meat: it had, in short, the means, motive and opportunity. In an earlier but similar investigation, Raymond Dart (1949) inferred that the 2.5–3.0-million-year-old australopithecines found in the cave deposits at Makapansgat in South Africa had hunted several types of animals, including carnivores, and had even used an ‘osteodontokeratic’ culture of animal bones, teeth and horns as tools, long before stone was used.

The key assumption in these investigations was that there was a *causal* association between the non-hominid animal remains, the hominid remains themselves (whether *Australopithecus africanus* or *H. habilis*) and, in the East African case, the stone tools. The seemingly common-sense proposition that the association of stone tools and animal remains indicated that hominids had hunted was most clearly expressed by Glynn Isaac (1978). His synthesis rested on the evidence of his own team at Koobi Fora as well as that which Mary Leakey (1971) had meticulously

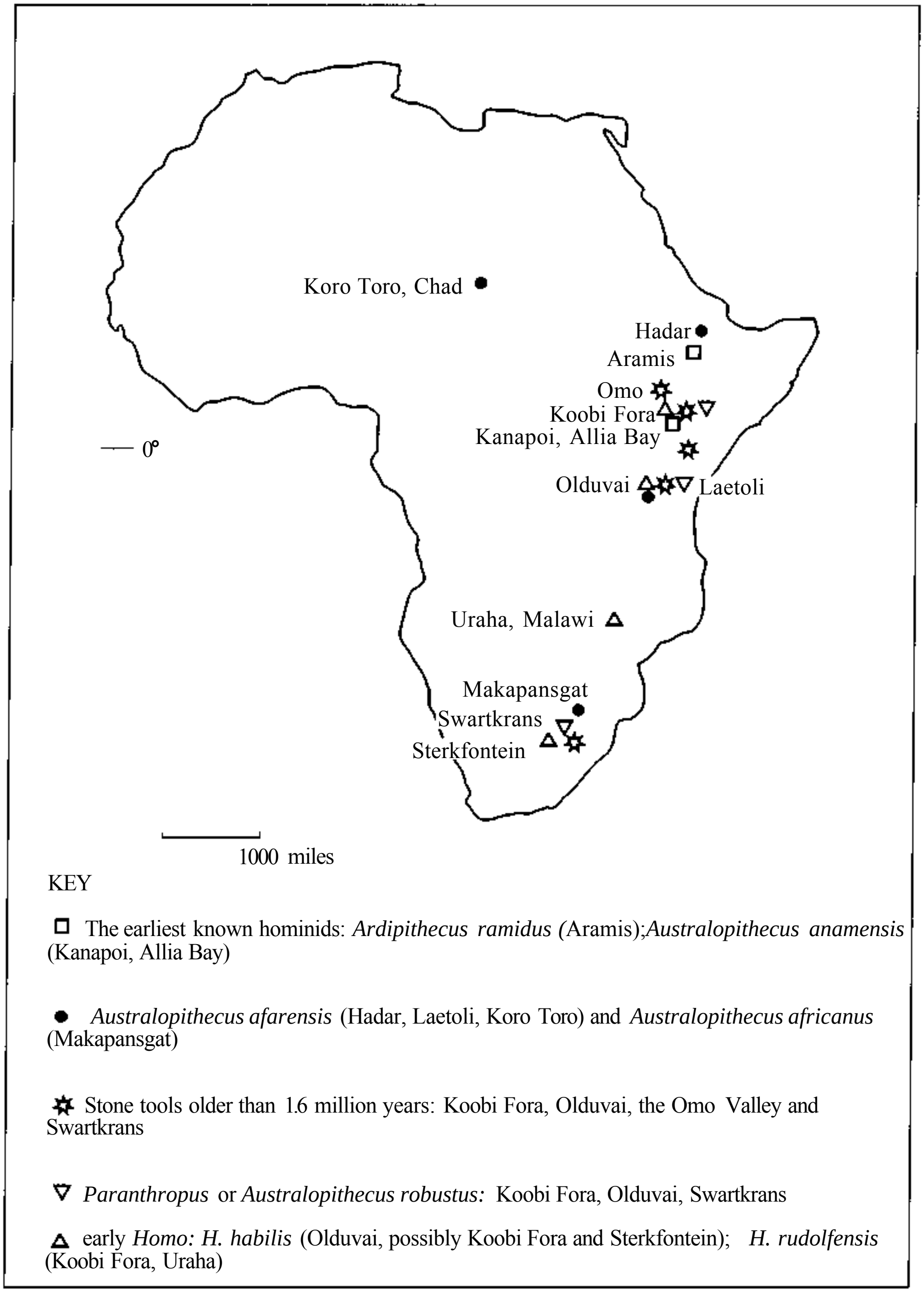


Figure 20.1 Principal localities of African hominids. 1. The earliest-known hominids *Ardipithecus ramidus* (Aramis) and *Australopithecus anamensis* (Kanapoi, Allia Bay); 2. *Australopithecus afarensis* (Hadar, Laetoli, Koro Toro) and *Australopithecus africanus* (Makapansgat); 3. stone tools earlier than 1.6 million years (Koobi Fora, Olduvai, the Omo valley, Swartkrans); 4. *Paranthropus* or *Australopithecus robustus* (Koobi Fora, Olduvai, Swartkrans); 5. early *Homo* (Olduvai, possibly Koobi Fora and Sterkfontein); *H. rudolfensis* (Koobi Fora, Uraha). Source: R.Dennell; drawn by D.Miles-Williams.

assembled at Olduvai. Her excavations had shown different types of sites: some contained large amounts of flaked stone and animal remains; others had a large amount of flaked stone but few animal remains; and others contained numerous animal remains but only a few stone artefacts.

At the time, the interpretation of this material seemed straightforward, and was similar to that routinely given to other, much younger, palaeolithic sites in Africa, Europe and Asia. Those sites with the remains of a few large animals and only a few stone tools were explicable as butchery sites, where animals were killed or scavenged, and from which parts of the carcass were removed for eating elsewhere. Sites with large amounts of bone and stone were explained as home bases, where members of a hunting group (assumed to be the males) took meat that could be shared with the rest of the group, and particularly with the females and their offspring. One site at Olduvai (DK) in Bed I even had the remains of what was interpreted as a hut, where hominids slept at night (Leakey 1971:24). Other sites with much stone but little bone were seen as 'workshop sites', where stone tools were made, and perhaps some meat consumed whilst doing so.

This model had several implications on early human behaviour, particularly that of *Homo habilis,* the probable maker of the Oldowan assemblage. Above all, it implied that *habilis* was already behaving in a recognizably 'human' manner 2 million years ago: there was already a sexual division of labour, whereby males hunted and females gathered; a basic family unit, in which males provisioned their female partners and young; meat was already a major part of early hominid diet, and this was acquired by hunting rather than by scavenging. As importantly, home bases were already integral parts of pre-human behaviour in providing foci where hominids ate, slept and cooperated together. A logical and obvious consequence of this model was that if *Homo habilis* was behaving in this way 2 million years ago, then so too were later hominids.

As already stated, the basic assumption of this approach was that there was a *causal* relationship between the stone tools and animal bones: both were found together because hominids had used one to process the other. But was this necessarily the case? Could this association have been merely *casual?* Suppose the stone tools and animal remains had been deposited independently of each other, and by different agencies? In what amounted to a retrial of *H. habilis* and *A. africanus,* and their current acquittal of all charges of systematic hunting and food-sharing, much attention was paid to the association of stone tools and faunal remains. One major starting point was Brain's (1981) reassessment of the evidence from the South African australopithecine caves such as Swartkrans. His work was part of a growing interest in taphonomy—the processes by which fossil and archaeological material is accumulated and buried. Brain paid close attention to the type of debris left by carnivores such as leopard after their feeding, to the types and age-groups of animals that they prefer, and to the parts of the skeleton that most commonly survive. In effect, he overturned Dart's (1949) earlier verdict that the australopithecines had been skilled hunters. In Brain's view, these had not been the hunters but the hunted: the remains of their skeletons amongst those of other animals indicated only that they too had been eaten by a non-hominid carnivore.

A second major starting point came from Lewis Binford, who engendered a lively and occasionally heated debate on how the East African early hominid localities had formed. He argued that a causal relationship between stone tools and animal remains had to be demonstrated, not assumed (Binford 1977). He further argued that such associations might have been entirely casual, in that that there was no clear evidence that hominids had accumulated the animal remains. In some cases, stone tools and animal remains could have been mixed together by stream action as a kind of 'fluvial jumble'. If so, the stone tools would have been derived from elsewhere, or during other activities not associated with meat procurement.

Others tested specific parts of the data on which Isaac's model depended—often encouraged by Isaac himself, whose own views developed considerably. Much attention was paid to which parts of animal skeletons were present (Blumenschine 1986; Bunn and Kroll 1986) to see if the debris at these early hominid sites was markedly different from that found at non-hominid feeding and denning localities. Evidence was also sought for cut-marks and tooth-marks as indicators of whether hominids or other carnivores modified bone debris. Both were often evidenced, and in some cases, as at Koobi Fora, the superposition of cut-marks over carnivore tooth-marks (and sometimes vice versa) indicated that both were involved (Gamble 1981). A further weakness of Isaac's original model was the length of time represented by these accumulations. Typically, present-day hunter-gatherer sites are very short term, and leave far less debris than the 'home bases' supposedly evidenced at Olduvai. Studies of the length of time for which bone was exposed before burial indicate that these early sites were often used repetitively, perhaps over several years (Potts 1986).

A decade or more of hard questioning has left very little of Isaac's (1978) and Mary Leakey's (1971) original model intact. The emerging consensus is that *Homo habilis* is far less 'human' than first thought: there is no clear evidence for hunting, let alone food sharing; the dietary importance of meat may have been overestimated; bone marrow may have been at least as important as meat; scavenging may have been more important than hunting; and carnivores probably played a large part in the accumulation of the bone at these localities. Furthermore, the 'home bases' were probably palimpsests of several different activities carried out intermittently under a large area of tree-cover (Kroll 1994) by different kinds of hominids and other carnivores. The role of primates such as baboons—commonly found at some Olduvai localities—in modifying some of these assemblages is another area of uncertainty. Even the hut at site DK at Olduvai now seems to have been a natural feature, resulting from surface weathering of the underlying lava (Potts 1988:28).

Archaeologists have thus had to accept that these earliest of archaeological sites do not lend themselves to any single, simple, explanation (Fig. 20.2). *Homo habilis* and its contemporaries probably did not live in nuclear families at a home base, or share out the meat that males had hunted and the plant foods that females had gathered. They may instead have fed in sexually discrete groups, and consumed much of their food at or near the place where it was found. Much if not most of the protein in their diet might have derived from insects, eggs, small mammals and reptiles, particularly given the problems of competition with and dangers from carnivores such as hyenas, dogs, lions and leopards. Early *Homo* and *Paranthropus* may also have scavenged off each other, in the same way that lions, hyenas and other predators regularly deprive each other of prey. Like apes and unlike modern humans, it is also likely that they ate and slept in different places, and seldom used one place for more than short periods of time (Sept 1982). It is also probable that much of their time—especially at night, their time of maximum danger—was still spent in trees: Susman and Stern's (1982) analysis of the hands and feet of *H. habilis* suggest it still retained an arboreal capability.

Nevertheless, these hominids were clearly targeting large carcasses, even if the few preserved might represent abnormal feeding events and not their primary source of food. They probably scavenged rather than hunted large animals, and used their technology to 'raid' carcasses so that parts could be removed quickly and taken elsewhere before other carnivores arrived. Smaller animals could have been killed and consumed nearby, in much the same way as some chimpanzees do (Boesch and Boesch 1989), and without leaving any significant archaeological debris. Unlike modern humans, it is also likely that they targeted bone marrow, and thus utilized the non-fleshy parts of carcasses that are normally left by carnivores such as lion or cheetah. Another strong probability is that they avoided direct competition with larger carnivores by, for example, concentrating their feeding activities into the mid part of the day, when the larger carnivores are normally resting (Wheeler 1992).

As stated earlier, proto-human behaviour has to be studied in its own right, and not merely as a crude precursor of what we see today. The lesson from the last decade's reassessments is that hominids of the Plio-Pleistocene behaved in a unique manner that is not seen today among humans, chimpanzees or any other ape. The implications of these reassessments have been far-reaching upon virtually all studies of later hominids. If Plio-Pleistocene hominids were not recognizably 'human' in that they did not hunt, share food, and use home bases, when did these features emerge? Can we assume that they were characteristic of hominids a million years ago, or even 100,000 years ago? At present, these uncertainties have not been resolved, and many former landmarks of the Middle and Upper Pleistocene have become ambiguous, if not discredited, indicators of proto-human hunting. One example is Olorgesaillie in Kenya. This Acheulian site is probably around 900,000 years old, and has often been interpreted as an example of communal hunting of

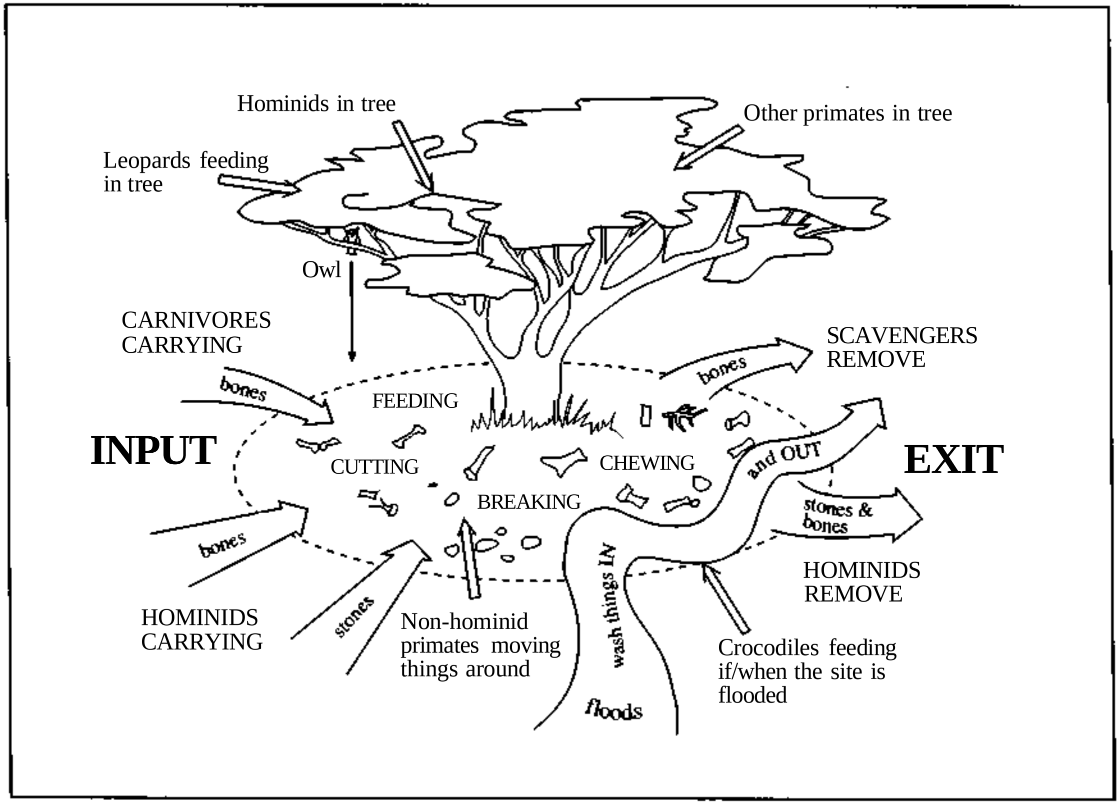


Figure 20.2 Early hominid localities as dynamic systems with stones and bones moving in and out of them. This figure is based on one of Glyn Isaac's published in 1984. It has been modified here to show that there was also much activity *above* as well as *on* the ground by hominids, other primates and some carnivores: leopards, for example, store their food in trees and eat there; primates and probably early *Homo* would have slept above ground level, and may also have consumed food there. On the ground other primates such as baboons might have moved stones and bones around; and if the area was by a lake and flooded in the wet season, crocodiles might also have fed there. In short, these are very 'busy' locations, and sorting out what hominids (*Homo* as well as *Paranthropus*) did is still far from clear. Source: R.Dennell; drawn by D.Miles-Williams.

baboons by *H. erectus* (Shipman *et al.* 1981), but it seems more likely that the baboon and other bones accumulated independently of the stone tools (Binford 1977).

THE BIG UNKNOWN: IN OR OUT OF AFRICA?

One of the most contentious arguments in palaeoanthropology is about when hominids first colonized Asia and Europe (Fig. 20.3). The long-standing view is that *H. erectus* first appeared in East Africa about 1.7–1.8 million years ago, but did not leave Africa until around a million years ago (Rightmire 1991). The site of Ubeidiya, Israel, which may be 1.0–1.4 million years old (Tchernov 1989), is often quoted as the oldest outside Africa. What has never been adequately explained is why the alleged dispersal of *H. erectus* beyond Africa was not accompanied by any major change in technology, anatomy or subsistence; nor was there any discernible climatic or environmental 'window of opportunity' that allowed *H. erectus* to move beyond its African homeland around a million years ago. Equally puzzling is why, once it occupied eastern Asia, *H. erectus* abandoned the Acheulian, bifacial technology that had proved so successful in Africa, Europe and south-west Asia. As will be seen shortly, an alternative view is that hominids had already colonized Asia and perhaps Europe by 2 million years ago (Tattersall 1997). A third possibility is that, if *A. afarensis* already occupied the African grasslands by 3 million years ago (Brunet *et al.* 1995), hominids could have colonized the adjacent Asian grasslands long before 2 million years ago (Dennell 1997).

The timing of the first colonization of Asia and Europe is absolutely critical to studies of prehistoric subsistence as well as to the broader theme of human evolution. By 500,000 years ago, hominids were able to survive in an immense variety of environments, from northern Europe to southern Africa, and from west Africa to northern China and south-east Asia. This alone means that they must have had a wide variety of successful subsistence strategies. What is not known at present is whether hominids possessed the same degree of adaptability a half million, a million, or even 2 million years earlier.

The lack of clear, unambiguous evidence for hominids outside Africa before a million years ago partly reflects the small amount of palaeoanthropological fieldwork in the Asian landmass in the last fifty years, but also results from problems over the context, identification, and dating of finds. Stone artefacts on their own are rarely accepted as sound evidence by hominid palaeontologists; in any case (and as noted already), *Homo* is probably not the only creature that has made simple stone tools in the last few million years. Hominid palaeontologists also have their own disagreements over whether a fossil fragment belonged to a hominid: Orce, Spain, and Longgupo, China, are two recent examples where

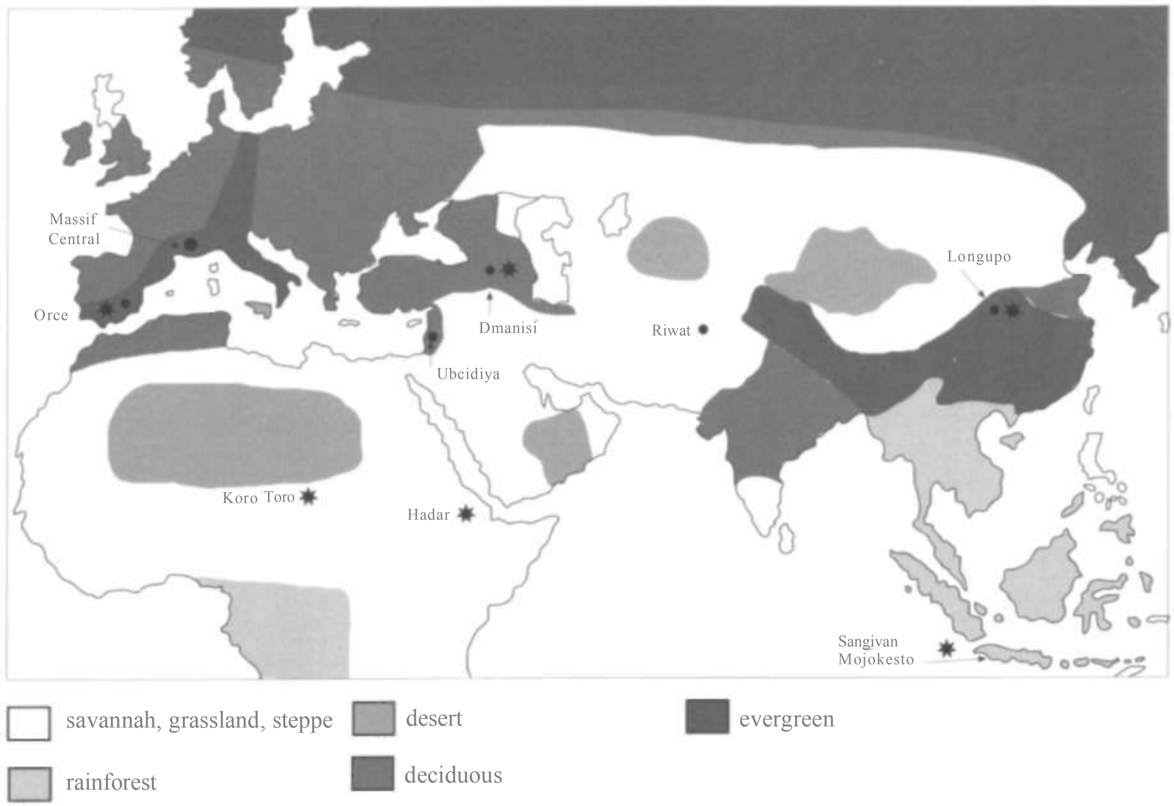


Figure 20.3 Out of Africa—the case for an early departure. The map shows those sites in Eurasia that figure most in claims that hominids left Africa well before 1 million years ago. The prevailing vegetation is taken from the reconstruction by Dowsett *et al.* (1994) of late Pliocene conditions around 3 million years ago. Note that in the late Pliocene, there was no Saharan desert barrier to cut Africa off from Asia, and grasslands (the assumed preferred habitat of early hominids) then extended from west Africa to northern China. If Lucy's contemporaries had already colonized the grasslands of Africa there was nothing to stop them from heading north and east towards China. Reprinted from Dowsett *et al.* 'Joint investigation of the Middle Plioceneclimate I: PRISM Palaeoenvironmental reconstructions', *Global and Planetary Change*, 9:169-95 (1994), with kind permission of Elsevier Science—NL, Sara Burgerhartstraat 25, 1055 KV Amsterdam, The Netherlands. Adapted by D.Miles-Williams.

the alleged 'hominid' might be something different (see Dennell and Roebroeks 1996). Uncertainties also arise over the geological or archaeological context of a find: these are especially acute in the case of the Indonesian hominid remains, which most authorities regard as only *c.* 1.0–1.2 million years old, *contra* a recent claim that the oldest may be as much as 1.8 million years old (Swisher *et al.* 1994). Likewise, the mandible from Dmanisi, Georgia (Gabunia and Vekua 1995), may have come from the infilling of an animal burrow dug into earlier deposits, and thus may be somewhat younger than 1.8 million years old. However, it is worth remembering that virtually every major European and African hominid and archaeological locality beyond the range of radio-carbon dating (that is, >50,000 years old) has had its own dating problems: as most of us know from personal experience, good dates are hard to come by!

Much smoke but little evident fire thus obscures our view of when hominids first inhabited Asia and Europe. If they were inhabiting a 7,000-mile-wide expanse from southern Spain to Indonesia by 1.8 million years ago (or earlier), they do not appear to have ventured more than 35 degrees north of the equator, and this may indicate that they were constrained by the length of daylight for locating, obtaining, and processing food during the winter, irrespective of body type, climate, or type of environment.

Sadly, there is little first-class archaeological evidence between 1.5 and 0.5 million years ago that provides more than a minimal view of how *H. erectus* survived. As noted already, the 900,000-year-old site of Olorgesaillie, Kenya, is most unlikely to indicate the mass-slaughter of baboons; sadly, the 700,000-year-long sequence from Upper Bed II to IV at Olduvai (Leakey and Roe 1994) is largely one of stream channels, the contents of which have been too coarsely sorted to indicate how stone tools and animal remains are found in the same geological context. In the absence of good evidence, assessments of how *H. habilis* (in the wide sense) behaved at Olduvai and Koobi Fora have cast a very long shadow over the way hominids may have behaved thereafter. When *H. habilis* was thought to have been a skilled hunter, so too was *H. erectus;* now that *H. habilis* is seen as a largely opportunistic scavenger, there is an understandable temptation to see *H. erectus* in the same light.

However, its larger brain and body must have required a greater intake of protein, and a higher proportion of this might well have been derived from animal meat. A greater degree of cooperative behaviour may also have been needed to ensure the survival of their offspring, assuming that these had a longer period of post-natal helplessness than those of *H. habilis*. *H. erectus* is also likely to have been a ground-dwelling creature, and thus able to deal with nocturnal predators; fire-reddened clay at the 1.5-million-year-old cave-site of Swartkrans, South Africa (Brain and Sillen 1988), and the 1.2-million-year-old site of Chesowanja, Kenya (Gowlett *et al.* 1981) may indicate that the usefulness of fire as a deterrent to predators was already appreciated, even if it was not routinely used until the Middle Pleistocene (James 1989). These conjectures aside, the quality of the African evidence between 1.5 and 0.5 million years ago needs to improve enormously if we are to see *H. erectus* in its own terms and not in those of its predecessor. Likewise, we need much more evidence from Asia before we can be sure when they were last absent from that continent.

HUNTING FOR IMMEDIATE CONSUMPTION

The earliest European evidence

If we leave aside the uncertainties of when (or even if) hominids first left Africa, the earliest unambiguous evidence for the deliberate, planned hunting and butchery of large mammals comes from northern Europe and dates to around 500,000 years ago (Fig. 20.4). The key evidence comes from two sites, and has been found only since 1995.

The first is the site of Boxgrove in southern England, which has been painstakingly investigated over the last fifteen years (Roberts 1986; Roberts, Stringer and Parfitt 1994). This is an Acheulian site, characterized by the use of bifacial handaxes, and dated on faunal and stratigraphic grounds to *c.* 500,000 years ago, making it one of the earliest sites in northern Europe. The archaeological layers lie in fine sands at the base of a former 60-metre-high cliff that was destroyed by the advance of the Anglian glaciation. Preservation is truly remarkable: most of the flints are as fresh as if they'd been knapped yesterday, and many are still in their original position and can be refitted to show the shape of the original flint nodule. Many bone fragments have not only cut-marks but also microscopic pieces of flint still embedded in them. What Boxgrove shows unambiguously is a number of butchery events, in particular of horse and rhino. These carcasses had been defleshed in an unhurried, systematic manner with the use of handaxes (as confirmed by wear analysis); experiments by a professional butcher on a deer carcass show that these handaxes, held between finger and thumb, are superlative defleshing tools (Mitchell, pers. comm.). In 1995, a horse scapula was found that had a circular perforation consistent with the impact of a thrown spear (BBC *Horizon* 1995).

The second and perhaps even more remarkable site is that of Schöningen in Germany. This is an open-cast brown-coal mine, containing peats and muds dated *c.* 380–400,000 years old that have produced numerous fresh flints and animal remains, many with cut marks (Thieme and Maier 1995). Wooden artefacts have also been found: these include a double-ended spear 0.8–1 metre long that was probably used at close quarters, and, recently, three superb complete throwing spears over 2 metres long and comparable in shape and proportion to a modern

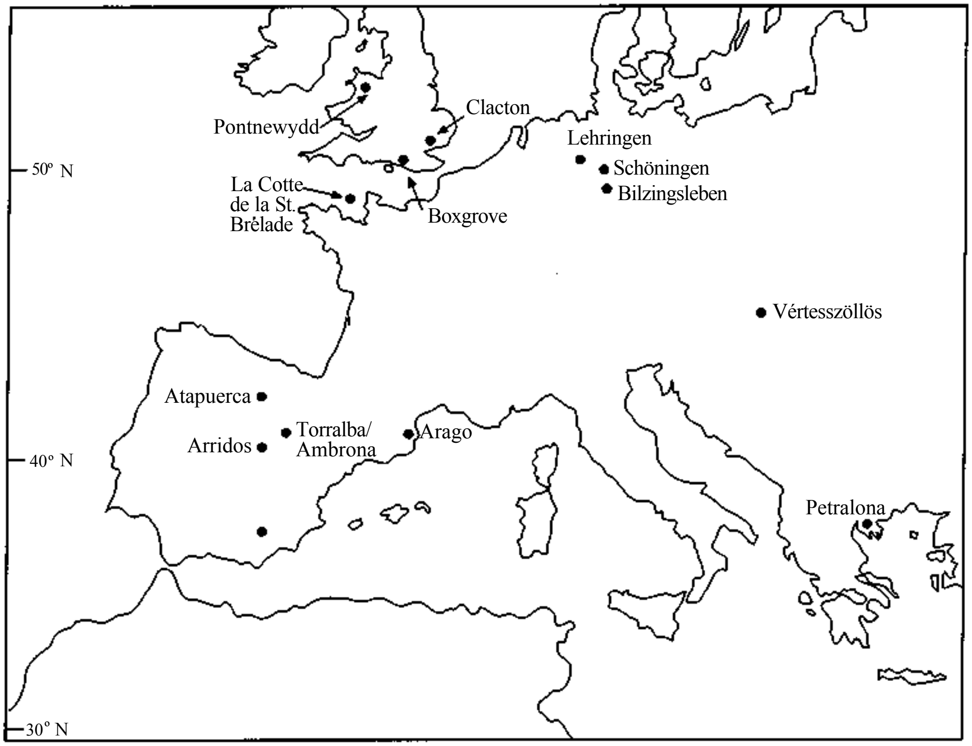


Figure 20.4 Major lower palaeolithic sites in Europe. Source: R.Dennell; drawn by D.Miles-Williams.

javelin (Fig. 20.5). Each was made from the trunk of spruce trees about 30 years old; the front, thrown-end, of these spears was made from the harder wood at the trunk base; and as in modern javelins, the centre of gravity was about one-third of the length from the tip to ensure stability in flight (Thieme 1997). Whilst the roughly contemporaneous spear-tip from Clacton, England has been interpreted as a digging stick or even a snow-probe for locating frozen carcasses (Gamble 1987), there can be no doubt from the size, shape, and craftsmanship of the Schöningen examples that these were throwing spears for killing large animals (Dennell 1997).

This evidence has to be seen in the context of the earliest colonization of Europe. If we leave aside various contentious claims that hominids were in Europe well before a million years ago, the oldest European evidence about which there appears to be reasonable agreement is the TD6 horizon at Atapuerca, Spain, dated palaeomagnetically to >780,000 years ago (Carbonell *et al.* 1995). If this dating is confirmed by faunal evidence, it would suggest that southern Europe was colonized (probably via the Dardanelles) well before northern Europe (Dennell and

Figure 20.5 Spear from Schöningen. Photograph: H.Thieme.

Roebroeks 1996). Intriguingly, the associated lithic assemblage is not Acheulian, but has more in common with the Oldowan; and the hominid remains have cut-marks and the same breakage features as the other animal remains. Whether this shows a ritual intake of human flesh, extreme nutritional stress, or a remarkably indiscriminate diet, remains to be established.

Atapuerca lies at 42° north; the oldest sites in northern Europe, such as Boxgrove, are at 51° north, and thus experience considerably more severe winters than southern Europe. Not only is food scarcest in winter, but the time available to locate, obtain and process it is also severely constrained by the short daylight hours. Even so, the hominids discarding handaxes at Pontnewydd Cave, northern Wales, 200,000 years ago were doing so at 53° north (Green 1981), which is more or less the furthest north that hominids operated before 30,000 years ago. The evidence from Boxgrove and Schöningen is the clearest evidence yet that by 380–500,000 years ago, hominids had acquired the ability to survive winter shortages in northern Europe by hunting large mammals year-round. What remains to be seen is whether earlier hominids possessed the same abilities.

Until recently, the evidence for big-game hunting in the European Lower Palaeolithic has been largely ambiguous and/or relatively recent: at Arridos, Spain, there is clear evidence for the butchery of elephants *c.* 300,000 years ago (Villa 1990), and at La Cotte St Brelade, Channel Islands, for driving rhinoceros and elephant over a cliff edge and then butchering them *c.* 130–200,000 years ago (Scott 1980). However, the faunal remains from earlier sites that were once thought to evidence big-game hunting (for example, of elephant and horse at Torralba/ Ambrona, Spain) are in disturbed contexts, small and/or in poor condition, and thus do not clearly indicate hunting, or, for that matter, scavenging (see Villa 1990).

Boxgrove and Schöningen will force a major revision of our assessments of lower palaeolithic subsistence in Europe. In the last fifteen years, the tendency has been to argue against earlier claims of big-game hunting in the European Lower Palaeolithic, and in favour of scavenging and some degree of opportunistic hunting (see, for example, Binford 1989). This caution has been understandable given the taphonomic complexity of many of these sites, and the probable degree of post-depositional disturbance. In contrast, Boxgrove and Schöningen have performed the same service for lower palaeolithic archaeology that the Hubble telescope has for astronomy. As importantly, they also provide a base-line for assessments of later European hominids, notably Neanderthals.

Bilzingsleben, Germany, is also highly relevant as perhaps the best example to date of a European lower palaeolithic living site (Mania 1990). It lay on the edge of a small lake, and is dated as *c.* 380–400,000 years old. It was perhaps occupied for only 20–30 years, and contains an enormous amount and variety of flaked stone and animal remains, many of which have cut-marks. Bone was also used to make tools, and one piece even has what seems to be a patterned series of marks that are hard to relate to butchery. Although the taphonomic aspects of the site are not fully clear, the spatial clustering of material is suggestive of work areas and structures.

The last glaciation

Both the quality and quantity of archaeological and human skeletal evidence improve considerably after 100,000 years ago. Discussions of this period are dominated by evidence from Europe and the Near East, and usually couched in terms of the 'Neanderthal debate' over whether or not Neanderthals became extinct or evolved into modern humans.

As with earlier periods, the evidence for subsistence is often difficult to interpret. Most of the evidence comes from caves, which have complex sedimentological histories, and were commonly used by animals other than humans. Many ungulate remains in such caves could have been taken by non-human predators such as hyena or wolf. At some sites in western Europe, the remains of bears and Mousterian stone tools were once interpreted as evidence of some kind of bear cult, but might simply indicate that some bears died whilst hibernating in caves that were used by Neanderthals in the summer. Even when it is reasonably certain that animal remains resulted from Neanderthals' activities, the usual problems arise in distinguishing scavenging from hunting by, for example, the type of animal, parts of the skeleton and/or type of damage to bones that are present. A good example are the Mousterian assemblages from the Grotte Vaufrey, France, which Binford (1988) regarded as the outcome of scavenging, but which Grayson (1994) argued were not.

Nevertheless, the ambiguities of much of this data should not obscure the point that systematic, planned hunting is evidenced in Europe 500,000 years ago, and so there is no need to suppose that Neanderthals lacked that basic ability, even if the details are unclear in many individual cases. Unlike their predecessors they may have used stone projectile points that were probably hafted onto a spear for stabbing prey at short distances (Boëda *et al.* 1996; Shay 1988). Nevertheless, meat was probably obtained in several ways: scavenging may have been necessary at times, and males and females (and different age groups) may have targeted different types of prey and used different methods. For example, Stiner (1994) has argued that early Neanderthals in Latium, Italy, scavenged head parts prior to 55,000 years ago, but thereafter ambushed large, prime-age animals. Each strategy seems to have relied on different ways of using stone: before 55,000 years ago the emphasis was on provisioning individuals, and thereafter on provisioning places in preparation for hunting.

Two other features of the European and Near Eastern evidence stand out. The first is that life was rough, tough and brief. There is no evidence of sewn clothing, and so Neanderthals must have survived glacial winters with little more than skin cloaks and the occasional fire. Every adult male Neanderthal skeleton found to date has evidence of repeated and sustained injury, especially to the shoulders, head and forearms: their nearest American counterparts today are rodeo riders (Trinkhaus and Zimmerman 1982). In the Neanderthals' case, the most likely cause of injury was in killing large animals at close range. Notwithstanding these injuries, many survived, most notably the Shanidar 1 individual, with multiple (and probably repeated) trauma to his head, shoulder, forearm and legs, and the 'old man' of La Chapelle-aux-Saints, who was crippled with arthritis and scarcely able to chew his food (Trinkhaus 1985). These examples are perhaps the earliest known of altruism.

Second, all the evidence to date points to the *immediate* consumption of food. There is no evidence that Neanderthals or their contemporaries prepared large amounts of meat for winter consumption by filleting, drying and/or smoking, or used any sort of storage facility. Hominids undoubtedly had the ability to hunt large animals, but must also have had to demonstrate that ability in areas such as northern Europe throughout the winter under conditions of low temperatures and short days.

The Neanderthal debate

As commented above, discussions of this period are dominated by the Neanderthal debate. There is little doubt that Neanderthals led different lives from later populations in all sorts of ways: in addition to the violent nature of their lives and their lack of storage technologies, there were many other things that they did not do, such as trapping small animals, fishing, burying their dead with elaborate grave-goods, wearing sewn clothes, carving elaborate tools from bone, antler or ivory, living in substantial structures, painting animal images, carving figurines and so on. However, all this appears to be equally true of their contemporaries, including those regarded as 'anatomically modern' in Africa and the Near East. In other words, the absence of all these features in the European and Near Eastern Mousterian is irrelevant to whether or not Neanderthals became extinct, as no other population possessed them either. It is up to those arguing that Neanderthals were replaced by incoming groups of humans (currently thought to have derived from Africa) to explain why the innovations seen in the Upper Palaeolithic, that supposedly gave modern humans the advantage over Neanderthals, were not evidenced in other areas beforehand.

HUNTING WITH THE OPTION OF DEFERRED CONSUMPTION

At some time after 35,000 years ago, humans appear to have exercised the option of deferring the consumption of what they hunted. Numerous European examples from the late glacial show the large-scale killing and processing of herbivores, notably reindeer and horse. These are migratory and live in large herds; not coincidentally, the best known sites such as Dolni Vestonice in the Czech Republic lie near where these are likely to have crossed rivers on their autumn and spring migrations. Processing technologies probably included the large-scale filleting of carcasses, followed by drying, smoking, and storage. Reliance on these kinds of preservative technologies has to go hand-in-hand with food-procuring strategies that can harvest key resources when they are most abundant—typically the autumn cull of migratory herds. This in turn requires very precise knowledge of where these are likely to be, and the means to kill large numbers of them very quickly. Perhaps significantly, there were improvements in the late glacial in the techniques used for killing animals: spear-throwers by the late glacial, ivory spears at Sungir in Russia at 23,000 BP, and even boomerangs in Poland by 20,000 BP (Valde-Nowak *et al.* 1987). Other changes include the trapping of fur-bearing animals such as arctic hare; sewing needles after 21,000 BP indicate the first use of sewn clothing and were probably accompanied by more careful and elaborate ways of tanning and curing skins. Cooking techniques also improved: the first stone-lined hearths at Abri Pataud (31,000 BP) are early examples, and thereafter common. Residential structures were also larger and better made, most notably those from eastern Europe.

Open-air European sites show often considerable advances over earlier constructions. Particularly good examples come from eastern Europe, where sites are preserved under loess (wind-blown dust that originated from the outflows of glaciers). Some of these sites indicate large structures, though their size may have been increased through solifluxion, and overestimated by archaeologists. Even so, many were substantial constructions that may have served as winter bases, or even as year-round settlements by some of the inhabitants (see, for example, Soffer 1985). Some of these structures may have had a ceremonial function. One notable example is from Mezherich in the Ukraine, where remains of a group of igloo-type huts were found, made of mammoth tusks and bones that had been arranged in a geometric pattern and painted.

The most visible change, and the one that attracts most public attention, is the representational art, whether engraved, painted or carved. Much of it is found in deep recesses of caves (doubtless facilitating its preservation), and most of it dates from well after 30,000 BP. It is also sporadic: most is in south-west France and northern Spain; other cave-rich areas, such as the Apennines, Italy, and south-east Europe, have none. So too with the portable, or mobiliary art: the enormous amount at Gönnersdorf, Germany, and none at many others. Brian Hayden (1993) links the occurrence of representational art and evidence for personal display (for example in the procurement of exotic items for personal ornamentation) to those environments (such as south-west France) that were rich enough to sustain the large-scale accumulation and storage of food. Others such as Mithen and Spivey (Chapter 18) link it to an information system that stored knowledge about the animals so crucial to a group's survival. For others, art served as a mechanism to facilitate the maintenance of social networks over large and sparsely inhabited territories via the scheduling of feasts and ceremonies. In all these scenarios, the art is deeply embedded in the procurement of food.

Datasets for the last part of the ice age from other parts of the world show long traditions of groups who lived by gathering and hunting, and in a manner that is recognizable today. Beyond Europe, the best are probably from the Near East, southern Africa and India. One of the most graphic examples is from the now defunct lakes of New South Wales, where aboriginal groups camped around the shores, harvesting and hunting numerous types of mammals, birds, fish, reptiles and plants (Lourandos 1987). Evidence from the Cape Province of South Africa shows similar groups, apparently exploiting a wide range of resources in a scheduled manner, and also maintaining a rich artistic tradition (see, for example, Deacon 1984).

The colonization of Australasia, the Americas and Siberia

Three continents and a substantial part of a fourth were colonized during the last glaciation (Fig. 20.6). The first people to reach Australia did so by 60,000 years ago

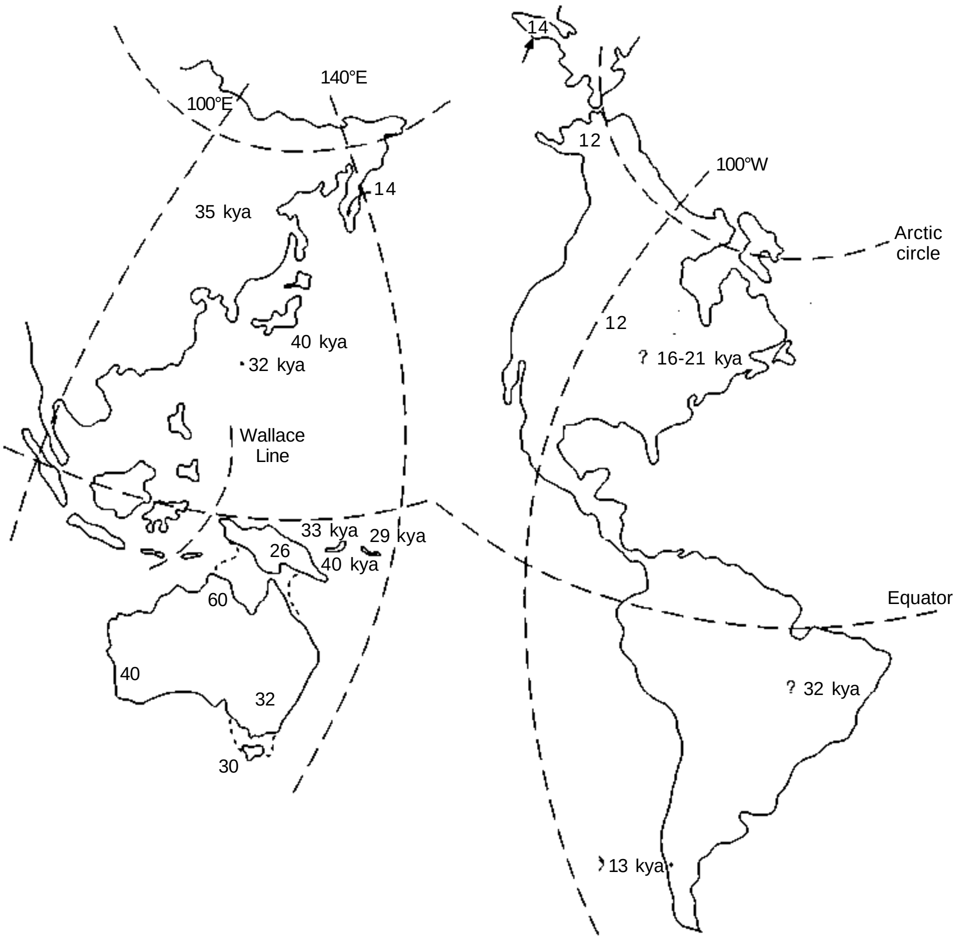


Figure 20.6 The colonization of Australasia and the New World; dates in thousands of years ago (kya). Source: R.Dennell.

(Roberts, Jones and Smith 1994) after crossing at least 60 miles of open sea between Indonesia and the landmass of Australia and New Guinea, then joined by the lowering of sea levels. By 30,000 years ago, some of the Pacific Islands were settled by voyages up to 120 miles across open sea (Allen *et al.* 1989). The other two were the Americas, probably reached via Siberia. This part of Asia may have been colonized around 39,000 years ago, according to recent C14 dating of animal bones associated with upper palaeolithic-type assemblages (Goebel and Aksenov 1995): however, this is at the limit of C14 dating, and the dated bones lack cut-marks and need not therefore have been of animals killed by humans.

When and from where the Americas were colonized still remains unclear. Those favouring an early date point to Meadowcroft in Pennsylvania, at 24,000 BP, to the cave of Pedra Fuerada in Brazil, occupied perhaps as early as 32,000 BP (but see Meltzer *et al.* 1994), and the site of Monte Verde in Chile, occupied 13,000 years ago (Dillehay 1984). Some still argue that the Americas were not colonized until the very end of the last ice age, around 10,000–12,000 years ago. It is of course possible that there was more than one episode of colonization, and possibly from more than one source. Whilst Amerindians probably derive from north-east Asia, it is odd that the earliest archaeological evidence is presently from South America rather than Alaska, the likely point of entry. Although North America could have been reached on foot across what are now the Bering Straits, the main obstacles lay in Siberia. The south-east part was occupied by 35,000 years ago, but the bitterly cold north-eastern part was too severe for humans until *c.* 14,000 years ago (Gamble 1993).

What does this coarse-grained information tell us about human subsistence strategies? And why was Australia colonized long before the Americas? The answer may lie in the issue of food storage. The colonization of Australia and New Guinea from the Asian mainland required a simple type of sea-craft; once ashore, humans could have survived without the need to store foods for long periods of the year. In contrast, the colonization during the last glaciation of north-east Siberia, and of the Americas via the Bering land-bridge, was possible on foot, but survival was impossible without the ability to store large amounts of food for consumption during the long and bitterly cold winters. For this reason, it is improbable that the Americas were colonized before food storage was in general use elsewhere in Eurasia.

The end of the last ice age

Momentous climatic changes some 10,000 years ago brought to an end the last ice age and ushered in the present interglacial (also variously termed the Holocene or Postglacial). The ice sheets that had covered much of Canada, Scandinavia, the British Isles and other large areas of the world retreated, and in many cases disappeared altogether. As a result of the melting of several million square miles of ice, sea levels rose by perhaps a hundred metres. An area the size of western Europe that had formed Beringia, the land-bridge between Siberia and Alaska, was inundated. Australia, New Guinea and Tasmania became separated, as did Europe from the British Isles.

The changes on land were no less dramatic. Areas previously glaciated became available for colonization, particularly Canada, Alaska, Britain and Scandinavia. Areas adjacent to former ice-sheets and glaciers also changed. In time, tundra was replaced by birch forest, and eventually by deciduous species such as oak. The fauna also changed: red deer, roe deer, pig and aurochs (the wild cow) displaced reindeer in much of northern Europe. Some animals such as musk-ox became locally extinct, and others such as mammoth, woolly rhinoceros and cave lion died out altogether. In coastal areas of western and northern Europe, shellfish such as oysters and mussels colonized waters that were previously too intemperate, or inaccessible. Similar types of changes affected the northern United States and Canada.

The net result of all these environmental changes over much of temperate and northern Europe and North America was a considerable increase in plant biomass, of which many seeds, nuts, fruits, and berries were seasonally useful food items for humans. Aquatic resources such as fish, shellfish and sea-mammals were also more common and widely used. Many of these foods, such as shellfish, nuts or seeds, came in small 'packages', and would have required considerable energy and time to process, or to consume in sufficient amounts. Nevertheless, human societies worldwide were rarely slow in developing bows and arrows for shooting individual (and often small) animals; nets, lines, hooks, harpoons and weirs for catching fish; or grinding equipment for processing plant foods (Fig. 20.7).

The types of adaptation to postglacial conditions depended much on where people were. In areas far from glaciated areas, changes were often slow and minor: often, the same sites and resources were used in much the same way as before, and there is no major break between the end of the Palaeolithic and the onset of the Mesolithic. In areas of major environmental change, such as northern Europe, the distinction is seen more easily. Different stone and bone tools were needed, and, unsurprisingly, the first European stone axes and adzes appear in the Mesolithic in northern Europe. (The earliest examples are from Australia, around 20,000 years ago.) Different subsistence strategies were also required. The enormous late glacial herds of reindeer and horse were succeeded by less gregarious animals such as red deer, roe deer and pig that were less easy to target in dense vegetation. A wider range of plant foods was also available, as well as river and sea resources, whether shellfish, fish or birds. In many parts of the world there was a shift towards exploiting a wider range of smaller resources. A good example is the prevalence of shell middens in areas such as northern Europe, Japan, southern Africa and Australia, where considerable amounts were collected during the summer months. (These middens, or mounds of discarded shells, can be several metres thick, and are highly visible both ethnographically and archaeologically. Their size can easily give a misleading impression of the dietary importance of shellfish, which probably formed less than 10 per cent of the total annual diet.) Plant foods such as nuts were also used. All these smaller packages require processing, and often the first grinding equipment is found.

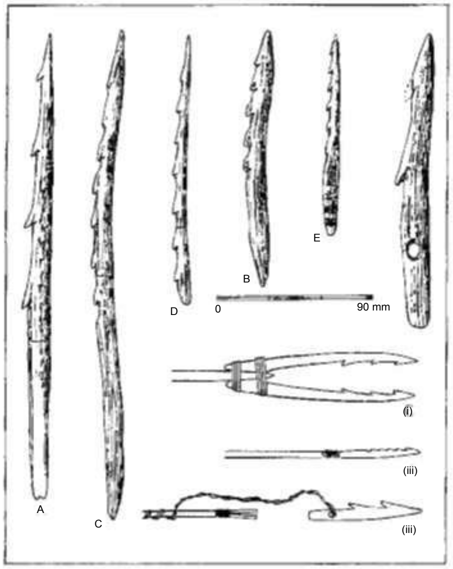
A considerable amount is known of those hunters and gatherers who lived in the postglacial before the appearance of farming communities. One of the best known areas is north-west Europe, partly because of the amount of research done there, but also through excellent preservation in peat bogs and on shorelines. The range of material evidence is often outstanding: boats, paddles, nets, traps, fish lines, huts and a whole range of perishable items that only rarely survive. In Eurasia these often show what could be called 'forest foraging' or even 'forest farming' (Zvelebil 1986). Environmental evidence indicates that areas of forest were managed by controlled burning as a way of encouraging rejuvenation, and thereby raising ground level biomass for animals to feed on, and creating areas where the location of game was more predictable. Evidence from shell middens shows that these were summer resources, probably gathered whilst other more lucrative activities such as fishing or hunting were carried out. In some areas, settlements were probably permanent. One example is Lepenski Vir in Serbia by the Danube, where stone-built houses were inhabited by a community that obtained much of its food from the Danube, supplemented by animals taken inland. Sites in western Russia show similarly stable communities, using hazelnuts, fish, game and so on.

Assessments of the Mesolithic in areas such as northern Europe have changed substantially over thirty years. For much of this century, mesolithic peoples were seen as evidence of decline and even degeneration. This prejudice was partly due to the seemingly sad contrast between the highly visible art of the late Palaeolithic and its apparent absence in the Mesolithic, and partly due to nineteenth-century prejudices of Europeans towards the hunter-gatherers they encountered—and often displaced—in Australia, southern Africa and America. A more realistic assessment is that the postglacial hunter-gatherer societies of northern Europe, Eurasia, and their counterparts in North America, Australia and Africa were among the most numerous and successful hunter-gatherers that have ever lived.

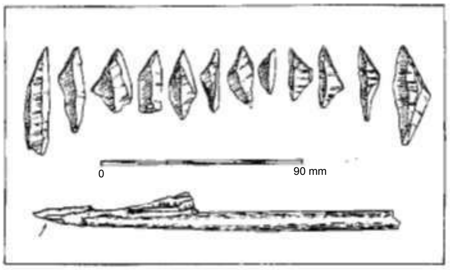
CONCLUSION

This review has attempted to impose some structure on the large and frustratingly incomplete mass of archaeological and palaeontological evidence for different kinds of hominids over the last 3 million years, and, ultimately, on all continents except Antarctica. In doing so, it has had to identify major groupings that are as useful for studying subsistence as fossil taxa are for palaeontologists, or artefactually defined periods were for the prehistorians of the last century. Four such periods have been tentatively identified.

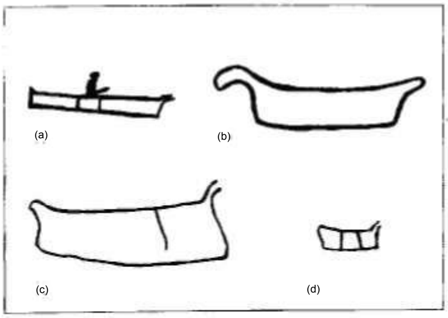
The first encompasses the earliest tool-making hominids. Whilst these ate the meat of large mammals, it is too early to state confidently whether this was their main source of animal protein, how often it was the outcome of premeditated hunting, and the extent to which early hominid omnivory was critically dependent



Some of the antler barbed points from Star Carr, Yorkshire, The constructions show how these could have been used as i) prongs for a fishing 3pear, ii) an arrowhead, or iii) a harpoon.

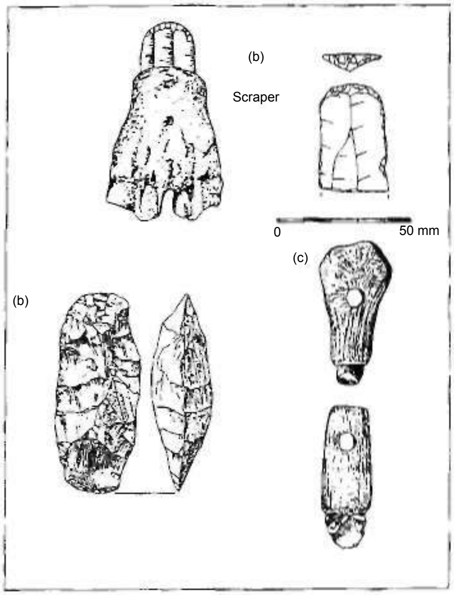


Some microliths, again from Star Carr. These were used as replaceable parts in ether tools, such as spears, harpoons, or an arrow, as shown in an example from Sweden.

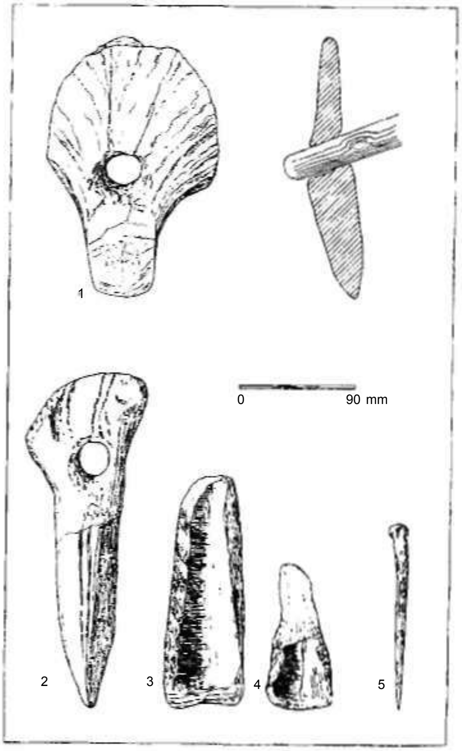


These Norwegian rock carvings remind us that mesolithic peoples used boats, either framed with skins, or made from tree trunks. Wooden paddles are also known from northern Europe.

Figure 20.7 Surviving items of mesolithic technology. At first sight, these do not look particularly impressive or effective. However, microliths could be used as replaceable parts of arrows and knives; and larger pieces of stone were used for scrapers and axes. Simple tools of bone, antler, wood, leather and various fibres enable their users to hunt, trap and fish; to prepare skins, furs and netting to fell trees, and dig for plant foods; and make a wide range of wooden items, varying in size from arrow-shafts to boats. Source: Smith (1991) *Late Stone Age Hunters* (London: Routledge)



Some larger stone tools, from the mesolithic site of Thatcham, Berkshire, The scraper [top] and axe or adze (bottom) were probably set in a bone or antler haft, as suggested here.



Some typical, simple mesolithic bone and antler tools; two mattocks from elk antler (1,2); two scrapers from long-bones of wild cattle; and (3) a bodkin, made from an elk bone.

upon the use of stone tools. The dense fog enveloping the subsistence behaviour of *H.erectus,* and whether or not it left Africa 1 million years ago or much earlier, impedes any useful discussion of hominid subsistence between 1.5 and 0.5 million years ago, and constitutes a second, and hopefully temporary, unit of study. Thereafter, recent evidence shows two major developments around 500,000 years ago. The first is that hominids extended their range in Europe to at least 53° north, beyond which they rarely ventured until after 25,000 years ago. The second is that by now they could hunt and butcher large animals, and without undue interference from large carnivores. The recent discoveries from Schöningen, Germany, show the sophistication of the spears they used; Boxgrove, England, also indicates that hominids also went prepared with their handaxes (or defleshing tools), and the antler hammers used to knap more if needed. It is tempting to link the colonization of northern Europe with these hunting skills; however, too little is known about the subsistence of *Homo erectus* before 500,000 BP to allow much certainty over this issue.

These earliest north Europeans, Neanderthals, their anatomically modern human contemporaries, and perhaps even some of their successors, are linked by the ability to hunt large animals, to survive in climates considerably colder than today's, and by the probability that almost all food was consumed shortly after it was obtained. In Europe at least, it is the ability to store food when it is plentiful, for consumption when it is scarcest, that was the most distinctive innovation. This development, probably in place by 25,000 years ago, was accompanied by improved abilities to hunt (probably by trapping) fur-bearing animals; at least some sewn clothing; more carefully constructed hearths; and a major reduction in the incidence of bone injuries. It was perhaps also related to the development of painted art and personal ornamentation as an adjunct to the accumulation and storage of food.

Despite an enormous amount of research in the last twenty years, Europe remains the best documented area in the world in terms of the evidence less than 500,000 years old. Yet other areas are no less important. South Africa is a major one that is also the southern hemisphere's equivalent of southern Europe, and also has a far longer archaeological record. Detailed comparisons of the two areas might indicate whether long-term patterns in subsistence override regional variants defined by artefact types or the presence/absence of Neanderthals. Another important and fascinating area is Australia, which also offers a healthy antidote to Europocentrism. One pertinent reminder is that 18,000 years ago, in the coldest part of the last ice age, the aboriginal Tasmanians were the most southerly inhabitants in the world, living within sight of glaciers but with one of the simplest tool-kits ever devised (Kiernan *et al.* 1983): whatever else they may have been, the cave art and elaborate tool-kits of the Magdelanian were not environmentally determined. What both show is that the range of responses human groups could and did make to their environments by 18,000 years ago was no less than the variety of environments which had been colonized by that time.

Finally, the mesolithic and other postglacial hunter-gatherers have been treated as essentially similar to early, late palaeolithic, groups in their ability to hunt and to store foods if needed. This is not to denigrate the distinctiveness of any of these societies, or to downplay the importance of many postglacial innovations, including the development and adoption of farming. Rather, through a telescope scanning a 3-million-year expanse of landscape, these are minor compared to the option of deferring the consumption of food, which is arguably one of the most defining features of *Homo sapiens sapiens*.

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Although there is a huge literature relevant to discussions of subsistence over the time-span of human evolution, there are no recent syntheses that focus on hominid and early human subsistence on a global scale, and most of the information is scattered throughout an enormous number of books and journals. As starting points, I would recommend the following as basic building blocks: the titles are self-explanatory, and each provides good overviews of various aspects of palaeoanthropology. A.Bilsborough, *Human Evolution* (London: Blackie Academic and Professional, 1992); J.Diamond, *The Rise and Fall of the Third Chimpanzee* (London: Vintage, 1992); C.Gamble, *The Palaeolithic Settlement of Europe*

(Cambridge: Cambridge University Press, 1986) and *Timewalkers: The Prehistory of Global Colonisation* (Bradford: Alan Sutton, 1994); R.G.Klein, *The Human Career* (Chicago: Chicago University Press, 1989); and C.Stringer and C.Gamble, *In Search of the Neanderthals* (London: Thames and Hudson, 1994). There is also much useful information in *The Cambridge Encyclopedia of Human Evolution*, edited by S.Jones, R.Martin, D.Pilbeam and S.Bunney (Cambridge: Cambridge University Press, 1992). Two especially thought-provoking books are *Chimpanzee Material Culture* by W.C.McGrew (Cambridge: Cambridge University Press, 1992) and *The Hunters or the Hunted?: An Introduction to African Cave Taphonomy* by C.K.Brain (Chicago: University of Chicago Press, 1981).

21

EARLY AGRICULTURAL SOCIETIES

Peter Bogucki

TRANSITIONS TO AGRICULTURE

The successful shift from a subsistence economy based wholly on foraging to one based primarily on food production was one of the most significant developments in the existence of the genus *Homo*. For several million years, human beings had obtained their diet first from scavenging, then from hunting, fishing, and collecting. Within approximately the last 10,000 years, markedly different subsistence economies based on cultivated plants and, in many areas, domesticated animals, have replaced hunting and gathering around the world. When viewed from this perspective, the origin and dispersal of food production took place very rapidly. Within these last ten millennia, however, the process of domestication or adoption of domesticates occurred at varying time-scales based on local environmental, economic, and social conditions.

The origins and dispersal of food production have attracted the attention of researchers for several decades and have come to be a major focus of archaeological research. Much of this research has been concentrated on the areas and periods in which plants and animals were first domesticated from indigenous wild species. Some (for example, Minnis 1985) have used the term 'pristine domestication' to refer to such situations in which the human control and manipulation of a species are sufficient to cause phenotypic changes for the first time. A considerably less-developed research orientation is the study of the adoption of domesticated plants and animals and the techniques of agriculture and animal husbandry by populations who did not domesticate the species themselves, as well as the spread of populations practising agriculture into areas where it had been hitherto unknown. As Minnis (1985:309) points out, such cases have been more frequent and more widespread than the instances of pristine domestication, and he uses the term 'primary crop acquisition' to describe them.

Early views of the transition held that it was an inevitable development on the road to civilization. Yet more thoughtful analyses of this shift in the last three decades have shown that it was not that simple. Much of our understanding of the ramifications of the change from foraging to farming comes from comparative ethnological studies of the remaining hunter-gatherer and incipient agricultural populations on the face of the earth. These studies have shown that foragers have some economic and social options that are not open to farmers and that farmers have other options not open to foragers. For instance, foragers have the option of mobility to respond to local environmental variation, while farmers are tethered to their fields. Foragers often have access to a range of food resources, while agriculture and grazing may reduce the variability in an ecosystem and reduce the number of dietary options. On the other hand, the concentration of food resources made possible by agriculture and animal husbandry can open up social options for exchange and alliances that may be limited for hunter-gatherers. The study of the transition to agriculture, then, attempts to identify the reasons why hunter-gatherers, either by choice or by necessity, found that the advantages of an economic system involving food production outweighed the options available to them as foragers.

THE ORIGINS OF AGRICULTURE

Approaches to the origins of food production in archaeology can be divided into two research orientations, each of which relies upon the other. The first includes both the methodological focus on the recovery of data relating to the phenotypic characteristics of seeds and bones that reflect the changes associated with human control and manipulation and the modelling of the sequence of these changes. In the last thirty years, the development of recovery techniques for small-scale remains, particularly seeds, has exponentially enlarged the corpus of data on early agriculture. Specialists in botanical and faunal analysis are now readily incorporated into archaeological research projects specifically to ask questions about the types of plants and animals used by inhabitants of archaeological sites, rather than to provide a species list appended to a report. New techniques, often involving microscopy and other technical methods of analysis, have been introduced. For instance, in the late 1970s the study of phytoliths, accelerator mass spectrometer (AMS) radio-carbon dating, and the analysis of bone for trace elements and stable isotopes were virtually unknown, while today they are frequently used to ask questions about the origins of food production in various parts of the world. As a result, archaeologists, archaeobotanists, and archaeozoologists have been able to trace the sequence of changes in relations between humans and plant and animal communities with progressively finer resolution.

The other aspect of the study of the transition to agriculture is the modelling of the process by which foraging populations first began to control and manipulate plants and animals. The goal of such studies is to identify the causal links in the sequence of agricultural origins that had the effect of transforming human societies by leading humans to turn from foraging to farming. Clearly this undertaking involves the generation and testing of hypotheses and the reconciliation of often-contradictory evidence. Although it has proved impossible to isolate an unequivocal cause for the transition from foraging to farming, archaeologists have no shortage of theories which provide a variety of reasons for this change.

Seeds of domestication

In 1971, Harlan identified three main centres of pristine domestication within which the major complexes of domesticated plants and animals which transformed prehistoric society were first established (Fig. 21.1). These are the Near East (emmer and einkorn wheat, barley, peas, lentils, sheep, and goats), northern China (millet and rice), and Mesoamerica (beans, chillies, maize, and gourds). To Harlan's three localized centres of domestication can be added one more which has come to light in the last fifteen years. In eastern North America, Smith (1989) has argued for the presence of an independently developed complex of domesticates that includes squash, sump-weed or marsh-elder, sunflower, and chenopod. In addition to these focal points in which pristine domestication was part of a complex transformation of society, Harlan also identified three larger, non-localized, regions in which domestication of a number of species of plants and animals also occurred. In South America, the potato and several camelid species became critical resources for highland populations, while in the lowlands manioc became a staple food. In the northern half of Africa, sorghum and possibly millet and cattle were early domesticates. Finally, there is the broad region of south-east Asia and the Pacific islands in which a complex of tree and root crops was managed, cultivated, and domesticated.

Within most of these localized centres and diffuse regions, an extraordinary amount of research has occurred in the last thirty years to document the initial appearance of domesticated species. The techniques for the recovery, identification, analysis and interpretation of botanical and faunal remains have been improved markedly. Whereas in the late 1960s there had been only a handful of individuals around the world with expertise in these materials, now there is an expanded cohort of researchers who have developed the necessary skills in identification and analysis for many additional species. To this broadened research base, the technique of radio-carbon dating using an accelerator mass spectrometer was added during the

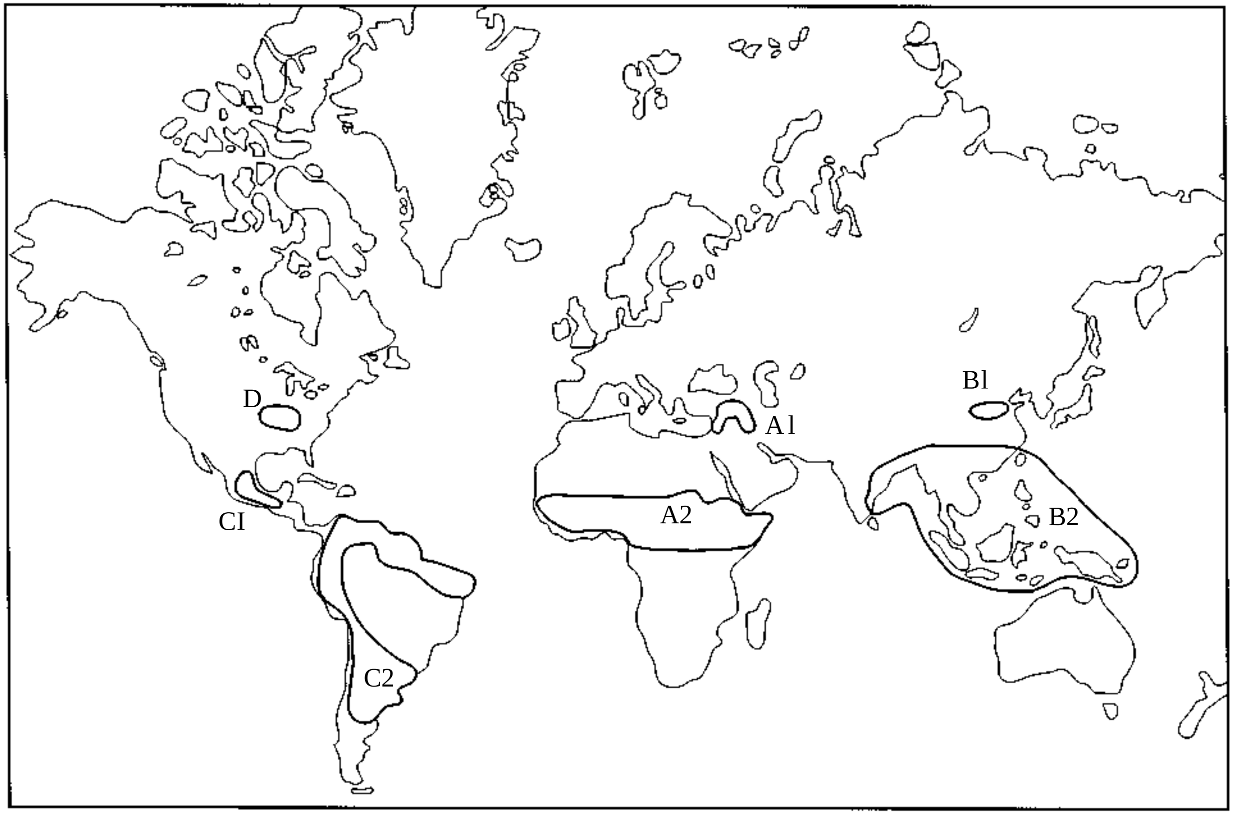

Figure 21.1 Centres and regions of pristine domestication. A1–C2: Source: Harlan, 1995, with permission of Cambridge University Press; D: Source: Smith, 'Rivers of change: essays in early agriculture in eastern North America', Science, 246: 1566–71, 1992. Adapted by D.Miles-Williams.

1980s. While this method is still expensive and not universally applied, it has enabled the dating of very small (under 5 mg) samples such as individual seeds or small fragments of animal bones. Much of the evidence for early plant domestication in eastern North America, for instance, rests on AMS dating.

Figure 21.2 offers a simplified chronology of early plant and animal domestication in the above centres and broader regions, though it must be stressed that it is impossible to summarize the current state of knowledge of the complexity of the process, particularly in terms of phylogenetics. The reader is best referred to several recent summaries which should form the baseline for knowledge for some time (for example: Clutton-Brock 1989; Crabtree 1993; Gebauer and Price 1992; Harlan 1995; Harris and Hillman 1989; Price and Gebauer 1995; Smith 1995; Watson and Cowan 1992; Zohary and Hopf 1993). Groups of archaeobotanists and archaeozoologists meet with regularity, and there is normally a major revelation at each of these gatherings.

Taking one step back from the seeds and bones themselves, it is important to consider the process of domestication, first by describing it and then by looking for factors that caused it. Rindos (1984) has proposed a typology of three different sorts of domestication, which he terms 'incidental', 'specialized', and 'agricultural'. Incidental domestication occurs when humans become the agents by which a species is removed from its native habitat and, in some sense, protected and exploited in its new setting. Specialized domestication is an outgrowth of incidental domestication in which humans begin to exhibit conscious and directed behaviour to propagate wild species and to begin to depend on them. Agricultural domestication involves the appearance of behaviour which completely transforms and alters the relationship between hitherto-wild species and humans by controlling the ecology and evolution of the domesticated taxa. Harvesting, seed selection and storage, weeding and removal of competitors, and tillage are all characteristic of agricultural domestication. In Rindos's view, while the origin of domesticated species is important, the more important transformation that occurs in the origins of agriculture is the change that is wrought in the ecosystem, specifically the relationships and interdependencies between plants, animals, and humans.

Ford (1985), writing from the perspective of the prehistory of the south-western United States, takes a somewhat different approach to the sequence of domestication. He distinguishes somewhat sharply between 'foraging' and 'food production' as the poles of the domestication continuum, while dividing the latter into stages of 'cultivation' and 'domestication'. Cutting across these stages of food production are a succession of methods, which Ford characterizes as 'incipient agriculture', 'gardening', and 'field agriculture', within which is a progressively more elaborate set of human activities, ranging from tending through tilling, transplanting, and sowing, to plant breeding.

An elaboration of the above sequences has been presented by Harris (1989), with

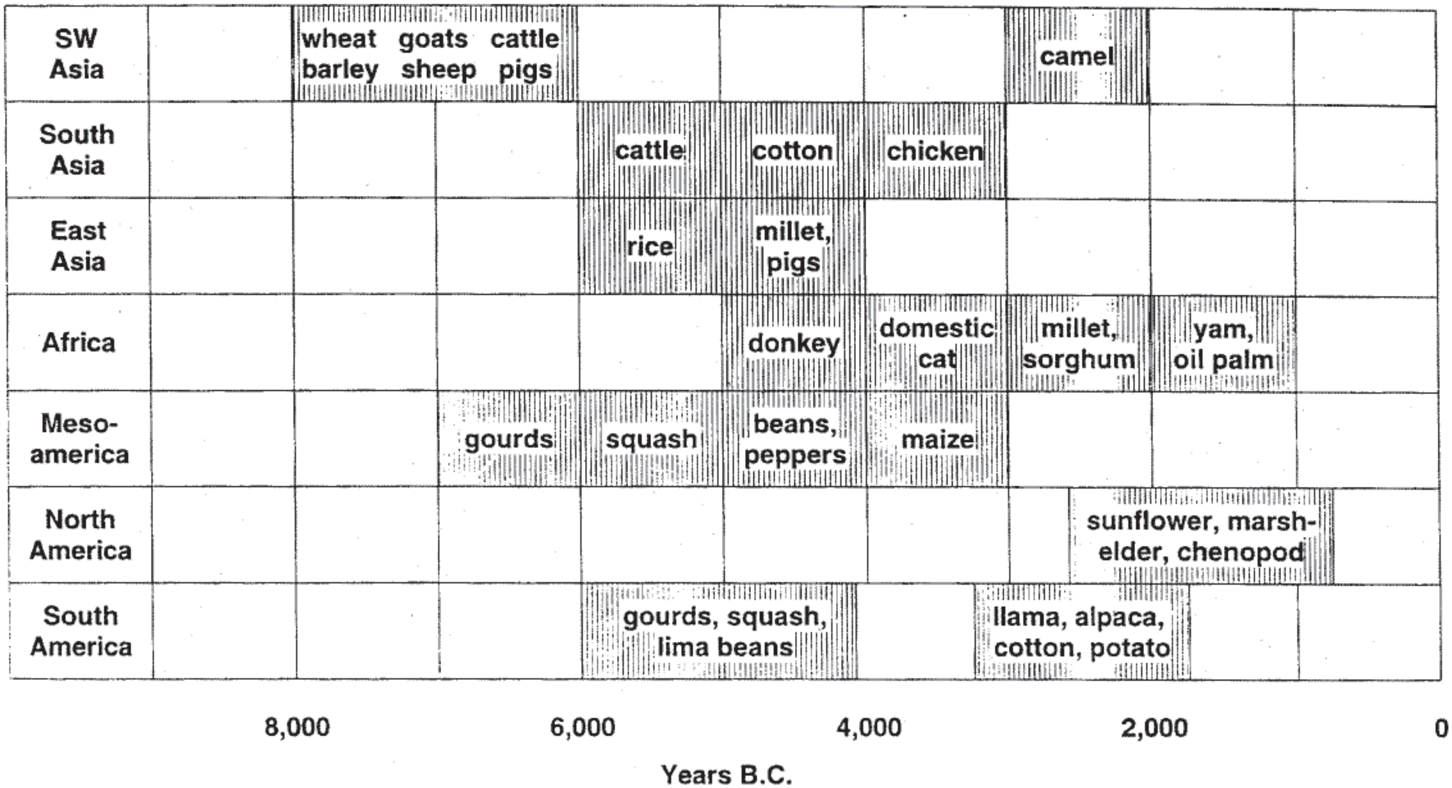

Figure 21.2 A simplified chronology of plant and animal domestication. After Price and Feinman 1993:127, with changes to reflect recent advances in dating after B.Smith 1995 and Harlan 1995.

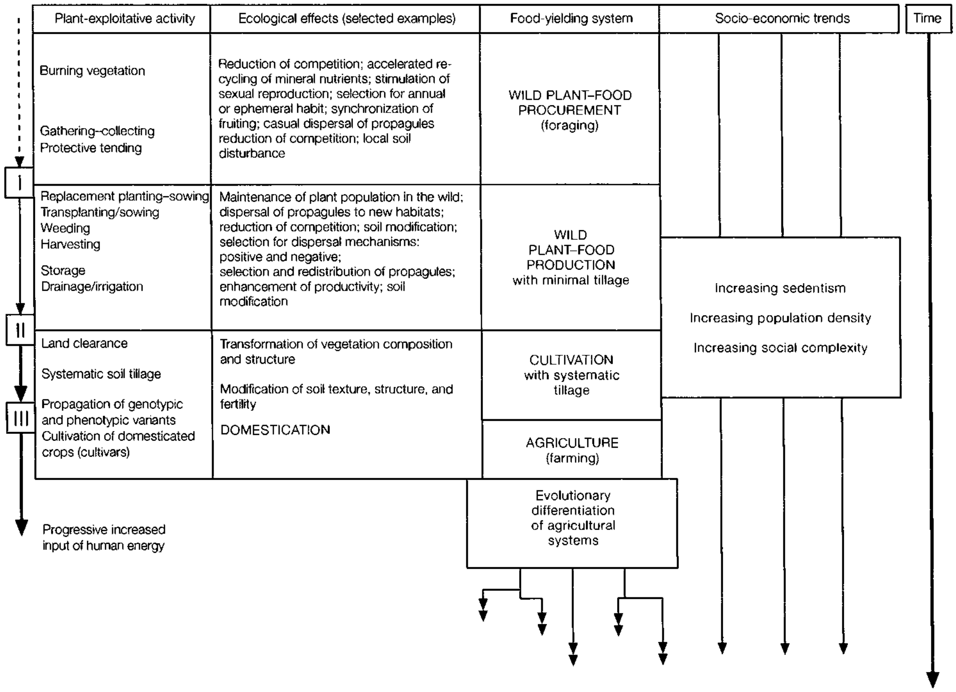

Figure 21.3 Evolutionary sequence describing the origins of cultivation; the Roman numerals at the left indicate thresholds at which a significant increase in energy investment is hypothesized to have occurred. Source: after D.R.Harris 1989, Fig. 1.1.

the addition of several thresholds in which the input of energy into food procurement and production was stepped up (Fig. 21.3). Harris begins with foraging, to include such activities as controlled burning of vegetation, gathering, and protective tending. Food production, in Harris's view, begins with the first leap in energy input, involving sowing, weeding, harvesting, storage, and drainage/irrigation (yet with minimum of tillage). At this point, the plants being used are still phyto-genetically wild. The second step up in energy input comes with the transformation of the environment through land clearance and systematic tillage. Finally, the third step, marked with another jump in energy investment, is the propagation of specific variants of the plants being used; namely, the actual domestication of the cultigens. It is at this point, in Harris's model, that agriculture truly begins, with the establishment of true agro-ecosystems.

The schema of Rindos, Ford, and Harris refer largely to plant domestication. With the study of animal domestication, more emphasis has been placed on the characteristics that mark the appearance of domestic forms rather than the shifts in human cultural activities that led up to domestication. An important universal characteristic of the development of animal domestication, which differentiates it clearly from plant domestication, is the shift from the importance of the *dead* animal for its meat alone to the selective propagation of the *living* animal (Meadow 1984, 1989) as a part of a breeding population. Another key difference between animal and plant domestication is that animal populations exhibit social behaviour which conditions their interaction with humans. The behavioural characteristics of the animals that were domesticated in prehistory vary widely, and as a result the sequence of domestication is also variable. The result is that there is greater consideration given to local patterns rather than to models that have global applicability, as well as to models that emphasize the interplay with the local progression of plant domestication (for example, Hole 1984). In general, there is a clear sense that the process of animal domestication was relatively quicker than with plants, with the more important aspect being its subsequent differentiation of emphases in animal husbandry and the products it yielded.

Evolutionary sequences such as those presented above *describe* rather than *explain* the progression of human cultural activities that culminate in domestication and agriculture: they do not provide the causal factors that move the process from one stage to the next. In other words, why did humans add weeding, harvesting, and storage to their earlier foraging activities and then proceed to clear land, till the soil, and propagate specific variants of edible plants? Why did they begin to control and breed herd animals like sheep and goats? Archaeologists have proposed a number of different models for the reliance of human populations on domesticated plants and animals, which are discussed in the following section.

Causes of food production

Once the question shifted from 'how' did food production develop to 'why', anthropological archaeologists began to try to identify causal factors which resulted in a shift from economies based on foraging to ones based on cultivation and livestock. In doing so, they develop models which seek to explain, not simply describe, this process. 'Explanation' implies a search for causation, and the models that archaeologists develop to explain the transition to food production involve an attempt to identify factors which caused societies to make this change. Some models try to isolate single factors, while others propose an interplay of several. It would be impossible to do justice here to all of the models that have been proposed, especially in the last twenty-five years, and this section will attempt simply to illustrate the variation in explanations that have been put forward.

In the first decades of this century there was relatively little attempt made to explain the origins of agriculture. As was often the case, the first real attempt to seek causality in the transition to food production was advanced by V.Gordon

Childe, who proposed his 'desiccation' or 'oasis' theory in 1928. Childe suggested that global warming and desiccation at the end of the last ice age led to the concentration of humans, plants, and animals in circumscribed locations, such as oases, and the sheer 'propinquity' or proximity of these species led to the establishment of human control over the eventual domesticates. The difficulty was that available evidence indicated a stable climate, without widespread desiccation, during the period in question between 15,000 and 10,000 years ago. Childe's theory was later overtaken by the view of Braidwood (for example, Braidwood 1960), who suggested that food production in the Old World emerged in certain 'nuclear zones' in the arc of the Taurus and Zagros mountains of the Near East known as the Fertile Crescent. Again, the mere proximity and familiarity of humans with the suite of emmer, einkorn, barley, sheep and goat would have led to the establishment of relations of control and manipulation which resulted in domestication. The advantages of domesticated plants and animals would have been so obvious that this would have become the dominant subsistence strategy in short order.

In the late 1960s there was a shift in anthropological thinking away from a belief in the inherent superiority or attractiveness of agriculture as an economic strategy. Instead, there emerged a prevalent belief that foraging was a successful and stable way of life and that humans would not have taken on the drudgery and risks of agriculture unless they were under duress. None the less, it was clear that in the last 10,000 years virtually all the world's population had made this transition, and the search for the factors which would have compelled humans to make it was intensified. Since 1968, there have been many different theories of the origins of food production that have been proposed, but they can be grouped under several convenient rubrics. Barbara Stark, in a review of the origins of food production in the New World, has identified three main types of models used by archaeologists to trace the transition to food production (Stark 1986), which she terms 'push' models, 'pull' models, and 'social' models (Fig. 21.4). This typology of models is also germane to the study of the origins of food production in the Old World.

'Push' models are by far the most commonly encountered in the archaeological literature. They tend to highlight the presumed duress which would have driven humans to adopt the time-consuming and risky business of food production. Such models, including those proposed by Binford (1968), Flannery (1969), and Cohen (1977) among others, are based on imbalances between population and resources and human populations acting under conditions of stress. Population growth, in an elaboration of the position taken by Boserup (1965), is often regarded as the main 'motor' which propels the sequence of causal relationships, with climatic change often introduced as the trigger which causes a sudden imbalance in the system. Other elements in such models are the emergence of sedentism and the diversification of resource use among terminal hunter-gatherers. As Henry (1989) points out, the main source of variation among the 'push' models is the sequence in which

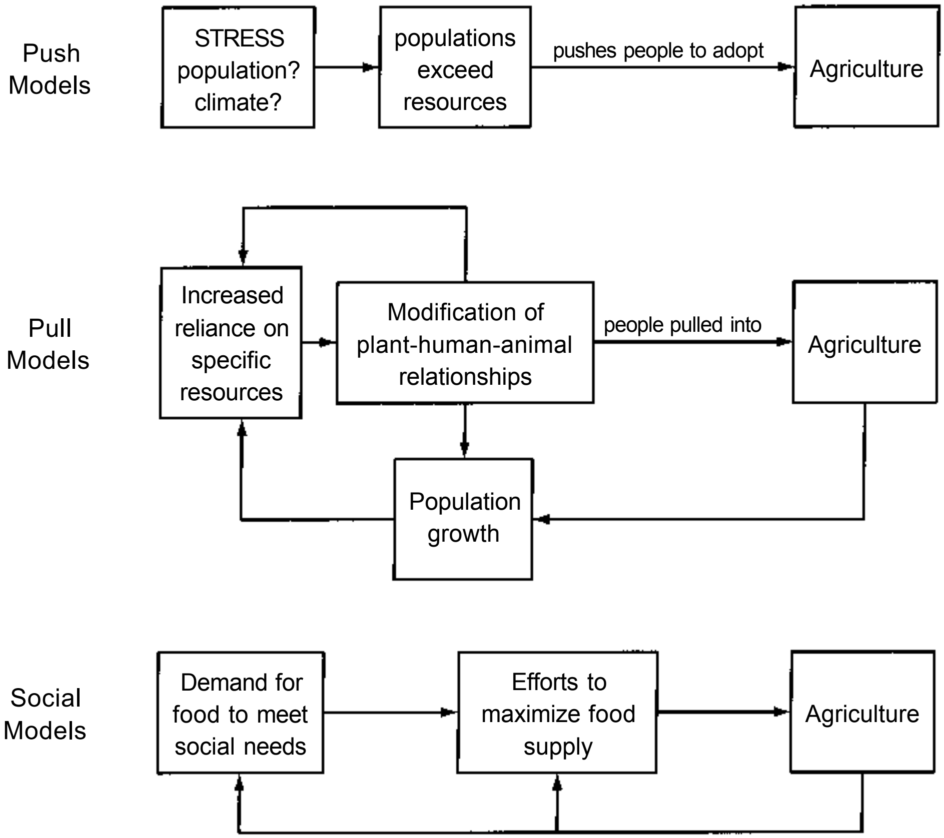

Figure 21.4 Schematic representation of the general arguments underlying 'push', 'pull' and 'social' models of the transition to agriculture. Source: P.Bogucki.

these three key elements are ordered. They are attractive in that the characteristics of sedentism, diversification of resources, and population growth can often be plausibly, if not necessarily conclusively, inferred from archaeological data.

An early example of a 'push' model was that of Binford (1968), who proposed that in certain coastal regions of the world, such as the Levant, populations that relied on rich marine resources grew in size. These populations increased to the point at which they were forced to spill over into adjacent inland zones which were not so richly endowed, also perhaps pushed by a hypothesized rise in sea levels at the close of the Pleistocene. In these marginal zones, these spillover populations needed to increase the resource base artificially, and they did so by sowing wild seeds of grasses like wheat and barley taken from the optimal zones. There is, however, no evidence of large late Pleistocene populations supported by aquatic resources in these regions, so Binford's model has remained unsupported, yet it is important in that it introduced demographic pressure as a causal factor in the discussion of agricultural origins.

Flannery (1969) proposed a model of agricultural origins in the Near East which incorporated many of the elements of Binford's scheme. He argued that, beginning about 20,000 BC, populations in the Near East began to broaden their subsistence base to include all sorts of previously underused plant and animal species—what he termed a 'broad spectrum' pattern. Human populations in certain optimal zones of the Fertile Crescent, where there were large natural populations of wild wheat, barley, sheep and goat, grew to the point where they exceeded the capacity of these regions to support them. At this point, about 8000 BC, they spilled over into adjacent marginal zones, whereupon cultivation began as an attempt to produce artificial stands of cereals 'as dense as those in the *heart* of the "optimum" zone' (Flannery 1969:81). At this point, phytogenetic changes in the cereals, such as the toughening of the rachis, set in to reinforce the human efforts. Still, harvests were uneven, and the domestication of sheep and goat was an effort to 'bank' food in an attempt to buffer the lean years. Flannery's model was seen as very compelling, and although some have made amendments to it (for example: Hassan 1977; Smith and Young 1972), it remained the basis for the genre of 'push' models of agricultural origins in south-western Asia throughout the 1970s. Attempts have been made to extend the population pressure hypothesis of agricultural origins world-wide (Cohen 1977), but the absence of compelling evidence from many regions has led many archaeologists to be sceptical of it as a universal explanation.

More recently, a certain dissatisfaction with single-factor 'push' models has set in, particularly due to the fact that demonstrating stress or inferring it from population growth is elusive. Moreover, it began to seem clear that the earliest sites with documented plant cultivation and animal husbandry were not in 'marginal zones' but rather in the most productive parts of the Levant. Recent models (McCorriston and Hole 1991; Moore 1982, 1989) have tended to emphasize the interplay of a variety of factors, including changing environments, demography, the foraging economy, settlement patterns, and social organization. The differences among them tend to be the factor which receives the heaviest weight. Moore (1982, 1989), for instance, emphasizes the change to a more sedentary form of settlement which increased pressure on local plant and animal resources. McCorriston and Hole (1991), on the other hand, stress the role of environmental change, as manifested in increased seasonal variation and the drying of lake basins. The increased prominence given to climatic change in many recent models indicates that Childe's speculations of the early twentieth century were not entirely wide of the mark.

Some archaeologists are not comfortable with isolating a source of 'stress' which compelled populations to shift from foraging to farming and have developed so-called 'pull' models, although these are somewhat rarer in the archaeological literature. In such models, the precursors of domesticated plants and animals are inferred to have had certain characteristics which drew human groups to rely more heavily on them than on alternative resources. The increased use of such resources then led to dependence on them to the point that it was impossible to return to the previous patterns of plant and animal exploitation. In such models, population growth continues to play a role, but it functions more as the force that prevents a group from reverting to an earlier pattern of resource use that maintained population at a lower level.

In highland Mesoamerica, Kent Flannery proposed one of the earliest 'pull' models in 1968. He argued that the foraging bands of upland Mesoamerica practised a tightly scheduled seasonal pattern of plant and animal exploitation. Subtle genetic changes in particular plants, especially beans and eventually maize, made them more attractive to foragers, who spent more time collecting them. This upset the tight schedule, leaving the foragers no option but to cultivate the plants on which they had focused in order to maintain their yields. Although it has been refined somewhat over the last two decades (for example, Flannery 1986), this model presents an attractive explanation of the beginnings of cultivation in Mesoamerica, although recent research results may revise our understanding of early agriculture in this region in the near future. For example, the transition from foraging to farming societies was long believed to be very gradual, based on radiocarbon dates of *c.* 5000 BC for maize cobs in the Tehuacan Valley and the eventual appearance of maize-based agricultural villages *c.* 2000 BC. Recent AMS dates, however, indicate that maize domestication may have occurred later, *c.* 3500–3000 BC (Fritz 1994).

Henry (1989) has developed a 'pull' model for agricultural origins in the Near East. He proposed that there were two key points in the process of agricultural origins in the Levant. The first occurred around 12,500 years ago, in which a world-wide increase in temperature promoted long-term settlement and necessitated a shift from what Henry calls 'simple' foraging to 'complex' foraging in the Levant, in which a variety of high-yield resources were exploited, including wild cereals. Restraints on population growth were relaxed. About 2,000 years later, this complex foraging system collapsed, possibly as the result of a second climatic change. The foragers had two options. In the highly productive areas of the Levant, where the highest populations were, they began to cultivate cereals (which, Henry believes, they had known how to do for some time, but had not needed to), while in the marginal areas they reverted to a simpler foraging system.

In 'social' models, factors beyond population growth generate demand for resources, leading to the intensification of subsistence pursuits and ultimately to food production. Among some human groups, it is hypothesized, there existed a need to increase the amount of food available to meet social demands for exchange, bridewealth, distribution for status, and alliance formation. The high productivity of certain potential domesticates led to a concentration on them for this purpose and ultimately to their domestication. The evidence to support 'social' models is quite elusive and requires crossing a wider inferential gap than for 'push' and 'pull' models. None the less, they should not be discounted simply because it is difficult to find direct support for them.

A recent 'social' model for the origins of food production is that of Hayden (1992), which he terms the 'competitive feasting' model. Hayden points out that most hunter-gatherers occupying fluctuating environments share food, and hence there is no incentive to invest time and effort in producing extra, since only others will benefit. In resource-rich areas, however, in which there was adequate food to relax such collective sharing, conditions may have arisen for competition as ambitious individuals staged competitive feasts to gain control over labour and loyalty. The need to generate large amounts of desirable foods in order to stage such competitive feasts stimulated cultivation, which represented no great discovery for foragers who were well aware of seeds and their propagation. Hayden proposes his model without strict geographical reference, suggesting that it may be applicable to both the New World and Old World alike. Similarly, Runnels and van Andel (1988) have argued that in the eastern Mediterranean agriculture may have arisen as a result of a need to produce surplus commodities for trade or to support craftsmen who made goods for trade.

THE DISPERSAL OF FOOD PRODUCTION

The question of the spread of agriculture and animal husbandry beyond the zones of initial domestication is just as important as the process of domestication itself. In addressing this issue, a variety of factors must be studied. It is necessary to differentiate between the expansion of agricultural communities into zones where they previously had not been found and the adoption of the techniques of agriculture and animal husbandry by communities that had previously practised only foraging. Both types of agricultural dispersals took place at various times around the world.

A number of different factors need to be taken into account in studying agricultural dispersals. One is the organization of early farming communities and why they might be expected to expand into new ecological zones. Another factor is the environmental conditions that prevailed at the moment when domestic plants and animals became available to local foraging populations and whether these encouraged or retarded the adoption of food production. Finally, it is necessary to understand the nature of the foraging populations that inhabited the area prior to the appearance of cultivation and animal husbandry.

Agricultural dispersal by colonization of wide areas was apparently rare in prehistory, but it can be documented for certain regions with some level of confidence. For instance, on the loess soils of central Europe, an area hitherto sparsely settled by foraging peoples, communities of the Linear Pottery culture settled

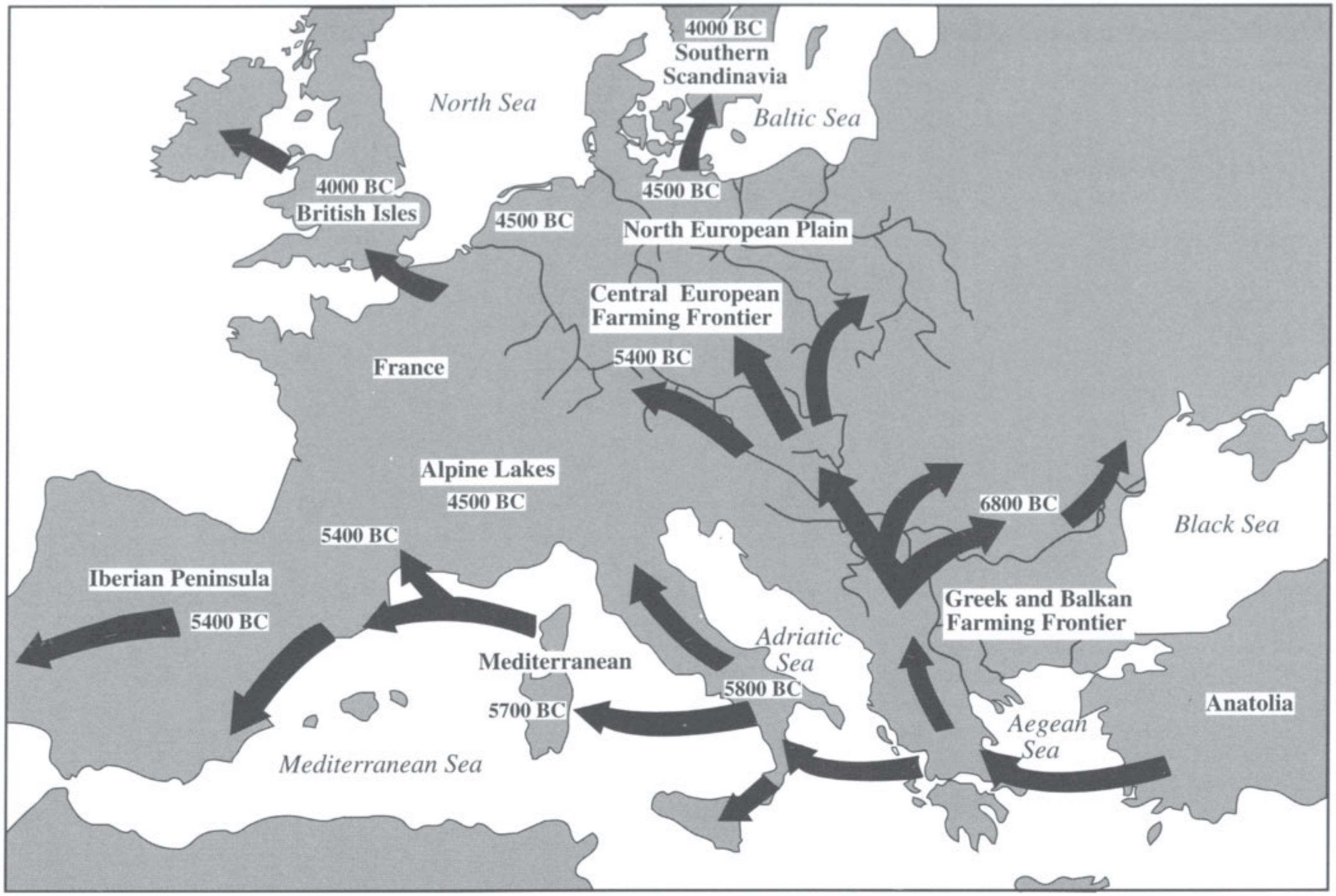

Figure 21.5 Agricultural dispersals in Europe, *c*. 6000-3000 BC. Note that the dispersal is not constant but rather that in the Balkans and in central Europe there were periods during which the frontier did not advance steadily. Reproduced with permission of *American Scientist*.

between 6000 and 5000 BC (Barker 1985; Bogucki 1988, 1996; Bogucki and Grygiel 1993; Hodder 1992; Price *et al.* 1995). Sharp contrasts in house form, chipped-stone tool types, and settlement location between earlier foragers and the Linear Pottery culture, and its fully developed pottery technology, suggest that this does indeed represent the spread of agriculture through the dispersal of people (Fig. 21.5). Similarly, the Austronesian-speaking colonization of Polynesia between *c.* 1600 and 500 BC brought with it a dispersal of cultigens and domestic animals (pig, dog and fowl), along with a variety of 'stowaways', including lizards, rodents, molluscs and weeds (Kirch 1983).

A more frequent occurrence in prehistory was the adoption of agriculture and animal husbandry by peoples who had previously engaged in foraging—what Minnis (1985) calls 'primary crop acquisition'. Indeed, outside of the rare instances of colonization, the adoption of agriculture by foragers has been the dominant mode of agricultural dispersals over the last ten millennia. As Minnis (1985:337) points out, however, the adoption of cultigens by foragers has received comparatively little attention alongside cases of pristine domestication. Yet 'primary crop acquisition' was crucial to the eventual success of agriculture as a food production system and often involves processes that are quite interesting in their own right.

In the south-western United States, foragers began to cultivate maize shortly before 1000 BC, according to the best available evidence (Wills 1988:149), clearly deriving the domesticated plants from Mesoamerican sources further south. Early maize was a subtropical plant not well suited to the Sonoran desert, and its adoption by the mobile foragers of this region did not at first result in a radical transformation of society. 'The initial introduction of domesticated plants in the Southwest was a monumental non-event with little *immediate* impact on native human populations' (Minnis 1985:310). It was not until much later, in the first millennium AD, that the inhabitants of many parts of the south-western United States came to depend on maize as their primary food source. Wills (1988) has advanced the hypothesis that the initial adoption of maize was an effort by foragers to alter their pattern of seasonal movement in order to spend more time in rich upland zones to monitor and exploit the wild resources there. In other words, in Wills's view, the introduction of agriculture to this region was to sustain and enhance a foraging system.

A similar situation existed in north-central Europe, in northern Germany and Poland, Denmark, and the Netherlands, shortly before 4000 BC (Bogucki 1996). Domestic plants and animals had been present just to the south in the areas colonized by the Linear Pottery culture for at least a millennium, yet they were not immediately adopted by the foraging populations of the northern European lowlands. These foraging populations, particularly in coastal regions of Denmark, Germany, and the Netherlands, exploited a rich environment with abundant terrestrial and marine resources (Price and Gebauer 1992). Several hypotheses have been offered to explain why the foragers in various parts of north-central Europe adopted agriculture, including imbalances between populations and resources caused by environmental change (for example: Larsson 1986; Rowley-Conwy 1985) and competition for prestige necessitating surplus production (Jennbert 1985). Price *et al.* (1995:125) note that in southern Scandinavia there seems to be no evidence of population pressure or climatic change directly involved in the adoption of domesticates, which suggests that social competition and demand may have been the primary factors.

A common theme in studies of 'primary crop acquisition' is that the mere *availability* of domesticated plants and animals did not lead immediately to their adoption by foraging populations (Zvelebil and Rowley-Conwy 1984). In both of the cases mentioned above as well as elsewhere, for example in southern Africa (Hitchcock and Ebert 1984), the presence of neighbouring populations practising agriculture did not demonstrate the 'superiority' of food production. Instead, there is normally a significant time lag between the moment a population becomes aware of food production and the eventual integration of domesticated plants and animals into its own subsistence economy. The challenge for archaeologists, then, is to understand *why* foraging populations choose to practise food production, but the answer to this question, as was the case with 'pristine domestication', is often elusive.

AGRICULTURAL COMMITMENT

The adoption of domesticated plants and animals was not the end of the transition to fully agricultural societies. Welch (1991), paralleling Bronson's (1977) comparison of 'cultivators' and 'farmers', has made the crucial distinction between, on the one hand, the initial use of domesticates, integrated into an economy similar in other respects to the preceding one based on foraging, and on the other, the *commitment* to agriculture reflected in the full linkage of human behaviour—economic, social, even ritual—with the maintenance of the agro-ecosystem and its production of reliable harvests. The commitment to agriculture represents the final step in the transition from one set of premisses on which society is organized to another. In the Levant, for instance, the domestication process itself, and the onset of cultivation, appears to have taken place relatively rapidly (Bar-Yosef and Belfer-Cohen 1992). On the other hand, the commitment to agriculture, with the establishment of communities that were specifically adapted to the maintenance of an agro-ecosystem, seems to have taken place more slowly over 2,000 years (Byrd 1992). By contrast, in the south-western United States, after a long period of practising mixed horticulture (gardening, hunting and collecting), communities rapidly made the transition to sedentary life structured around sustainable agriculture (Welch 1991).

Considerable archaeological research has been dedicated to the documentation of the initial appearance of cultigens and domestic animals, while much less has been devoted to the shift to committed agriculture. Yet the eventual dependence on agriculture is not simply the inevitable result of the initial use of domestic plants and animals. It is the product of a further set of choices, decisions and responses which resulted in fundamental organizational changes in society (Hodder 1990; Whittle 1996). In both regions of 'pristine domestication' and of 'primary crop acquisition', most prehistoric populations eventually crossed the threshold of commitment to agriculture. The discussion below focuses on some of the issues that faced societies which have crossed this threshold.

SEDENTISM AND OPTIONS

A significant correlate of the transition to an agricultural economy is sedentism. According to Kent (1989:2), sedentism is the opposite of nomadism along a continuum of mobility. In other words, if nomadism represents the movement of a group on a landscape, sedentism is the lack of such mobility. Of course, no human group or community is entirely sedentary, just as none is absolutely nomadic. All fall between the two extremes on this continuum, although for classification purposes they can be characterized as one or the other depending on which state of mobility or non-mobility is most prevalent. Although it is not possible to say that there is a causal relationship between agriculture and sedentism (Rindos 1984:173), it is clear that agriculture can *change* patterns of mobility and residence.

The transition to agriculture, specifically by the establishment of fixed locations where crops grow, forces a group to reconcile its patterns of mobility with the demands of the agricultural system. Rindos (1984:176) terms this reconciliation *agrilocality,* as it represents a dynamic interaction between human locational strategies and the demands of a new agricultural system. It would be wrong to say that agriculture is incompatible with mobility or that sedentism is restricted to agriculturalists. Indeed there are many known groups who are not completely sedentary who grow crops. In Massachusetts in the seventeenth century, for example, the Wampanoag tribe maintained winter inland settlements and summer coastal settlements, where crops were raised (Williams [1643]1973: for a critical review, see Bragdon 1996). In the Amazon drainage, a number of horticultural groups could be categorized as semi-sedentary, the best known being perhaps the Siriono of Bolivia (Holmberg 1969). Some Kalahari hunter-gatherers combine food production and a nomadic way of life (Hitchcock and Ebert 1984). None the less, the fact that agriculture represents an investment of effort and time, however minimal, in a fixed location, causes a society that incorporates some measure of mobility into its residential pattern to confront the question of whether it can continue its nomadic mobility patterns to the degree hitherto practised.

For nomadic societies, mobility provides a variety of options for adjusting conflicts and imbalances: in scheduling, in resource availability, in population, in social transactions. Increasing sedentism, or lack of mobility, implies that the options afforded by mobility would also decrease. Alternative structures would need to be developed to resolve the same imbalances. In large measure, the social and economic consequences of the transition to agriculture revolve around the decreasing options afforded by mobility and the elaboration of alternative structures for addressing conflict and imbalances: storage, exchange, social structure, ritual, warfare.

Sedentism also represents a shift in the human approach to territoriality and time (Carlstein 1982). It also permits the accumulation of material possessions and enhances conditions for population growth. These factors, however, open the door to further challenges posed by increasing complexity in social and economic structures, which Johnson (1982) has called 'scalar stress'. One solution would be to invoke the remnants of the mobility option, as settlements fission and relocate. Another would be to elaborate extramural ways of addressing imbalances, such as trade and warfare.

LABOUR

Among small-scale agriculturalists in the world today, land, labour and capital form the elements of the productive system, and their control is the basis for access to status, power and wealth. Early agricultural societies are generally considered to be 'pre-capitalist' in the sense that they did not have the conditions under which productive assets constituted capital and there was not a category of people who earned their living solely from the accumulation and exchange of such assets. Thus, land and labour are usually considered to be the critical factors in determining the productivity of agricultural systems such as those which would have been found in the first several millennia following the transition to agriculture. Today, in most parts of the world, ability to acquire land is viewed as the primary limiting factor on subsistence production, yet for most early agricultural societies it is likely that arable land was relatively abundant in absolute terms. Although optimal habitats might have soon been thoroughly settled, adequate amounts of arable land on lesser-quality soils or in otherwise suboptimal habitats would have been available. Instead of land, labour supply was probably the major limitation on early agricultural production (Bogucki 1988).

There are periods in the agricultural cycle, such as land clearance, planting, weeding and harvesting, which require considerable amounts of labour, but over relatively short periods of time. Such periods are typically referred to as 'labour bottlenecks' (Jaeger 1986:7; Richards 1985:68). The agricultural community must balance its labour requirements for these bottlenecks against its ability to support this workforce over the remainder of the agricultural year. Generally, a compromise results which constrains the overall productivity of the subsistence system, perhaps in terms of the amount of land it can bring under cultivation or the degree to which fields can be weeded. Labour, then, is a very inelastic resource, which limits the ability of an agricultural community to produce both for its own survival and for accumulation and exchange.

Along with sedentism, the transformation of the mobilization and control of labour was an important structural change that accompanied a commitment to agriculture. Societies which were still largely based on foraging with some cultivation would not have needed to make many adjustments to accommodate labour bottlenecks. Once a society was primarily dependent on agriculture and animal husbandry, however, the size and structure of the labour pool would have been a primary determinant of agricultural productivity. It is possible, then, to see limitations on labour, particularly at the bottleneck times, as a factor in the eventual development of innovations which permit human energy to be invested

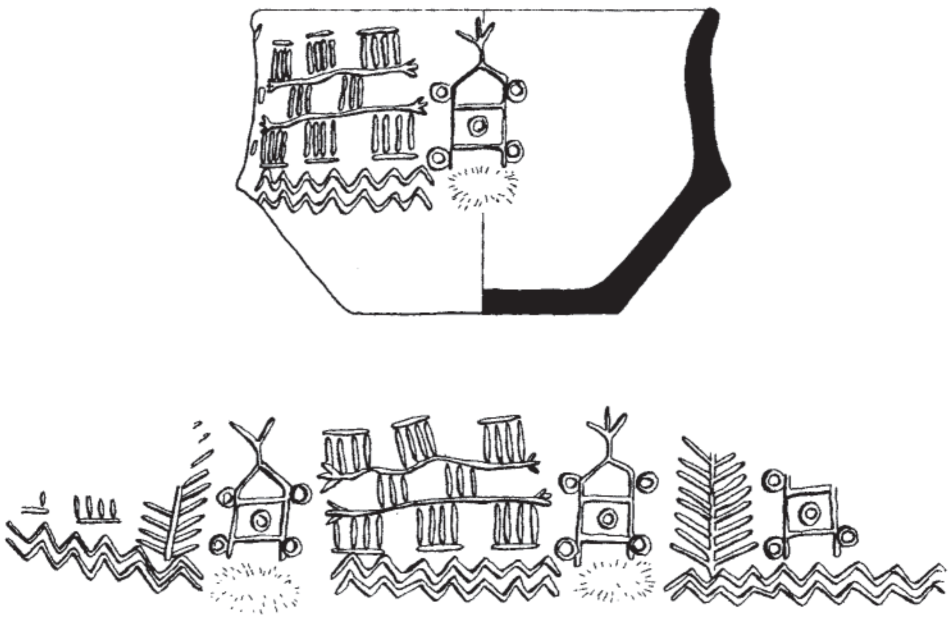

Figure 21.6 Representation of a wagon on a vessel from Bronocice, Poland, dated to the fourth millennium BC, indicating an early use of animal traction for cartage. Source: Milisauskas and Kruk 1982.

in agriculture in other ways to increase the productivity of a parcel of land (see, for example, Bogucki 1993). Such innovations would include animal traction for ploughing and cartage (Fig. 21.6), irrigation and raised fields, and manuring. The management of livestock and the digging of irrigation ditches clearly involve human labour, but these can be done mostly at times other than those of the labour bottlenecks that constrain the productivity of agriculture.

HAZARDS, RISKS AND UNCERTAINTY

Agriculturalists must constantly make decisions, the consequences of which they must predict, on the basis of available information, experience and intuition. In this process, the farmer must make some assessment of the range of potential outcomes. Economists and ecologists have recently taken an interest in the fact that farming decisions are not made on the basis of complete certainty. Instead, agricultural decision-makers must incorporate some consideration of the unknown, the random, and the unpredictable into their behaviour, which in turn determines how they respond to their environment. An ideal world of full information and complete certainty bears little resemblance to the conditions under which human groups operate. Instead, we must recognize that prehistoric societies did not have complete information about their environment or ways to predict random environmental hazards.

The environment of early agricultural groups had considerable potential for hazards and stress. Hewitt (1983) has pointed out that the removal of domesticated plants from their original habitats increased their vulnerability to hazards. The subsistence system of agricultural peoples is based on an artificial association of plants and animals that can be maintained only through human intervention. As such, it is inherently unstable and prone to fluctuations of environmental conditions—rainfall, sunlight, insects, diseases—and changes in the ability of human groups to invest the labour required to maintain fields and livestock (Fig. 21.7). We cannot simply assume that these variables can be eliminated from consideration and still hope to develop models that accurately explain the archaeological record.

Economists and ecologists identify two important conditions under which decisions can be made: risk and uncertainty. This distinction was first made by the economist Frank Knight in 1921, but since then there has been little consensus about the dividing line between risk and uncertainty, or whether the two concepts can be separated at all. Knight differentiated between *risk,* in which probabilities could be assigned to a range of known outcomes, and *uncertainty,* in which an absence of information or predictive data made the range of outcomes unknowable. Some economic anthropologists have argued that this distinction is useful in dealing with small-scale agrarian societies. Cancian, for instance, noted that there are differences between how farmers take account of known environmental variation

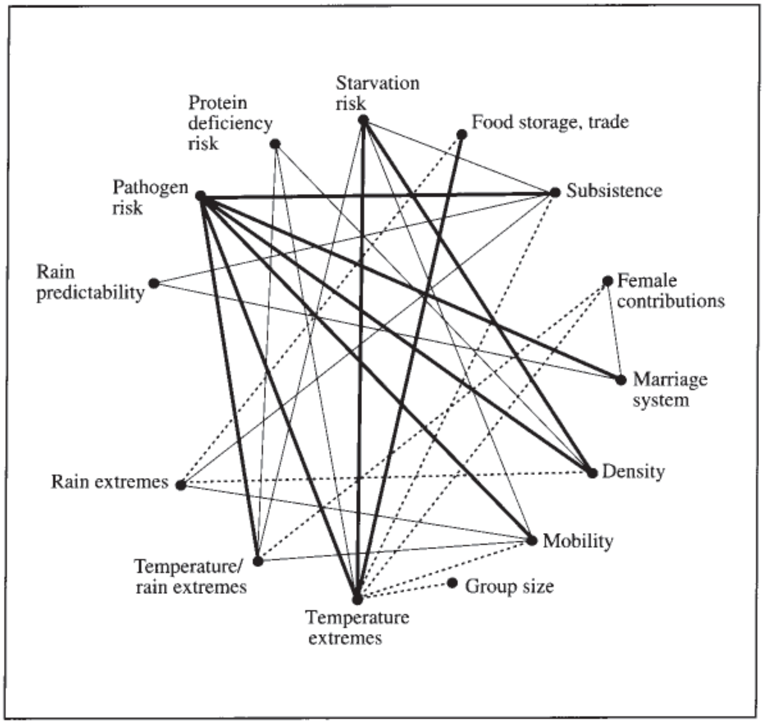

Figure 21.7 Relationships among critical variables of risk and uncertainty. According to Low's analysis, heavy lines indicate at least one relationship of $p < 0.001$ or more than one relationship of $p = 0.01$; light lines indicate at least one relationship of $p = 0.01$, or more than one of $p = 0.05$; dotted lines indicate at least one relationship of $p = 0.05$. Source: E.Cashdan, redrawn by D.Miles-Williams.

such as rainfall in their decision-making and how they deal with the unknown results of new technology (Cancian 1980). Others have maintained that this distinction is artificial, for 'probabilities of future events are never "known" with complete certainty' (Berry 1980:325).

Social scientists recognize several components of risk (Merkhofer 1987). First, there must be a source of risk, a *hazard*. Second, there must be a process by which people and their property are *exposed* to the hazard. Third, there must be a process by which the exposure produces adverse results. The *perception* of the risk by individuals and groups involves a further process that incorporates an evaluation that the severity or inequity of the adverse results is sufficient to be of concern. This final process of risk perception is generally subjective, but none the less constitutes a probability judgement about the frequency or likelihood of an unpleasant event.

How do farmers reduce risk? One way is to subdivide and thus multiply the number of units (fields or crop varieties, for example) exposed to hazards. Rather than have one large field on a single soil type, farmers can have a number of small fields on a variety of soil types. The trade-off for this is a loss of efficiency in travel and scheduling, but if the probability of environmental hazard is judged sufficiently high, such a cost might be acceptable. Another diversification strategy is to grow a variety of different crops that respond differently to climatic variation (see, for example, Halstead and Jones 1989). Minnis (1996:62–64) points out that the use of low-preference foods, or 'famine foods', which are neglected in times of plenty, constitute yet another form of diversification. Storage can also be viewed as a response to risk (Bettinger 1991). Finally, the establishment of reciprocal exchange relationships with other individuals and households can be viewed as a form of insurance which spreads the exposure to hazard over a number of units (Cashdan 1985).

The position taken here is that the distinction between risk and uncertainty can provide an important insight into different patterns of prehistoric behaviour. Calavan (1984), for instance, points out that farmers, in making production choices, operate differently under these two conditions. Farmers producing a long-established crop with a familiar and traditional technology will obtain yields that will vary from year to year but within predictable limits. Based on their observations of environmental conditions, they can allocate subjective, but reasonably accurate, probabilities to these yields, and base their investment of labour and time accordingly. In such a circumstance, farmers operate under conditions of risk. On the other hand, farmers who are trying a new technology or a new crop, or who are colonizing new environmental zones, will find themselves in a situation where the yields cannot be predicted with confidence. While such innovation can pay off richly if the guess is correct, it can also be catastrophic if the farmer guesses wrong in allocating his resources. In this situation, the farmer operates under conditions of uncertainty. Such uncertainty can be turned into risk through experience and learning, although this may take several generations for knowledge of the range of possible outcomes to accumulate.

The question of innovation is another important dimension of early agriculture. Studies of subsistence farmers today show that they are avid experimenters (Richards 1985), and there is no reason to believe that prehistoric farmers were not equally prone to experimentation. Innovation is closely linked with risk and uncertainty (Cancian 1979; van der Leeuw 1989), particularly in situations where there is pressure from external sources on the agricultural economy to increase production. When does the need to increase production offset the risks involved in new and untried methods? This brings us to yet another critical issue in the study of small-scale subsistence agriculture—that of *intensification*.

INTENSIFICATION

Intensification can have a variety of meanings and connotations for different researchers, and it is important to be explicit about what the term actually means. A broad definition is offered by Brookfield (1972:31), who defines it as 'the addition of inputs up to the economic margin', the margin where the application of further inputs will not increase total productivity. The inputs can take a variety of forms. Anthropologists have tended to concentrate on raw labour inputs and 'skills' as easily quantifiable and indexed dimensions of intensification, but Brookfield emphasized that there are many other components to consider, including organization of labour and structure of land use (1972:32).

A somewhat narrower concept of intensification has been used by other anthropologists and economists who have studied agricultural societies (for example: Boserup 1965; Conklin 1961). Their definition of intensification is focused on the length of the fallow period, the time in which fields lie unplanted, with the degree of intensification inversely correlated with the length of the fallow. While narrower in scope, such a definition of intensification is related to that proposed by Brookfield in that a shorter fallow period usually demands an increase in labour and related inputs per plot.

Most archaeologists who employ the concept of intensification come to it via the so-called 'Boserup hypothesis', which links intensification to population growth. Boserup argued that agriculture will be intensified, by shortening of fallow length and the introduction of the plough and irrigation, as population increases. Since settlement sizes and distribution are believed by many archaeologists to be reliable proxy indicators of population increase, the causal relationship between population growth and intensification is attractive. We have already discussed how the Boserup model was extended to form the basis for some of the prevalent 'push' models for the origin of agriculture, and it also forms the theoretical rationale for many attempts to explain changes in early agricultural societies as well.

The expression of intensification only in terms of fallow length and as strictly related to population growth is but a limited version of a much broader process that can touch society in many other ways. For instance, the dispersal of settlements to minimize travel time to and from fields and the integration of animal traction into the household economy can be viewed as intensification strategies, even though they do not involve the direct input of labour into agricultural work. Bogucki (1988, 1993) has argued that both of these were employed in the fourth millennium BC in Europe to intensify the agricultural system. If this is the case, then there are clear implications for the social and economic relationships implicated in a change in settlement pattern and the investment in assets such as draught animals. Moreover, an equally plausible trigger for agricultural intensification is constituted by changes in social relationships that make demands on the subsistence system for greater production of materials to be used in social transactions (Bender 1978; Nassaney 1987).

Intensification is not a unilinear process, and there are examples known from the ethnographic record of shifts from more to less intense levels of land use, referred to as 'deintensification' (Guillet 1987) or 'disintensification' (Brookfield 1972). While in many cases these examples can be correlated with population shifts, their existence suggests that intensification is dependent on a number of factors besides raw population size or its rate of change. One interesting issue is the relationship between intensification and agricultural risk. For example, Nichols (1987) has argued that the emergence of intensive irrigation agriculture in the Basin of Mexico was a response to the risks posed by annual variation in water supply. In her model, intensification occurs before there is an imbalance between population and resources. The implication of this model is that if the source of risk were to dissipate (which would be unlikely with populations, unless they moved away), then there is at least the theoretical possibility that the process of intensification could be arrested or even reversed.

FORAGERS AND FARMERS

The adoption of agriculture around the world was not instantaneous, of course, or even inevitable. Food-producing populations have often lived in proximity to human groups for whom farming and herding had little importance. Moreover, the adoption of agriculture is not a one-way street, and it is possible for groups to decide to give up sedentary farming life if conditions allow them to do so. Even among populations that were fully committed to agriculture, such as those of medieval and early modern Europe, gathered foods played an important role in the diet.

Ingold (1984:5) has noted that anthropologists have the tendency to remove people from the category of foragers if they have any attributes of agriculture or pastoralism. There are really, however, four basic categories of human groups in terms of subsistence systems: (1) those who subsist on uncultivated plants and wild fauna—foragers; (2) those who have a mixed subsistence economy, based partly on domestic and partly on wild resources: these can be subdivided further into two sub-categories, (2a) foragers who farm (yet still closer to category 1), and (2b) farmers who hunt (yet still closer to category 3); (3) those who gain no significant subsistence from uncultivated plants or wild fauna—agriculturalists and pastoralists. In general, anthropologists have tended to view the universe of human subsistence economies as a binary set: those in category 1 and those in category 3. The root of the problem may be that the colonization of Africa, the Americas, Australia, and the Pacific in the eighteenth and nineteenth centuries essentially 'froze' many societies as either foragers or food producers depending on their circumstances at the time of European contact. The point of this frozen moment was then assumed to be fixed on the unilinear scale of progress from hunting and gathering to farming and stock-herding. Early anthropological studies that were based on short-term contact tended to reinforce this viewpoint. Yet all does not seem to be so simple. Long-term studies of a number of groups reveal fluctuations between foraging and farming with an annual or even longer periodicity.

There is a prevailing belief among anthropologists that once a society heads down the road to agriculture it cannot return. In general, it is widely believed that once population growth occurs as a result of the 'improved' food supply brought about by food production, the society comes to depend more and more on its crops (for example, Cassidy 1980). Actually, there is little evidence to suggest that population growth is an automatic effect of the adoption of agriculture, and it appears that even among agricultural societies there are mechanisms that restrain population growth and fertility (see, for example, Englebrecht 1987 for a discussion of this among the Iroquois). It is entirely possible for societies at this boundary between foraging and farming to slide back and forth from one strategy to another, following one for a few years, then reverting to the other, and back again. For instance, the Agta in the Philippines, long thought to be prototypical hunter-gatherers (Peterson 1978a, 1978b), actually are opportunists who make use of the subsistence strategy that best suits the conditions of the moment (Griffin 1984).

These conditions can be determined both by the natural environment and by the sort of interactions that a group is having with agricultural neighbours at any given moment. In studying the dispersal of agriculture beyond areas of 'pristine' domestication, archaeologists have begun to draw on comparative ethnological studies of forager-farmer interaction and to propose models for such interaction in prehistory (for example: Bogucki 1995; Gregg 1988). Often these involve the exchange of hunted or collected resources from the foragers for cultivated products of farmers, although the potential of forager populations for providing agricultural labour cannot be underestimated. The study of such forager-farmer interactions holds great promise for the understanding of the spread of food production, particularly in cases where foragers adopted domesticated plants and animals from nearby farming populations.

CONCLUSION

The establishment of sedentary agricultural communities in both the Old World and the New World laid the foundation for subsequent changes in human society. It is important to realize, however, that despite the rise of urbanism and state societies in some regions, rural agrarian communities have continued in a way of life that had its roots millennia earlier. Farmers continue to make decisions about how to allocate land and labour under conditions of risk and uncertainty. Agrarian societies respond to needs and challenges by intensifying their production. Although a tractor can be substituted for oxen, and cultigens can be selected and improved, farmers seek the same opportunities and work under the same basic constraints today as did their counterparts millennia ago.

The two most significant changes in agriculture in the last several millennia have been the emergence of cash-cropping, in which choices are determined by market concerns rather than nutritional needs, and the global dimensions of agriculture. A potato farmer in Poland today worries about the productivity of an Andean domesticate, while the plains of the central United States are covered by fields of wheat first domesticated in the Levant 10,000 years ago. Pigs in Iowa, descended from animals first domesticated in Anatolia in the seventh millennium BC, are fattened on maize, domesticated in highland Mexico. Considered in this light, the origins and, just as importantly, the dispersal of food production as a successful economic strategy have truly shaped human existence for the last ten millennia.

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The last decade has seen a proliferation of books which discuss the transition from foraging to farming and early agricultural societies. This is probably the ultimate result of the concentration of archaeological field research on this problem in the 1970s and 1980s. For comprehensive overviews of the botanical and zoological basis for early domestication, the basic sources remain Harris and Hillman (1989) and Zohary and Hopf (1993) for plants, and Glutton-Brock (1989) for animals. Harlan's *The Living Fields* (1995) is a memoir of a remarkable botanical career which includes reflections on the current status of the study of agricultural origins. Archaeological anthologies of articles discussing the transition to agriculture include Watson and Cowan (1992), Gebauer and Price (1992) and Price and Gebauer (1995). A highly readable, single-author treatment of agricultural origins is Smith's *The Emergence of Agriculture* (1995). Stark's 1986 article is a classic discussion of the models used to explain agricultural origins and remains widely cited a decade later. Regional studies of early agricultural societies are fairly numerous and include Smith (1992) for the eastern United States, Wills (1988) for the south-western United States, and Bogucki (1988) and Barker (1985) for Europe. An up-to-date synthesis of agricultural origins in Mesoamerica has yet to appear. Discussions of issues such as labour, risk, and uncertainty in early agricultural societies are relatively rare, but examples include Bogucki (1988), Wills (1988), and papers in Tainter and Tainter (1996).

22

THE DEVELOPMENT OF RANK SOCIETIES

Stephen J.Shennan

INTRODUCTION

The idea of the 'development of rank societies' is a problematical and ambiguous one, which the position of this chapter in the *Encyclopedia* highlights: the two previous chapters are defined in terms of types of subsistence economy, while the subsequent one is concerned with a specific form of socio-political organization, the state, which only occurred in the context of certain productive agricultural economies. Rank societies, in so far as the term is meaningful (see below), can be and have been argued to exist in the context of hunter-gatherer economies, of early agriculturalists, and of societies with agricultural modes of existence which lasted for thousands of years.

This chapter will review the concept of rank society and the way it was introduced into archaeological discussion. Various criticisms of the concept, its application, and its archaeological uses will then be examined. Next, a series of case studies of 'rank societies' from different parts of the world will be presented. Finally, some rather different approaches will be suggested which in various respects both build on and depart from the original concept of rank society.

THE CONCEPT OF RANK SOCIETY

The idea of '*rank society*' (Fried 1967) derived from the renewed concern with social evolution which developed in American anthropology in the 1950s and 1960s following the earlier pioneering works of Julian Steward (1955) and Leslie White (1959). These latter authors were reacting against the ethnographic particularism of the Boasian school, itself opposed to the nineteenth-century evolutionism of such authors as Morgan, Tylor and Engels (see Chapters 2 and 12). White proposed a theory of general evolution in terms of which progress could be traced in human societies through time, based on their increasing capacity for energy capture from the environment, which culminated in the emergence of industrial societies. However, energy capture cannot easily be measured, especially for societies which existed in the past, and it was proposed that a suitable proxy measure for its study in the past and the present would be a society's investment in social structure, defined in terms of social differentiation (Sahlins and Service 1960). Societies can be differentiated vertically, in terms of hierarchical levels, and also horizontally, in terms of the division of labour. The categorization of societies in terms of their degree of social differentiation was the basis of the enormously influential evolutionary scheme produced by Service (1962). His categories, from simplest to most complex, were band, tribe, chiefdom and state, with the implication of a general evolutionary progression from one to the next (Fig. 12.2). As we will see, his tribe and chiefdom categories correspond broadly to the idea of 'rank society'.

This latter category was introduced by Fried in reaction to Service and differs in certain important respects. First, Fried's concern was not with social *differentiation* but with mechanisms of social *integration*—how societies were held together. He, too, proposed a fourfold categorization with evolutionary implications: egalitarian society, rank society, stratified society, and the state. He specifically eschewed Service's 'tribe' category, since he argued that tribes as units were the result of the impact of colonial conquest on groups whose membership and interconnections had previously been much more fluid. In this chapter we are concerned with Service's 'tribe' and 'chiefdom' categories and with Fried's 'rank society' and, to a lesser extent, 'stratified society'.

Service (1962) saw his tribal level as more complex than the band, in that tribes possessed new forms of integration and were internally more diverse. However, the two were seen as similar in that they were egalitarian and did not have distinct organizations of political control or economic or religious specialization. Indeed, the basic residential units of tribal society were seen as alike—largely self-sufficient economically and with a great deal of autonomy; in fact, still characterized by what Durkheim (1933) called *mechanical solidarity*—the relatively limited solidarity arising from the fact that people in similar situations tend to have similar interests.

In this and many other respects, tribes contrasted with chiefdoms in Service's scheme, the latter defined as 'redistributional societies with a central agency of coordination' (Service 1962:144). The basis of the chiefdom was ecological, in that it was argued that chiefly territories were ecologically diverse so that different parts were suitable for producing different crops. In order for the whole population to acquire an adequate supply of the various resources, it was necessary for resources from each of the zones to go to the central agency, the chief, and then be redistributed to those areas which lacked that particular resource. Chiefdoms were thus characterized by *organic solidarity*, involving specialization and the mutual dependence of unlike parts, and the chiefs were the managers of the system. In terms of Service's scheme, the great contrast, and in effect the great transition in human history, was that between bands and tribes on the one hand and chiefdoms and states on the other, because it involved the loss of local autonomy.

In Fried's scheme the category of 'simple egalitarian societies' corresponded to Service's 'bands', whilst 'rank societies', the next step up from egalitarian societies, were those 'in which positions of valued status are somehow limited, so that not all those of sufficient talent to occupy such statuses actually achieve them' (1967:109); in other words, apart from bands, no societies are egalitarian. Rank societies were conceived to have a number of specific characteristics. They tended to have larger and denser populations and were usually agriculturally based. There was little in the way of specialized craftsmanship, and age and sex were the bases of the division of labour. Of particular importance in these societies was the emergence of formal descent principles, defined in terms of kinship relations and affecting people's rights to resources. Genealogy became important and the potential existed (and was frequently realized) for a hierarchical arrangement of kin to develop in terms, for example, of genealogical proximity to a particular ancestor. Rank societies, in Fried's scheme, are characterized by an ideology of kinship, whereas egalitarian or band societies have an ideology of co-residence.

In the economic sphere, the major process of integration was redistribution, as with Service's chiefdom category, but conceived on a smaller scale in that there could be village redistributors, one of whose key roles was the giving of feasts through which prestige was acquired. Such feast-giving depended on mobilizing the resources of the community and involved the redistributor in encouraging local production for such purposes. There were, however, few effective sanctions to maintain the authority of such leaders. On the one hand, it depended on success in feasting and other communal activities; on the other, it was associated with ritual leadership and the usually pre-eminent position of the leader in the kinship system as the living person nearest to the ancestors, in turn connected with the gods. However, Fried concluded, the power of groups or individuals of higher rank was distinctly limited, in that local communities were economically autonomous: the differences between egalitarian and rank societies were slight, since the new institutions impinged in only a minor way on everyday life. It was only at the 'stratified society' stage that economic dependence of the general population on the élite arose, associated with a differential distribution of the basic resources to sustain life, and for Fried this was a transitional stage on the way to the state. However, within his scheme there was potential for varying degrees of ranking within the same broad social blueprint, without the radical disjuncture present in Service's scheme, which contrasted bands and tribes with chiefdoms and states. Fried's view on this matter is paralleled by that of Sahlins (1968), whose study of what he called *tribal societies* suggested that these covered a range with chiefdoms at one end and segmentary tribes at the other, and that particular societies could oscillate through time between more and less ranked states.

RANK SOCIETIES AND CHIEFDOMS IN ARCHAEOLOGY

These neo-evolutionary ideas were introduced to archaeology in the late 1960s and early 1970s as part of the emergence of the 'New Archaeology' (see Chapter 2). Archaeology was rejecting its normative and culture-historical past in favour of new goals, and in particular an anthropological orientation towards the study of past societies. There were very few models available for such studies, especially those not concerned with early states and civilizations, for which, in any event, written sources of some sort were often available. Conventional history was largely concerned with the analysis of particular sequences of events over short periods, while the majority of anthropology was devoted to the examination of societies in the present. Neither was appropriate as a basis for social archaeology, whereas the neo-evolutionary framework of Service, Sahlins and Fried provided exactly what was felt to be wanted: a broad-scale view of human societies within an evolutionary framework. The fact that the framework was largely based on the comparative study of present or recently existing societies was an asset, because it offered an account of the functional principles of those societies to which archaeological evidence could be related. For those areas of social and economic life where archaeological evidence was unavailable, the detail could be filled in by a straightforward inferential process, because within a given stage there were relatively fixed patterns of social and economic relations: for example, if settlement pattern studies pointed to the existence of a centre in a region in a particular period, then redistribution could be assumed to be the mode of exchange. Inferences about past societies, especially prehistoric ones, had previously been regarded as beyond the grasp of archaeologists using archaeological evidence alone, but now a set of ideas was available which made them possible. Two types of archaeological project were particularly appropriate for realizing the new aims: settlement pattern studies based on archaeological survey, which could identify centres and their dependent sites; and cemetery analyses, since the differences between graves in terms of their monumentality or the quality of their grave-goods could apparently provide direct information on the relative social ranking of their occupants.

Two studies may be mentioned here as characteristic. Renfrew (1973) examined the distribution and scale of neolithic (*c.* 4000–2000 BC) monuments in the Wessex area of southern England and argued that the development of a series of chiefdoms could be traced over the course of this period, with the monuments, which represented large investments of labour, representing the chiefly centres. In another study Peebles (1971) analysed the burials from Moundville and surrounding sites belonging to the Mississippian of the south-eastern United States (*c.* AD 1000– 1500) and showed that there were marked differentials between them. In particular, the richest and most distinctive grave-goods were restricted to the Moundville ceremonial centre itself and to specific locations within it, where they made up about 5 per cent of the population in the Moundville II phase (Peebles 1987). On the basis of this and other evidence, he postulated that Moundville was an élite centre, dominating the surrounding area.

As we shall see below (pp. 879–85, 891–94), where they are presented at greater length, both these studies have in many respects stood the test of time, but the neo-evolutionary ideas which provided the background for them have been much criticized and it is to these criticisms that we must now turn.

CRITIQUE OF THE CONCEPTS OF 'CHIEFDOM' AND 'RANK SOCIETY'

One of the first issues to be subject to critical examination was the role of the chief or leader as redistributor. Earle (1977) examined the historic organization of Hawaii, where chiefdoms existed and where there was a great deal of ecological diversity. He showed that chiefs did not play the role of redistributor, despite the apparently ideal circumstances. On the contrary, local communities ensured their own subsistence by various means and the chiefs levied tribute from them to finance their own activities. The role of the chief, not merely as a redistributor but as a beneficial manager ensuring the evolutionary advance of his community, was called into question. The same argument was made on general grounds from a Marxist perspective (e.g. Gilman 1981): far from being beneficial, chiefs were exploiters of their societies, exercising their desire for power in circumstances where local populations could not escape them, for example where people were tied to their land as a result of such major investments in subsistence resources as irrigated or cleared fields.

Today, definitions of the term 'chiefdom' are more generalized. Earle (1997) defines a chiefdom as:

> a regional polity with institutional governance and some social stratification organizing a population of a few thousand to tens of thousands of people. Chiefdoms are intermediate-level polities, bridging the evolutionary gap between small, village-based polities and large, bureaucratic states…Characteristically the organization at this scale requires political hierarchy or an overlapping series of hierarchies for coordination and decision-making; the advantages gained by a few within such a hierarchy result in a measure of social stratification.
>
> (Earle 1997:14)

Other definitions take a rather different perspective. Feinman (1991:230) follows Wright in seeing them as forms of organization in which social control activities are 'externally specialized vis-a-vis other activities, but not internally specialized in terms of different aspects of the control process' (Wright 1984:52). In other words, there will be 'a supra-household decision-making structure or relatively permanent positions of leadership, but not the marked internal differentiation of such structures' (Feinman 1991:230).

Whereas Earle still sees the chiefdom as a useful, meaningful, and relevant category for characterizing societies, the proponents of Wright's view see it as referring solely to a political form and not to a type of society, since societies possessing this form of political organization can be in other respects enormously diverse (Feinman 1991:230). From this perspective the term 'chiefdom' may be a useful generalized label but offers little in the way of analytical usefulness (Drennan and Uribe 1987). In short, while there is still general agreement that the term usefully refers to societies which are not states but show some degree of centralized organization, it goes little further than that.

The same may be said for the term 'rank society', which has likewise been largely drained of its specific content and in particular has been subjected to detailed criticism by Khazanov (1985). As he points out, where leadership is present, which is more or less universally, 'there always exist formal or informal rules and selective criteria, regulating access to leadership and thus restricting the number of leading positions…The principle of limitation of leading positions is inseparable from the very essence of leadership and its functions' (1985:83), even in egalitarian societies. Indeed, one could take Fried's characterization of a rank society as 'one in which positions of valued status are somehow limited so that not all those of sufficient talent to occupy such statuses actually achieve them' (1967:109), and turn it around. In societies where statuses are achieved, such as the Big Man societies of Papua New Guinea, which Fried and others regard as rank societies, the process of social competition is such that there are indeed as many positions of valued status as persons capable of filling them (Khazanov 1985:85). If one takes Fried's criteria seriously, Khazanov concludes (1985:89), 'essentially, a limited number of societies, mostly the Polynesian ones, may be referred to as ranked on the basis of the criteria and characteristics suggested by Fried'. In fact, this is precisely because Fried's rank society is an attempt to universalize a local Polynesian phenomenon, the conical clan, 'a descent group in which all subgroups (lineages) and members are ranked by criteria of genealogical priority or proximity to the common ancestor' (Khazanov 1985:90).

In short, if we wish to continue using and working with the concept of rank society, we have to use it in a generalized way as simply indicating societies in which there are status and power differentials but social stratification is not marked and the state form of organization is not present. This is clearly pretty vague, and indeed even more so than the chiefdom, which at least has the notion of a centre. In particular, the question arises whether, in these terms, there have ever been any societies which were not rank societies.

THE POSITION OF RANK SOCIETIES AND CHIEFDOMS IN EVOLUTIONARY SEQUENCES

In what we may call the traditional neo-evolutionary view, these societies had precursors in the band (Service) and egalitarian society (Fried) categories. The basis for these categories were such hunter-gatherer groups as the Shoshone of the Great Basin in the western deserts of North America and the !Kung/San groups of southern Africa. The latter provided the classical model of what an original hunter-gatherer band should look like, with their small-scale egalitarian form of organization. Indeed, in neo-evolutionary terms, if the San hadn't existed it would have been necessary to invent them, because the evolutionary scheme, like its nineteenth-century predecessors, presupposed an initial undifferentiated form of organization out of which more complex forms could then develop. It now turns out, however, that the San were in a sense invented, at least as representatives of some original pre-Fall state of human society. Work has shown that they have a complex history of interaction with neighbouring groups, including episodes of pastoralist activity (see, for example: Kent 1993; Shott 1992). More generally, it has become clear that the hunter-gatherer societies available for study by ethnographers, and which have provided the basis for archaeological models, are largely marginal remnants pushed into harsh and remote corners of the world; there is no reason to believe that they provide valid models for the hunter-gatherers of the past. This belief has been strengthened by the increasing archaeological evidence for 'complex hunter-gatherers' (Brown and Price 1985), who do not appear to fit the standard egalitarian band model (see the final case study, pp. 902–3).

The basis for believing that many hunter-gatherers, as opposed to a few exceptional groups like those on the north-west coast of North America, were indeed non-egalitarian has been clarified by an important discussion on the difference between *delayed-return* and *immediate-return* systems of subsistence among hunter-gatherers (Woodburn 1980). In immediate-return systems, food is consumed by members of a group as soon as it is obtained, on a day-to-day basis. Delayed-return systems involve investment in such facilities as traps or fish weirs, or the need for storage, often associated with seasonal climates. Although they involve the use of wild resources, in the fact that returns are delayed such systems are comparable to agricultural ones, where crops need to be grown and animals reared. There is an initial investment which is only repaid later; thus groups practising such systems will have a greater commitment to staying together. The contrast, then, is not between hunting/gathering and agriculture, but between immediate and delayed return. Delayed-return systems involve defining rights and obligations between categories of people; inequality between households in terms of power, wealth and status is often present (Brunton 1989). In any event, as Ingold has pointed out, the number of cases of immediate-return egalitarian societies 'is so few, and their existence so hedged round by special circumstances, that doubts must inevitably arise as to the significance of these societies as constituting the supposed baseline of social evolution' (Ingold 1983:554, quoted in Brunton 1989).

If we accept this line of argument, we may suggest that human societies have always been characterized by varying degrees of inequality and social differentiation (*contra* Erdal and Whiten 1994). The problem then becomes not one of explaining the origin of rank societies, but accounting for their many and varied forms in different places over the course of human history.

However, though we can cast doubt on the idea that human societies evolved from some primeval egalitarianism, we can raise similar concerns about the extent to which, at the other end of the scale, chiefdoms must be precursors of states, as the standard neo-evolutionary schemes imply. Within the context of such schemes, 'something must precede states that is not even crypto-egalitarian, yet is not exactly state-like, and it requires a name' (Yoffee 1993)—hence the chiefdom. However, some time ago Sanders and Webster (1978) argued that chiefdoms were an alternative to state development and were typical of subsistence environments of low risk and low diversity. In a similar vein, it has recently been argued for the specific case of Mesopotamia that early states developed not out of chiefdoms but as a result of the emergence of socially differentiated households (Maisels 1987; Yoffee 1993). The basis of the argument is that chiefdoms and states are structurally incompatible with one another, since the former are organized in terms of kinship and lineages, while the key point about the Mesopotamian city-states was that their forms of organization subverted kinship links.

We are left with an enormously diverse range of societies which were not states and were not egalitarian, many of which seem to have remained in this situation for thousands of years—or rather, when specific societies disappeared, they were replaced by others with similar forms of life and organization. Within these societies, we may distinguish those characterized by some degree of centralization from those which were not, but we should not think of the distinction as a major qualitative break, nor should we imagine that all centralized societies conformed to our idea of the chiefdom (see pp. 871–72), although some undoubtedly did.

EXPLANATIONS OF CHANGE IN RANK SOCIETIES

Most studies of change in rank societies have been concerned with how they emerged from egalitarianism or developed into states, a perspective we have already criticized. Although a great variety of explanations emphasizing different factors have been employed in the explanation of change, especially change in the direction of 'more complex' forms of society, undoubtedly the most important group has been social circumscription models (Carneiro 1970). Societies are constrained to change their way of life and form of organization as a result of the appearance of new pressures, whether internally generated or from outside, which they cannot escape. By far the most important cause cited for the growth of circumscription has been population pressure, whether in the form of the expansion of neighbouring groups, leading to competition for resources and ultimately warfare, or internally generated population growth leading to subsistence degeneration and the emergence of new managerial requirements if society is to survive. These have been seen by their proponents as universal models, relevant to increased ranking at one end of the scale and the emergence of the state at the other (Johnson and Earle 1987).

Although population pressure may be a relevant factor in certain circumstances, it is increasingly clear that relationships between this and other factors are complex and variable, especially within the range of societies being considered in this chapter. In an ethnographically based study of some non-state American societies, Feinman and Neitzel (1984:77–78) found that total population, population of the largest settlement, number of status markers, number of functions of leaders, and number of administrative levels failed to form the closely related group of traits that one might have anticipated for the chiefdom category, nor could they find an association between their status, leadership and administrative variables for this group of non-state societies.

Feinman and Neitzel's dataset has been reanalysed by Upham (1987) to investigate further aspects of the relationship between population and social organization in non-state societies. Of particular interest is his examination of population thresholds. At a global level there are clearly relationships between the population sizes and densities of societies and aspects of their organization: when one is contrasting small hunter-gatherer groups with modern urban societies this is hardly surprising. Much more interesting is the population scale at which organizational distinctions appear to be relevant. Such aspects of hierarchy and complex organization as the control of storage, the presence of special burials, the use of forms of obeisance, the existence of special food types, and the presence of a number of administrative levels in the society, all had a statistically higher probability of occurrence in societies with total regional populations larger than *c.* 10,500. In fact, the threshold varied for different attributes: for special burials it was 9,200, while for special food and control of storage it was 14,000. It is thus apparent that it is only at a relatively large scale that issues of population size become relevant. Furthermore, the results say nothing about the role of population size in the appearance of these phenomena: they merely indicate that societies with populations above the threshold are more likely to possess those attributes.

A great variety of other factors has also been advanced in studies of the development of ranking and inequality and some of them will be seen in the case studies below. However, it is clear from the earlier part of this chapter that explaining the development of ranking, complexity, or stratification is not, as such, the issue. Primeval egalitarianism cannot be assumed as the default state of human society, nor population as the motor which drove it away from that state. What we have is an enormous range of variation which cannot be placed straightforwardly in an evolutionary line even if that were desirable.

CASE STUDIES OF THE EMERGENCE OF CHIEFDOMS

The vast majority of the concrete work which has been carried out subscribes to some version of the evolutionary perspective. Nevertheless, much of it is extremely interesting in its demonstration of what may be achieved using archaeological evidence. Its strength, however, lies in its documentation of archaeological sequences, rather than in the explanations offered for them. Three case studies are presented and discussed below.

Neolithic and bronze age Wessex

In 1973 Renfrew postulated the evolution of chiefdoms in Wessex during the Neolithic, on the basis of the labour investment in monuments: he suggested that the chiefdoms continued into the Bronze Age but became different in nature since they were now evidenced by burial mounds with rich grave-goods (Renfrew 1973, 1974). His ideas have been developed and to some extent modified, especially by Bradley (1984, 1991). The account which follows is based particularly on Earle (1991).

During the period 4000–3000 BC, settlements were distinctly ephemeral and the major demands on labour were made by funerary monuments—long mounds (Bradley 1991). These monuments, present from the beginning of the sequence, already point to at least some symbolic differentiation among the population, in that the number of human remains found in the burials is too small to account for the whole of the local population—it seems likely that successive phases of the burial ritual were increasingly selective (Bradley 1991:50). In other words, even at the beginning of the sequence we are dealing with societies where symbolic distinctions were already in existence between different elements of the local population.

During the course of this period, towards *c*. 3500 BC a series of 8–10 ‘causewayed enclosures’ were also constructed in Wessex. These are characterized by 1–3 concentric ditches and banks enclosing areas of 1.5–7.7 ha. A number of activities seem to have gone on at these sites, including feasting, exchange, and the exposure of the dead; they may have been used for seasonal aggregations (Bradley 1991:50). Both the funerary monuments and the enclosures were apparently constructed in segments, possibly by different work parties, and this may reflect the participation of separate communities in their construction. The function of the causewayed enclosures seems to have changed through time: some became residential and defensive in nature and there is evidence that some of these were attacked and destroyed. Bradley (1991:50) draws attention to the marginal position of the enclosures in relation to settled areas and to the fact that they were often built in woodland to argue that they are unlikely to have been the centres of social territories, but Earle takes the two-tiered settlement pattern implied by at least the later phases of the enclosures as evidence for a political arrangement of simple chiefdoms. On the basis of the distribution of the enclosures and the long barrow funerary monuments, Earle postulates the existence of four distinct polities believed to represent chiefdoms, made up of local groups which worked together to construct larger monuments, together with a number of smaller less centralized groups.

In the subsequent later neolithic phase (3000–2200 BC), settlements continue to be ephemeral although later neolithic lithic scatters are denser and more extensive than earlier periods, perhaps suggesting reduced mobility, and the Wessex landscape comes to be dominated by a different kind of monument: the henges. These are circular banked enclosures with a ditch typically inside the bank, varying very considerably in size (0.1–12.5 ha) as well as in elaboration. Like the causewayed enclosures which preceded them, the larger ones required enormous numbers of man-hours for their construction, but Bradley (1991:53) suggests that this was now organized on a different and more centralized basis, as there is no longer any indication of the ‘segmentary’ construction seen in the causewayed enclosures. The largest henges are postulated to have been the centres of individual polities (Fig. 22.1), with the smaller ones serving more local populations.

Although the henges continued to be used and modified for a considerable period of time, from around 2200 BC round burial mounds began to be constructed, eventually over 8,000 altogether. These are often complex monuments used for a series of burials and enlarged over time, but they are much smaller in scale than the henges and could have been constructed by much smaller-scale groups. What distinguishes at least some of them is the deposition of grave-goods, such as copper, gold and amber items, which must have been obtained by long-distance exchange, a phenomenon which had begun in the Later Neolithic. The small scale of the burial mounds might be taken as an indicator of a change to a more localized form of

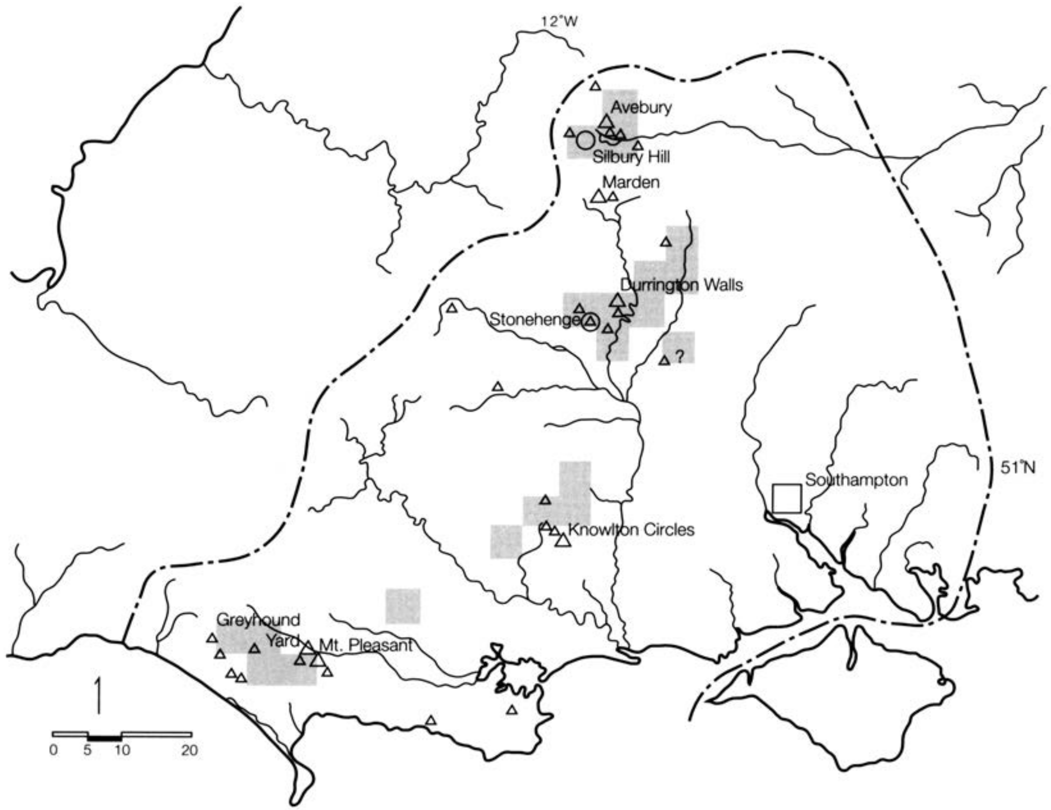


Figure 22.1 The location of late neolithic and early bronze age monuments in Wessex. The triangles indicate henges, large for the major monuments. The circles indicate other special monuments. The shaded areas represent 25 km2 survey blocks that contain 50 or more round barrows. The Avebury, Stonehenge, Knowlton and Mt Pleasant monument complexes represent the suggested ceremonial centres of group territories. Source: Earle 1991.

organization; however, although they are widely scattered across the landscape, the barrows are concentrated around the four pre-existing major henge monuments (Figs 22.1, 22.2), and the fact that most of the more exotic grave-goods also tend to be in burials within the major concentrations suggests that the region continued to be divided into four major political units centred in the area of the monuments.

Around 1400 BC this long-lasting pattern changed. Whereas previously settlements had been ephemeral and difficult to detect archaeologically, the Wessex landscape now came to be characterized by new large-scale field systems and associated small settlement enclosures, indicating the first appearance of mixed arable subsistence farming. As Earle says (1991:93), the overall impression is that, in contrast with the preceding periods, the landscape was divided into many small political units. The subsequent Early Iron Age was characterized by the appearance of hill-forts, defended enclosures often with multiple banks and ditches, but the distances separating even the larger ones are small, averaging *c.* 6.5 km, emphasizing this small-scale pattern. Earle (1991:94) suggests that the chiefdoms of the Early Bronze Age had fragmented and that political units remained small because their foundation was now the control of subsistence resources, seen in the field systems and centralized storage facilities, whereas previously it had been based on the control of people and wealth.

Suggesting explanations for the pattern of change observed is very problematical. The earlier neolithic causewayed enclosures may have been the centres at which local groups who recognized themselves as in some way part of a single larger entity came together for occasional ceremonies. What is not at all clear is how this system came to be transformed into that characterized by the henges. In this case there are much stronger grounds than for the earlier neolithic monuments to think in terms of a regionally centralized form of organization focused on people with a distinctive social status and special powers. It is noteworthy that, although one can apparently detect the same four regional units as in the Earlier Neolithic, the ‘centres’ are now more central and in a better position to have the kind of role they are supposed to have in centralized organizations. Furthermore, as Earle (1991:96) says, the major henge monuments with their enormous external banks and internal ditches may well represent sacred spaces for ceremonies, involving the separation of the officiants from the rest of the population. Their legitimacy was supported by their identification with universal cosmological forces, exemplified by the celestial orientation of some of the monuments, contrasting with the emphasis on ancestors in the Earlier Neolithic. However, rather than suggesting that the monuments and their rituals simply legitimized the power of an élite group, it is at least as plausible to suggest that it was the process of building the monuments and being associated with the rituals within them which actually created the central power and the polity around it, as a newly imagined community perhaps based on a longer-standing feeling of common identity (Kertzer 1988).

Figure 22.2 The Stonehenge area and its monuments. Source: D.V.Clarke (1985) *Symbols of Power,* Edinburgh: HMSO.

The extent of that power initially and the spheres in which it was operative are more or less impossible to assess, although clearly it involved enough control for the labour to be organized for the construction of the monuments in what may have been a process of competitive emulation between different groups. Bloch (1977) has sketched out the kind of process which may be relevant to the ensuing institutionalization of power by its holders:

> They do this by creating an office of which they are the legitimate holders, but which has reality beyond them. This is done by gradual ritualization of the power-holder's communication with the rest of the world and especially his inferiors. As this ritualization process proceeds, communication loses the appearance of a creation on the part of the speaker and appears like repeats of set roles specified by the office which appears to hold him. Reality is thus reversed and the creation of the power-holder appears to create him.
> (Bloch 1977:330–31)

However, neither the power-holders themselves nor the rest of the population can completely see through this situation: both subscribe to some degree to the values being promulgated. The process is one of 'negotiation' in day-to-day and year-to-year practice. One relevant analogy may be with aspects of the caste system, in which high ritual status is associated with greater power and influence, but not necessarily wealth, and in which part of the political process in the contesting of caste positions and rights centres on such issues as what clothes people are entitled to wear (Kertzer 1988:110–13). Such processes, of course, will be centred on the symbolic resources existing at the time in that particular place.

In other parts of Britain henges were less important, and during the period of henge construction there is increasing evidence of long-distance exchange and the deposition of burials with exotic goods. From *c.* 2200 BC onwards these connections come to be extended to the European mainland. In Wessex, however, these developments were slow to penetrate, although when they eventually did the burials of the region represent a concentration of exotic materials not matched elsewhere in Britain. This is no doubt a reflection of the special nature of the local hierarchies, who on the one hand may have been able to call on greater wealth, for example in the form of animals, from surrounding populations, and on the other may have exchanged esoteric knowledge for foreign valuables (cf. Harrison 1993).

The end of this system may have come about because of the strain it imposed on the landscape. Although there is little evidence of agricultural intensification during the Early Bronze Age, it is clear that there was an expansion of the settled area onto marginal soils, which came under pressure just as the long-occupied areas started showing signs of soil erosion (Bradley 1991:55). The consequent decline in available resources, which may have coincided with or been the cause of loss of control of long-distance exchanges, led to the decline of the system. As we have seen, it was replaced by one in which political units were much smaller in scale, subsistence was centred on fixed mixed agriculture, and social organization was based on the control of the resources for this, including the ownership of arable land.

Polynesia

It was the ethnography of Polynesia which provided much of the basis for the construction of the neo-evolutionary typologies discussed above. However, in recent years there have been enormous advances in the archaeology of Polynesia which have led to the construction of an overarching model of diachronic change in Polynesian society (Kirch 1984).

At the time of European contact, different parts of Polynesia had widely divergent forms of society. Kirch has developed a phylogenetic model of Polynesia, in which the colonization of the Pacific is associated with a branching evolution of social forms from an original common ancestral form which he calls Ancient Polynesian Society. The origins of this lie in the so-called Lapita cultural complex, which had spread eastwards to the Fiji-Tonga-Samoa area by *c.* 1500 BC. Its reconstruction is based on both archaeology and linguistics. Central to this original social form was the conical clan (see p. 875), in which rank was determined on the basis of proximity to a founding ancestor. The ranking system and associated kinship terminology made an important distinction between senior and junior individuals, although initially there were no elaborate material or behavioural distinctions associated with rank differentials. These societies had as their titular heads hereditary chiefs, belonging to the senior line of the conical clan, who formed a critical link in the chain from the gods to the earth and thus occupied the central role in rituals of production. This role was of key importance in the subsequent development of Polynesian societies. In Kirch's model these basic structural elements were carried with them by all the colonizing groups as they moved out into the Pacific, and the key to understanding what went on is the interaction between the structural elements which the people brought with them and the conditions on the new islands which they colonized. However, more recently it has been argued that Kirch did not give sufficient attention to the role of continued interaction between islands, subsequent to their initial colonization (Terrell *et al.* 1997).

In all the islands which were successfully colonized, population grew rapidly, leading to densely settled societies in which competition for land and other resources was pervasive. The high level of resource exploitation had a serious impact on local ecosystems. The result was the development of intensive forms of production, including irrigation. However, a further factor leading to intensification was the demands of the chiefs on their populations; the development of such mechanisms as irrigation systems provided them with a further source of control. Warfare also played an important role in the transformations which Ancient Polynesian Society underwent, and not solely because of local demographic or ecological conditions:

it was both a means of preserving the divine power and status of chiefs and an opportunity for rivals to usurp that status and achieve positions to which they were not entitled on hereditary grounds. Indeed, in some places the basis of political power underwent a transformation from one based on descent to one based on the ability to apply coercive force, with repercussions for economic organization as well as religion.

One Polynesian trajectory is represented by Easter Island, which was reached in the first half of the first millennium AD. The initial colonists brought with them the concept of *ahu* or temple, which was then locally developed. By AD 1000 many such monuments, including the famous statues, were being constructed (Fig. 22.3). It is generally agreed that the *ahus* were constructed and used by ancestor-based kin groups. Examination of the stone quarries suggests the activity of many groups working independently of one another. Subsistence was based on intensive dry-field agriculture, but fishing was also important. During this period a developed form of the Ancestral Polynesian lineage system characterized the island, in which the direct descendants of the original founding chief had high rank and provided a paramount chief whose power was more ritual than secular.

However, it appears that by *c.* AD 1300 Easter Island was chronically overpopulated and environmental degradation was setting in as a consequence. The result was endemic warfare and social disintegration. Stronger groups seized the land and enslaved the populations of weaker ones. Archaeologically, the developments are indicated by the appearance of huge numbers of flaked obsidian spearheads, the end of *ahu* construction, and the deliberate destruction of the *ahu* and their statues; and by settlement pattern changes, especially the occupation of defensible caves. Power was taken over by warriors and the warring groups organized themselves into two loose opposing coalitions. This was the state of Easter Island when it was first discovered by Europeans.

In this case, then, there was no trend towards increasing hierarchization or organizational complexity, but rather one towards devolution and destruction: population increase and pressure on resources do not always call forth the organizational innovations which were believed to be associated with them in the traditional evolutionary models.

A rather different pattern is visible in the Marquesas Islands (Kirch 1991). Archaeological evidence suggests that population remained fairly low until *c.* AD 1100, when a population upswing began, seen in greatly increased numbers of sites and the appearance of new forms of site, including fortifications. By AD 1400 population had outstripped resources. Resource degradation can be clearly seen in the archaeological record, including the erosion of arable land and the depletion of wild foods, including the extinction of a number of bird species, leading to an intensification of breadfruit cultivation and increased pig husbandry and pit storage, whilst human flesh may also have become a significant part of the diet. There were also changes in monumental architecture and settlement patterns, including large-scale labour investment in the *tohua* ceremonial centres, and domestic architecture became more elaborate and a basis for prestige distinctions. After AD 1400 there was a rapid increase in the number of *me'ae* temple structures. In the historic period these were inhabited by powerful ritual specialists, again a development of an original Ancestral Polynesian concept, and the increase in the number of *me'ae* structures may be an index of their growth in power and prestige. At the same time there was a general population shift indicative of pervasive warfare: whereas earlier the people had lived in small hamlets scattered along the coast, during the population increase phase between AD 1100 and 1400 and afterwards the population moved to the inland valleys, to situations which were more readily defensible and which were often further strengthened by means of fortifications.

These changes were not, in Kirch's model, *determined* by the ecological degradation and population increase which occurred. Rather, these were forces affecting the evolution of the Polynesian socio-political organization of the islands' inhabitants. In this case the pressures made it possible for rivals to usurp the position and roles of the traditional chiefs, rather than enabling the latter to strengthen their power. Shaman priests, who achieved rather than inherited their position, were able to use ecological crises to suggest that the traditional chief's inherited sacred power was no longer effective (Kirch 1991:141), while competition for resources enabled warriors to achieve greater secular power (Fig. 22.4).

These trends developed still further in the subsequent Classic period after AD 1400, leading to the situation found at first European contact. Production and storage increased, and because the storage facilities were controlled by the élites, they were increasingly used for their own purposes. Prestige rivalry and competition increased at two levels: inter-tribal competition for scarce resources; and within-group competition between the traditional chiefs, shaman priests, and warriors for control over the group's resources.

Unlike some of the other Polynesian islands, such as Hawaii, the societies of the Marquesas did not approach early states in their complexity or population. Rather, despite their similar social, economic, and cultural starting points, the process of competition tended to destroy its own conditions of existence through social violence and the destruction of the means of production (Kirch 1991:143). Here again, 'the evolution of chiefship did not proceed towards increased and encompassing hierarchy' (Kirch 1991:143).

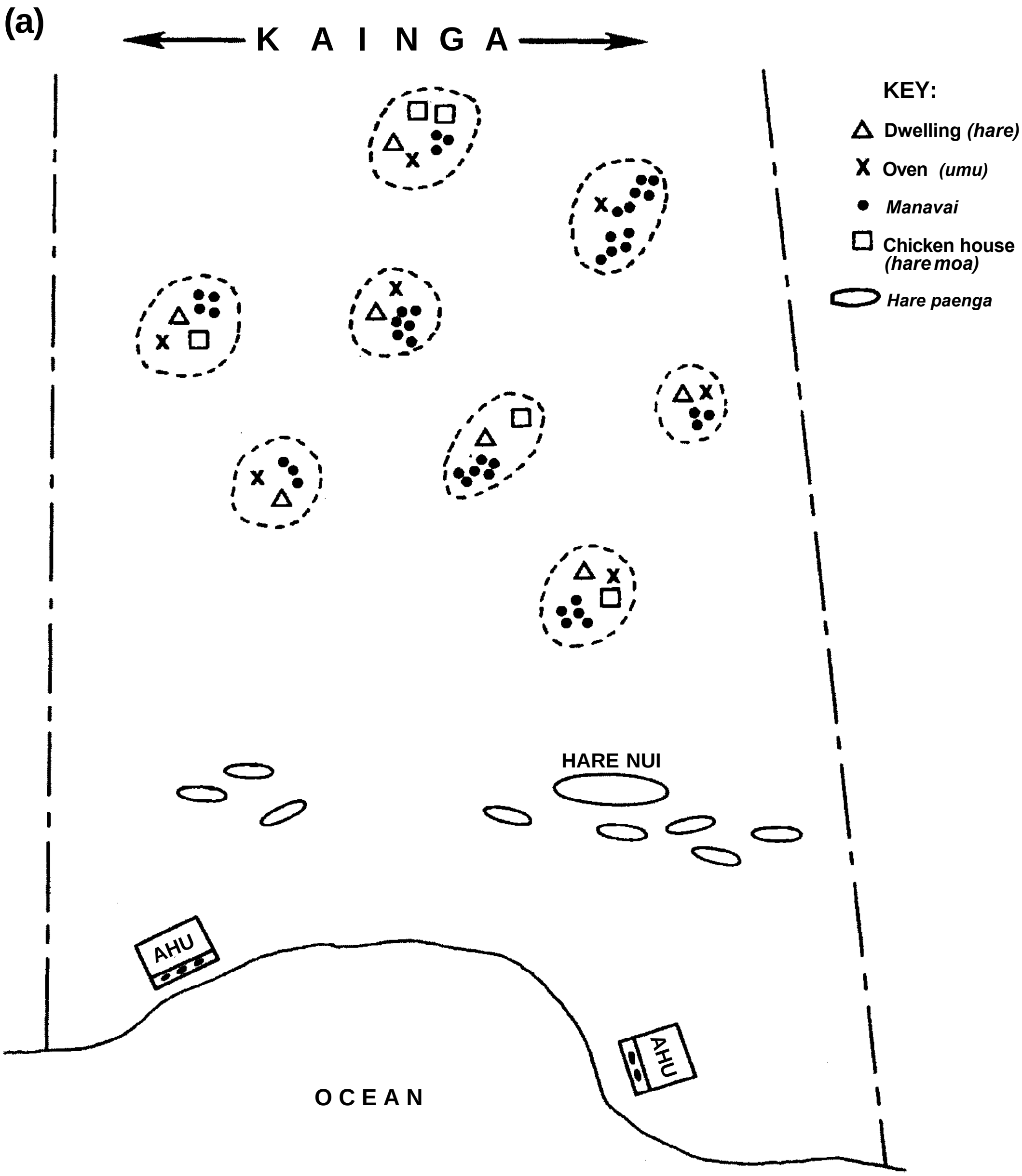
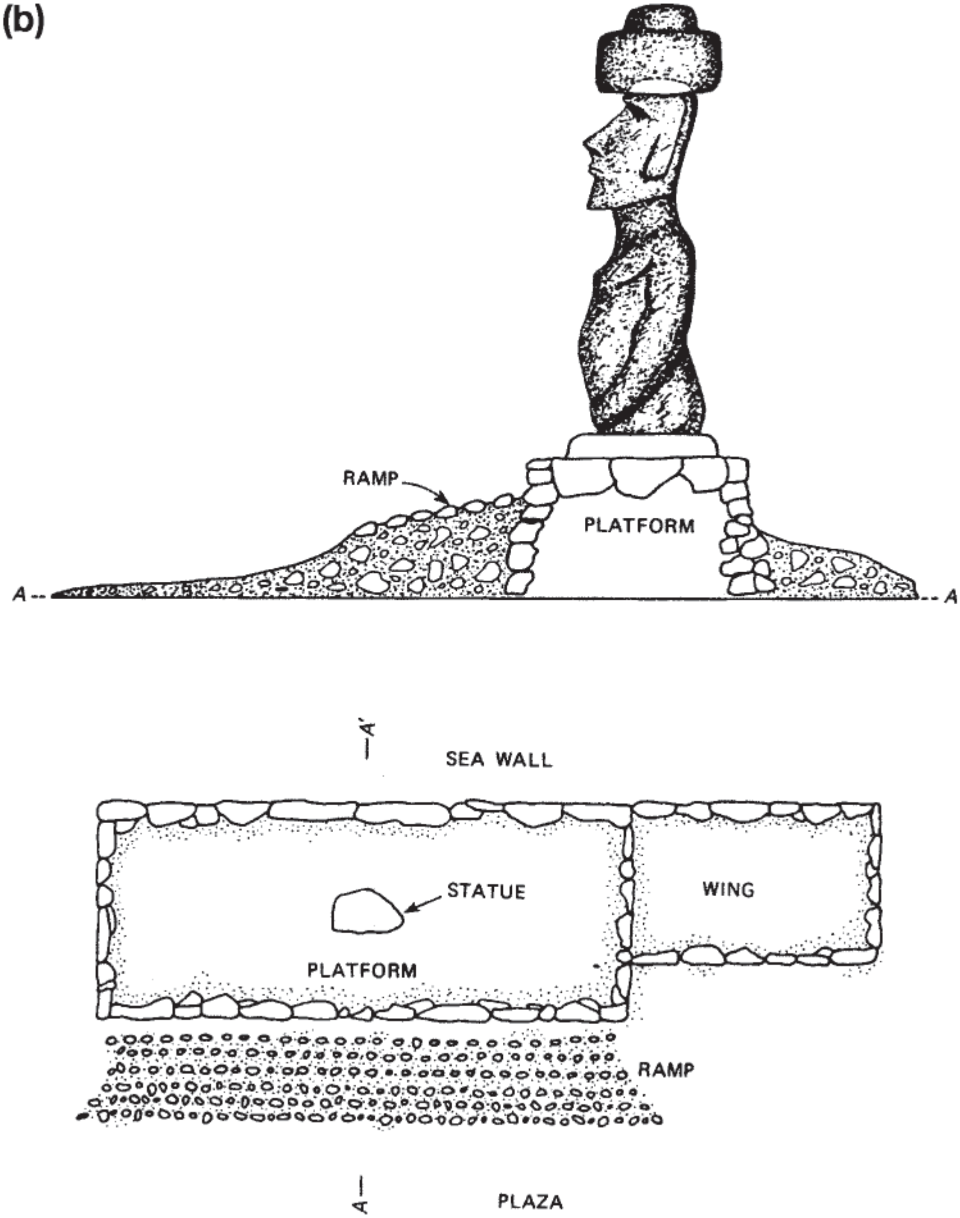


Figure 22.3 (a) Diagrammatic representation of Easter Island settlement patterns, with *ahu* (temples) and residences of high-ranking households near the coast, dispersed commoner households inland, (b) Plan and elevation of a typical Easter Island *ahu* or temple. Source: Kirch 1984, figs 91 and 90.

(b)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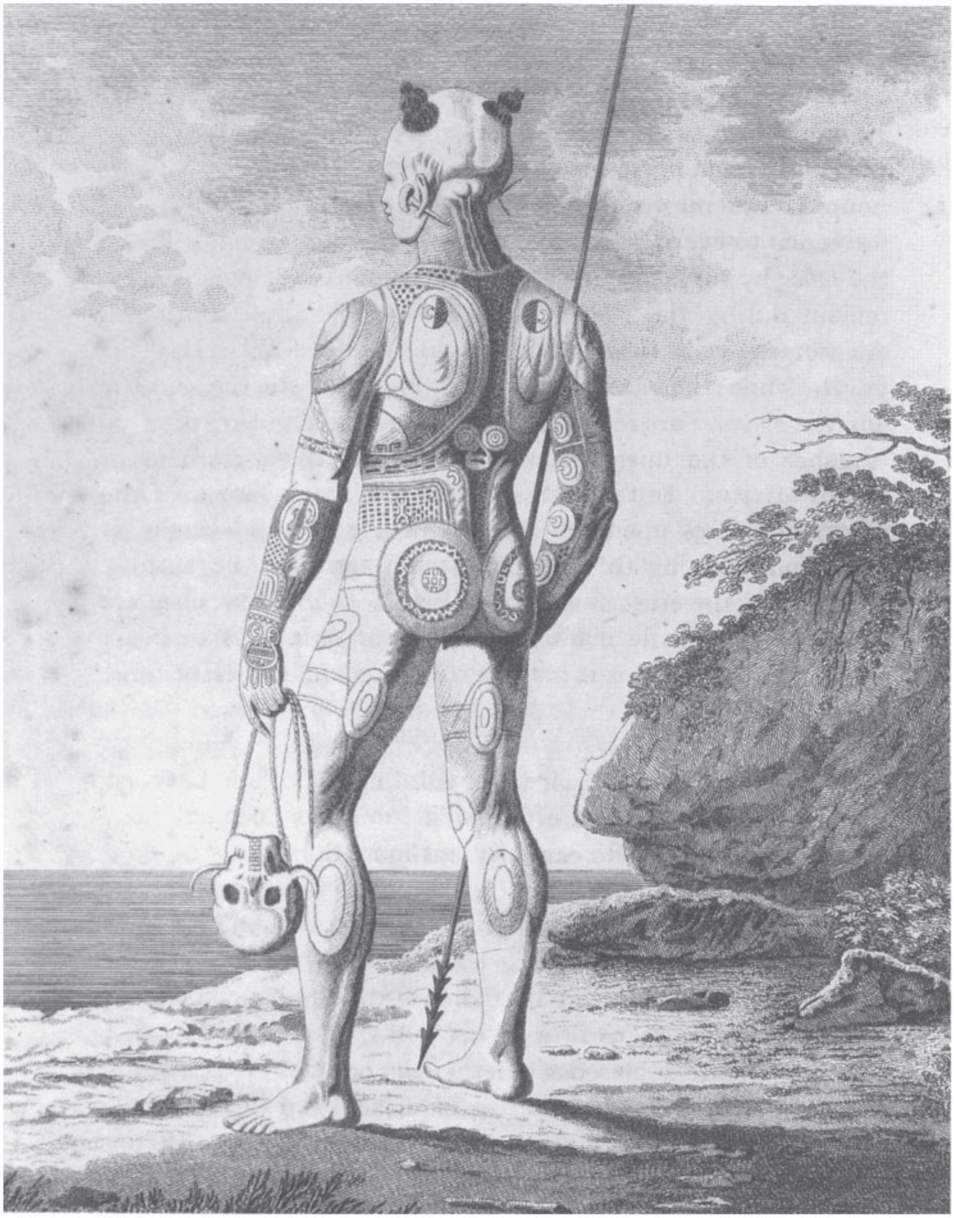

Figure 22.4 A Marquesan warrior with trophy skull, as sketched during the voyage of Krusenstern in 1803. Source: Bishop Museum, Hawaii.

Moundville and the Mississippian

Unlike the Polynesian examples, where we have evidence from linguistics, genealogies, and ethnohistory as well as archaeology, our knowledge of the chiefdoms of the south-eastern United States *c.* AD 900–1500 is based entirely on archaeological evidence. This case study focuses on the site of Moundville and its region in the Black Warrior Valley in Alabama (Peebles 1987; Steponaitis 1991; Fig. 22.5).

At the beginning of the sequence, *c.* AD 900, there is a settlement pattern of small villages with estimated populations of 50–100 people, as well as much smaller, possibly seasonal, occupation sites. Despite variation in village sizes, there is no evidence for any social differentiation between them, in that no sites are known to possess mounds or elaborate burials. Steponaitis (1991:97) postulates a situation characterized by autonomous villages and a relatively egalitarian society. Around

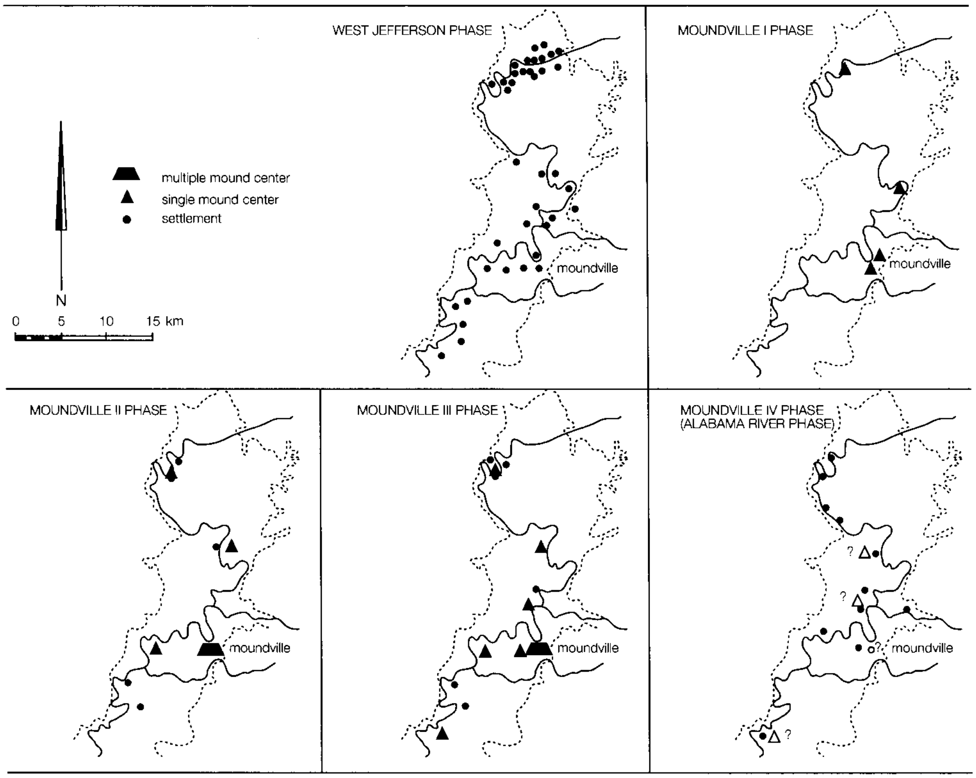

Figure 22.5 Major settlements in the Black Warrior river valley AD 900–1600. Source: Peebles 1987.

AD 1050 there were major changes in this pattern. Single mounds were built at four of the previous villages and some of these had nearby cemeteries which included elaborate burials containing exotic grave-goods. Mound construction coincided with a change in settlement pattern, in which the previously relatively nucleated population spread out across the landscape; the mound sites are assumed to have been centres for the dispersed population. At this point there appears to have been no difference between Moundville and any of the other centres in terms of their social or political standing. However, the area around it seems to have had an unusually high population density, despite the fact that it had no obvious advantages in terms of subsistence resources.

When Moundville became the dominant political centre around AD 1200–1250, a very extensive ceremonial area was laid out and an extensive programme of mound construction begun which lasted until *c.* AD 1500. Other centres continued to exist but orientated towards supporting Moundville. The centres with the largest mounds are those furthest from Moundville, where more labour was available for local use and Moundville's control was weaker. Development as a ceremonial centre led to a drop in the local population at Moundville. Presumably residence there became more exclusive and was restricted to members of the local élite and their retainers. It has been argued that this group was supported by tribute, seen, for example, in the differential distribution of deer body parts in élite versus non-élite rubbish deposits (Steponaitis 1991:200). But although the population *living* at Moundville decreased, it is clear that it was a burial centre for a much wider area, a point which clearly emphasizes its ritual role. Differentiation in the burials suggests very marked social distinctions, with a small group of burials, about 5 per cent of the population, accompanied by very elaborate grave-goods and interred in or near the mounds. These individuals also seem to have had a superior diet and health, including a lesser likelihood of injuries.

Around AD 1500 the polity centred on Moundville began to collapse: there were fewer burials, whilst burial and further mound-building began at outlying centres. Shortly afterwards all the centres, including Moundville, fell out of use, the population once more became aggregated into large villages, indications of social differentiation except in terms of age disappeared from the burials, and the health of the population deteriorated. A century later the area had been largely abandoned (Steponaitis 1991:202–3).

Subsistence developments may have been some sort of precondition for this dramatic pattern of rise and collapse. Around AD 900 subsistence was based on a mixture of wild and cultivated resources and maize represented less than one per cent of the diet, but around AD 1000 there was a rapid increase in maize production, which came to represent half the diet. Craft activity also changed over the period: between AD 900 and 1050 the manufacture of shell beads occurred in every village, whereas after that date it declined and the manufacture of items from exotic materials was largely restricted to the local centres. Indeed, after *c.* AD 1250 it was largely restricted to Moundville itself, an indication that it was most probably being carried out by attached specialists (Brumfiel and Earle 1987) dependent on the local paramount chief and carefully controlled for social/political reasons.

Apart from its use as evidence for the pattern of political centralization, the settlement pattern can also provide a basis for inferences about the prevalence of warfare, on the assumption that settlement nucleation represents a response to warfare that is intense and/or unpredictable. This would suggest that conflict was frequent in the period AD 900–1050, lessened during the *floruit* of the Moundville centre, but rose again as the latter declined, an argument supported by the distribution of skeletal evidence for injuries. The evidence for long-distance trade also shows a pattern related to the emergence and decline of Moundville: a jump in the import of marine shell beads and greenstone apparently occurred *c.* AD 1000 and foreign materials continued to increase until *c.* AD 1200, when Moundville became the paramount centre; the succeeding period saw the highest frequencies of exotic materials in burials, until a drastic decline *c.* AD 1500, some time before the collapse of political centralization, at a time when there are no signs of decline in production and consumption of locally made goods.

It seems clear that there is some kind of relationship between all these different developments; it is its nature that is the issue. The argument that has been advanced in the past—that centralization arose as a means of organizing production to avoid large-scale crop failure—does not seem to work, since it has been demonstrated that the risk of such failure was virtually non-existent (Scarry 1986, cited in Steponaitis 1991). Steponaitis integrates a number of lines of evidence. The early, relatively egalitarian, phase of the sequence was a time of conflict and competition, during which the production of such craft items as beads and beaded clothing greatly increased. These may well have served as exchange items in social transactions associated with the gaining of prestige. At the same time, the developments in the subsistence economy led to a system which was capable of producing much greater amounts of surplus than previously, and thus of providing the basis for new political developments. The positive feedback between prestige competition and increased production led to growing social differentiation in which the emergent élite were eventually able to 'symbolically split themselves off from the commoners by placing their residences atop mounds' (Steponaitis 1991:214). These mounds were most probably regarded as sacred—indeed, they had forerunners in the region which had been used to delimit areas used in funerary rituals; thus the new élite was in effect appropriating this symbol as an aspect of legitimation. The centralization of regional burial may be seen as part of this same phenomenon.

During the Moundville I phase, *c.* AD 1050–1250, when there were four regional centres, the manufacture of socially valued goods was increasingly restricted to these centres, at the same time as the acquisition of exotic goods through long-distance exchange also increased. By the end of this phase, regional political activity was characterized by a 'prestige goods economy' in which the acquisition of exotic goods both demonstrated the power of the élite and enabled them to control their followers through limited redistribution of the less important items (Peebles 1987; Steponaitis 1991:214). As a result of such processes, Moundville itself emerged as a paramount centre, for reasons probably connected with its greater population. This was not because of a pressure on resources leading to a requirement for greater management; rather, a larger population meant a greater aggregate production, of which a portion could be diverted to the newly emergent élite 'in return for' their ritual services and their limited distribution of exotic goods.

The centralized system remained in existence for *c.* 300 years before the collapse which has been described above. Steponaitis (1991:216) is sceptical of the view that its demise was associated with the arrival of Europeans, noting that the decline seems to have begun before the earliest European incursions. The latter may have merely contributed to a process which was already underway as a result of such factors as the severing of long-distance exchange routes, which may have arisen from declining success in warfare with neighbouring groups, and declining surpluses. Once Moundville lost its dominance, competition developed within the region, especially for hunting territories. The result was warfare, a decline in the health of the population, and eventually a decline in the population itself.

ALTERNATIVE CONCEPTUALIZATIONS

The three case studies described in the preceding section may all be considered classic archaeological examples of the development of rank societies/chiefdoms, in that we see the emergence of social-political units which are in some way regionally centralized, with clear evidence of social hierarchies. All of them confirm the arguments outlined earlier about the role of population pressure. In two of the cases— Wessex and Moundville—there is no suggestion of such pressure. In the case where it is evident, the two Polynesian examples, the result is the appearance of what we may call, if we wish to make a value judgement, social pathologies, endemic warfare, and collapse, not the emergence of new managerial capacities. On the other hand, large regional populations, so long as they do not lead to pressure, may well be an enabling factor or precondition for the development of such centralized polities. However, there is no sense in which any of these societies could be seen as going on to become states in some inexorable evolutionary process. The Moundville system collapsed after 300 years, again leading to warfare. Wessex is perhaps more unusual in that there is quite good evidence that the same pattern of polities remained in existence for *c.* 1,500 years, from the beginning of the Neolithic to the end of the Early Bronze Age. Here too, however, the evidence suggests that when pressure on resources did finally develop, the system collapsed.

Moreover these studies, important and interesting though they are, in many respects do not challenge some of the basic assumptions of the neo-evolutionary school, in that all involve increased centralization of organization (and thus increased complexity in terms of the standard definitions), and movement towards more hierarchical social relations, or even stratification in Fried's sense. Broadly speaking, in other words, none of them challenges the view that there is really only a single important dimension in terms of which social change can and should be studied. But even if one accepts that this is true of the cases just presented, and it is certainly arguable in the case of Wessex, it does not mean that this is so universally. Furthermore, again in at least the Wessex example, explanations for the emergence of the phenomena described are distinctly lacking, perhaps as a result of an inadequate conceptualization of what needs explaining.

There are other schemes available which divide up social reality in rather different kinds of ways, or disentangle some of the strands in social patterns which have usually been bundled together. For example Flanagan (1989), in discussing hierarchy in simple 'egalitarian' societies, distinguishes between:

1 Social stratification, referring to the dominance of entire communities which endow all their members, irrespective of age and sex, with prerogatives and privileges over all other members of the dominated communities.
2 Hierarchy, implying the existence of inequalities between persons.
3 Complexity, usually referring to organizational arrangements, especially the number of administrative levels and the differentiation between the units which the administration manages.
4 Egalitarian ideologies, which are 'equality of opportunity' ideologies: societies espousing these may have enormous inequalities in both material resources and access to power, attributed to the differential abilities of the people concerned.
5 Egalitarian practices, or equal-outcome systems, where measures are taken to override and negate any differences which might emerge.
6 An autonomy dimension, distinguishing between situations in which individuals have high degrees of autonomy from those where it is low; this may relate to the extent to which monopolies of various kinds can be created within societies.

Flanagan further suggests that there are no egalitarian societies, but that there may be egalitarian contexts or situations. Even societies which in many respects are rigidly hierarchical may contain such situations, while so-called egalitarian systems may contain insidious hierarchies. He, like others such as Trigger (1990), suggests that the interesting question may not be how hierarchical societies arose, but how it is that some societies have had extensively egalitarian situations which have been strongly maintained. Some of the complexities in characterizing hierarchy and inequality which Flanagan explicates concern gender, which in many societies is a key idiom of domination/subordination.

THE ARCHAEOLOGY OF GENDER IN RANK SOCIETIES

Two examples are described here to illustrate the likely complexity of gender relations in rank societies.

The first concerns the importance of gender relations in the preparation and consumption of food discerned by Hastorf (1991) in the archaeological evidence associated with the incorporation of an Andean chiefdom into the Inca empire, taking into account local ethnographic and historical information about female roles in food preparation. Examination at settlement sites of the spatial distribution of botanical remains, especially those of maize, suggests that, as the region lost its autonomy, there was increased circumscription of day-to-day female activities within the household, seen in the more restricted distributions of botanical remains of crop- and food-processing. At the same time, the quantity of maize processed increases, suggesting increased female processing labour for the preparation of a crop which historical data indicate was largely consumed by males.

The argument is expanded through the use of skeletal evidence from the two phases. Isotope analysis of male and female skeletons indicates that in the earlier phase their diet parallels the local production data, including a small amount of maize, and that there were no differences in this respect between males and females. Inasmuch as historical evidence suggests that maize was mainly consumed in the form of beer used in ritual/political gatherings, this suggests that both genders participated equally in ritual events, provisioned by female labour. In the subsequent Inca phase, however, the diets of 50 per cent of the male individuals whose skeletons were examined included a greater proportion of maize than females. The women were processing larger quantities of maize than before, but it was being consumed largely by men, who also appear now to have been consuming more meat than women. We know from other sources that incorporation in the Inca empire would have meant participation in gatherings and obligatory workforces for which meat and maize beer would have been provided. The isotope data suggest that it was largely males who participated in these activities. Women did not join in non-domestic political consumption and their position outside the household as well as inside became increasingly restricted. Here we see a large-scale political change having a significant effect on gender relations and their construction.

Whilst Hastorf's study has the advantage of relevant historical and ethnographic information for a period not long after that with which the study is concerned, my second example illustrates how it is also possible to carry out such investigations when only archaeological information is available, the case study being the Late Neolithic of south-central Europe *c.* 3500–2500 BC, particularly the 'lake village' sites of the Alpine area (Petrequin and Petrequin 1988). In the Jura region of eastern France these lake sites were reoccupied *c.* 3100 BC after a gap of some 300 years. In the material assemblage from the sites one finds a new emphasis on bows and arrows, stone hammer-axes, flint daggers and various kinds of ornaments. Arrowheads are found not only in larger numbers but also in a greater variety of types, many derived from southern France. Since hunting was beginning to decrease in practical importance at this time, the attention devoted to the arrow-heads is better seen as an indication of a new symbolic significance for the bow which, together with the hammer-axe and the dagger, came to be one of the defining features of a new male status. This argument is supported by Petrequin and Petrequin (1988) on a variety of grounds. Most of the imported items which are found, such as the daggers, are male-associated. Bifacially retouched flint side-scrapers, on the other hand, may have been a woman's tool and these were usually made of local flint. More generally in fact, exotic materials and aesthetic considerations played a decreasing role in those items of equipment which stayed in the house, while exotic materials obtained by exchange were sought out for male weapons and tools. As men invested increasing amounts of energy in the competition for prestige items, they simplified the manufacture of domestic tools of stone, bone and antler, a process which contributed further to the devaluation of the domestic realm with which women were associated.

An analysis of contemporary rock art from an adjacent area of northern Italy points in a similar direction (Robb 1994). Weapon symbolism is linked to males. In hunting scenes weapons are used by males, while on stelae associated with burials, halberds, axes and particularly daggers are consistently used to distinguish males from females. Furthermore, although we know from bone assemblages that a variety of different animals were hunted, the only one commonly represented in art is the deer, and in particular the stag with its antlers; if the gender of hunters is represented, it is male, distinguished by a phallus. Images of ploughing show a similar situation—male oxen are indicated by their horns and the people using the ploughs are frequently identified as male. It is very plausibly suggested by Robb that the various representations have a common pattern to do with the expression of male gender: daggers, male hunters, male ploughmen, oxen and stags: 'scenes using these ideologically-highlighted symbols emphasize the maleness of both subject and object. The male vitality of the animal, symbolized visually through horns and antlers, implies the male strength of the hunter killing it or the ploughman controlling it' (Robb 1994:34).

These representations would have contributed to an ideology of male power in which the male-female distinction was a hierarchical one and women were excluded from at least the public power structure. The dagger was the key icon in representing this and it was this role which was the source of its public use, rather than its 'prestige' as such, although it was male status items which were made of exotic prestigious materials. On this view, the distinctions defined through prestige competition were not those between élite and commoner but between male and female; although prestige goods circulated, there was little formal hierarchy, political or economic: 'distinctions among males were probably due to differential realization of an ideal to which all males had access; they were competing for parity…while excluding females' (Robb 1994:37). This male-orientated ideology valorized male activities at the expense of female ones, and was based on values centred on hunting, violence and the importance of exchange activities for obtaining exotic materials; the domestic domain was symbolically devalued. While men and women were symbolically unequal, males were symbolically equal, although no doubt varying in their prestige according to their role in local kin groups and their success in prestige-creating activities. On the basis of this model, the key social dynamic in late neolithic south-central Europe was not concerned with the development of ranking as such, but with the definition of male-female symbolic distinctions and thus a restructuring of gender relations, although competition between males may have led to rank/prestige differentials of a different nature from those which existed earlier (see Shennan 1993). The point is, however, that without the focus on gender relations the whole process would be completely misunderstood.

INDIVIDUALS, INTENTIONS AND RANKING

The approaches to the study of ranking which developed in the 1970s emphasized the notion of *system*. Broadly speaking, individual societies were conceived as systems, made up of sub-systems such as social organization, subsistence, ideology, and exchange. Changes arose from the interaction between the sub-systems. So, for example, subsistence intensification might be conceived as producing social change in the direction of increased ranking. The problem is that all these sub-systems are abstractions which do not have any reality: what exist in the world are people with intentions, resources, and perceived constraints. One of the features of 'post-processual' archaeology was an insistence on refocusing attention on individuals and their intentions and contexts, but this insistence did not go far enough: it did not recognize the possibility of micro-scale interactions between such individuals having unpredicted and unpredictable effects in terms of the larger-scale patterns to which they give rise. Such interactions lead back to the idea of systems, not now in terms of abstract variables, but modelling groups of interacting individuals and seeing what larger patterns emerge from their interactions. Such a framework also tends to have the effect of playing down the significance of ranking as such—it is something which may emerge from a particular system of changing interactions. Some of these issues are well illustrated in the study described below of cooperation and 'sequential hierarchy' in the south-west United States.

Between AD 900 and 1300, centres appeared in this region which included elaborate architecture, large-scale ritual, other structures such as the 'roads' of the Chaco Canyon area, indications of long-distance exchange contacts, craft specialization, and considerable variation in the elaboration of burials. Some have seen these features as evidence of developed social stratification (in Flanagan's (1989) sense, see p. 895) and the existence of élites, while others have argued that they could have been produced by egalitarian societies of the kinds known from the recent ethnography of the region. Johnson (1989) has reviewed the evidence and argued for a distinctly limited degree of inequality and an organizational pattern which has a number of levels but is essentially non-hierarchical in nature.

The amount of surplus available to these communities was small because of the marginal nature of agriculture in the region. However, if social stratification existed, one would expect élites to have the benefit of what there was in terms of better access to food. At Chacoan centres such as Pueblo Alto, there appears to have been more animal bone than expected in relation to its size, which might be taken as evidence of élite consumption. On the other hand, skeletons from burials with elaborate grave-goods at these centres suffered subsistence stress sufficient to generate skeletal pathologies, and the large quantities of animal bone are better seen as a reflection of consumption by large numbers of periodic visitors to the centres.

As far as the concentration of large amounts of labour in the monumental architecture is concerned, Johnson argues that the construction of residential room blocks was not a particularly labour-intensive activity and that the same was true of the construction of ceremonial 'kivas'. Furthermore, the number of kivas at sites seems to be directly proportional to community size, implying a relatively low degree of centralization of ritual activity. Finally, although there is a considerable amount of variation between burials, Johnson notes that the most elaborate ones were almost invariably adults, and that there is little evidence of status differences ascribed at birth through kin group membership. In addition, most 'rich' burials only contained one type of trade good, when in fact a variety of items obtained by long-distance exchange was available. The conclusion again is that this is a pointer against social stratification.

Johnson accounts for the existence of social variability, population aggregation, labour coordination, and exchange in terms of the idea of 'sequential hierarchy' (Johnson 1982), seen as a solution to the problems of achieving cooperation in human groups, since it is well established that cooperation tends to break down when groups become too large. In the face of such cooperation problems there are three possibilities: the group can split; a non-consensual hierarchy can be imposed; or a consensual 'sequential hierarchy' can be developed:

> in the sequential solution, basal organizational units are aggregated into larger (and thus fewer) entities among which consensus can be obtained more easily. Lower order units are subject to minimal potential coercion by higher order organizational entities because the former retain the fission option characteristic of egalitarian [entities] that can be applied if higher order consensus is locally unsatisfactory.
>
> (Johnson 1989:379)

On this view, the small kivas or ceremonial rooms found on small sites represent a level above the household where cooperation problems were resolved in a sanctified context. The larger special structures at large sites then represent one or more levels of sequential hierarchy above the 'household cluster' level. The larger sites were in fact multiples of these household clusters, which represented the 'social modules' from which they were built up, and a constant ratio of roughly one kiva to 4–6 units was maintained. In the Chacoan settlements a three-level settlement hierarchy can be seen, reflecting different scale aggregations of such modules and their need for the sacred legitimation of cooperation at different scales. The basic household units, however, were essentially autonomous, potentially mobile, and able to disperse, an option which was exercised at intervals: 'social complexity' of the Chacoan type was something which appeared and disappeared at intervals in the south-west.

Chaco itself seems to have had storage facilities on an exceptionally large scale, given that the resident population on the basis of the number of rooms and kivas was relatively small. However, as we have noted already, the fact that individuals in elaborate burials seem to have suffered dietary stress suggests that the local population did not gain any special benefit from these storage facilities. Johnson suggests that participants in the Chacoan system could have made use of these stored reserves in times of difficulty, which would justify their contribution to their maintenance. However, the system was fragile, in that the reserves were not great on a regional *per capita* basis, so that the emergence of continued subsistence problems, for example as a result of climatic change, would rapidly have exhausted them and made them impossible to replenish. At this point there would have been few advantages in joining the system, and withdrawal by only a small proportion of participants would have led to the collapse which actually occurred.

A wider explanatory framework for these phenomena has recently been developed by Kohler and van West (1996) from a similar basis in the self-interest of individual households. They begin by showing that pooling of food is most likely to develop in circumstances of high mean productivity, high variability in productivity from year to year, and great spatial differences in productivity. This contrasts with the standard models of risk and its implications which have been used in archaeology, since these presuppose great variability in space/time but *low* mean productivity—in other words, where there appears to be most need for sharing. However, analysis of production functions produces the apparently counter-intuitive conclusion that sharing is not actually in the best interests of the individual households when little food is available, since greater utility is obtained, on average, by not sharing. In such circumstances, sharing will be likely to break down if it is present, and if it is not present it is unlikely to develop.

Kohler and van West obtained palaeo-productivity estimates for a 1,500 km^2 region in south-west Colorado, covering the period AD 900–1300, taking into account soil depth and estimates of soil moisture derived from palaeoenvironmental studies. These were used to define periods of high and low average production. Measures of spatial and temporal variability were also calculated. Aspects of the archaeological record believed to be relevant as evidence for food sharing included community growth and aggregation, the existence of great kiva ritual structures, and the presence of reservoirs. The breakdown of sharing was taken to be evident in the dissolution of aggregated sites. In general terms, the patterning in the archaeological record follows that predicted by the model, in that aggregation episodes are associated with periods when expected cooperation is high; this is the case, for example, with the appearance of the so-called Chacoan system, involving the development of a ritually based regional centre with spectacular architecture. The break up of this system and the final abandonment of the region both occur in periods when defection from sharing arrangements is the advantageous thing to do from the point of view of household self-interest. Evidence for cannibalism also occurs in periods when abandonment of sharing is predicted. However, the pattern is complicated by indications of high levels of cooperative behaviour at times when population is high. This is the opposite of what is anticipated by the model, since higher population would be expected to lead to lower levels of food per household. It appears that, while defection into an open landscape at times of low production was easy when population was low, this changed as population increased because alternative resources to defect to were no longer available. When the region was abandoned towards AD 1300, climatic factors were cutting productivity—and thus the utility of sharing—at the same time that the increasingly full landscape was removing the option of defecting.

From this study it emerges that a model of behaviour based entirely on the self-interest of the participants generates patterns in the settlement of the region which correspond closely to those actually found, in terms of the aggregation and dispersal of settlement. This appears to be in marked contrast to ethnographically known patterns of social organization in the south-west, which place great emphasis on the group at the expense of the individual. However, there is also a contrast in settlement processes: while the period from AD 900 to 1300 was characterized by the cyclical patterns we have seen, since that time aggregated village settlement in areas actually occupied has been uninterrupted. The reason for this, Kohler and van West suggest, is the emergence of new sharing rules emphasizing village level activities, combined with new sanctions against defection. In the societies which then emerged, egalitarianism and an emphasis on group values represented an active commitment, not an absence of evolution (cf. Trigger 1990). As we have seen already, the move towards centralized hierarchy represents only one possible trend in social change: other patterns are possible, including trends towards an asserted equality of outcome. To call such changes 'devolution' would be to subscribe to the progressive metaphor which this chapter has been at pains to criticize.

HOUSEHOLDS AND RESOURCE CONTROL ON THE CANADIAN NORTHWEST PLATEAU

A recent study by Hayden (1997) of the social and economic organization of prehistoric foragers on the Canadian Northwest Plateau brings together many of the points which have been made earlier in this chapter, showing how archaeological data can be used to reconstruct patterns of behaviour and organization in different spheres of prehistoric life and thus not only provide descriptions of prehistoric social differentiation but suggest how this differentiation relates to the control of resources.

The starting point of the study is an analysis of the spatial patterning in the archaeological residues within the larger structures excavated at the Keatley Creek site near the Fraser River. The structures were circular housepits around 10 metres in diameter containing a series of hearths forming a ring around the wall. Each hearth was associated with a range of debris consistent with domestic rather than specialized functions, suggesting that the hearths represented a series of domestic groups. However, there were differences in the patterns between the eastern and western halves of the housepits: for example, all the large hearths were in the western half of the houses and the large storage pits were associated with them, even though both halves seem to have been occupied by domestic groups rather than used for different activities—there was archaeological evidence of bedding material along the walls of both sides of the house, and anthropogenic soil chemical patterns were also the same. Hayden concluded that the pattern existed because the large houses were occupied by high status domestic groups in one half and lower status groups in the other.

The question then arose as to why these residential groups had come into existence and why some groups seemed to be richer and more powerful than others. An analysis of the salmon remains which were the subsistence staple revealed that residents of smaller and poorer housepits consumed only pink salmon, which are the easiest species to catch but the least desirable of those available, whereas residents of larger houses were the exclusive consumers of larger sockeye and chinook salmon, varieties that keep further away from the shore and can thus only be caught from rocks jutting out into the river or from specially constructed fishing platforms. In recent times such sites were largely owned by specific families and Hayden infers from the bone distribution that only the residents of the larger houses had access to the best fishing locations. He concludes that the main reason for the formation of the large residential groups was control of the most productive fishing sites which, on the evidence of ethnographically recorded trade in dried salmon, would also be the most lucrative. Elite members of the house groups would have had the rights to the production sites and poorer families without such rights would have attached themselves to them for the benefits they would receive in providing a source of labour, although how much choice they would have had in the matter is another issue. The resources and labour that élite members of such groups controlled are indicated by the presence of prestige burials including such items as trade shells and whalebone from the coast.

Scientific analyses of stone debitage from the large housepits showed that each was associated with a distinctive combination of lithic materials. This not only confirmed that each group associated with a large housepit represented a distinct economic entity, but also suggested that each group had exclusive access to the resources of a different mountain area containing the specific lithic resources used (and no doubt other resources as well on the basis of what is known ethnographically). In addition, the fact that the same distinctive types of materials are found in the earliest levels of the housepit middens as in the latest indicates a continuity of inherited rights to territory and resources associated with particular housepit groups lasting in some cases for over a thousand years. It also suggests that the large housepits were in the possession of the same residential group for extremely long periods:

> the persistence of the largest and most successful of these residential corporate groups as discrete, identifiable entities for over 1000 years is a remarkable testimony to the powerful effect that control over lucrative economic resources can exert over the social structure of [what Hayden calls] transegalitarian communities, whether complex hunter-gatherers or agriculturalists.
>
> (Hayden 1997:259)

CONCLUSION

A number of points have emerged from this consideration of rank societies and chiefdoms and the social processes which are characteristic of them as evidenced in the anthropological and archaeological record. In the first place, the terms have lost the specific meaning content which they had on their introduction to archaeology, because that content has been subject to detailed and justified critique. The terms remain as very useful generalized labels for a valid but very wide-ranging field of anthropological and archaeological investigation. It is not satisfactory to see these societies as an intervening stage in an evolutionary progression from the band to the state: the reality and validity of the supposed preceding stage are open to considerable doubt, and development into states is not the characteristic fate of chiefdoms— their disappearance and/or the emergence of endemic warfare are far more likely outcomes.

The relationship between various aspects of population size and density and political organization is enormously complex and varied. In addition to the examples described above, Netting (1990:56) has pointed out that in some regions chiefdoms with territorially defined political and landholding groups are found in areas of low population density and extensive resources, while areas with high densities are characterized by non-centralized descent-based lineage systems. This merely emphasizes Johnson's (1982) point, and indeed Gilman's (1981) Marxist view, that cooperation problems, if they occur, can be solved by sequential hierarchies at least as well as by forms of organization based on major power differentials and extensive institutionalized inequalities. In short, what the neo-evolutionary approach saw as a tightly correlated set of economic and social attributes all co-varying through time together, can now be seen as largely independent of one another, albeit contingently related in particular circumstances. It is this realization, among others, which has led to the new interest by archaeologists studying these societies in analytical and typological schemes which include a variety of different distinctions and operate at a more detailed level. At the same time, the new work in the anthropology and archaeology of gender has demonstrated that this is a key dimension in terms of the structuring of society and therefore the trajectories of change which societies follow.

In terms of this multidimensional perspective, it seems rather dubious to privilege the emergence of centralized hierarchies and stratified class-based systems above all other topics as subjects of investigation in connection with the sorts of societies described in this chapter—the tendency to do this is simply a reflection of our preoccupation with the 'rise of civilization' as the only subject of interest to archaeology once modern humans had emerged and agriculture had appeared. However, if we are to continue the investigation of these subjects in the context of rank societies, there are clearly a number of requirements. First, it is important to take into account the various distinctions made by Flanagan (1989) described earlier. Second, we must investigate the circumstances in which 'sequential hierarchies' arise as distinct from conventional ones, and the ways in which the former may change into the latter (Aldenderfer 1993). It may well be that ritual and symbolic distinctions have a key role here: as we have seen, it appears that Polynesia developed in a 'conventional' hierarchical direction at least partly because a set of original symbolic categories channelled subsequent developments. Such symbolic distinctions will also have an impact on the form taken by resistance to hierarchy and inequality. In effect, many of the studies of the past twenty-five years have accepted the propaganda of élites that all social power emanates from them. Next, analysis of competing interests in a changing symbolic environment must have a theoretical foundation at the level of the individuals in whose daily lives those interests were at stake. Finally, Hayden's case study shows us that, by working at a detailed level of analysis, it is possible to use archaeological data to draw conclusions about the organization of rank societies which are not contained in their premisses and which can surprise us with their novelty and their implications.

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The best source for following up the archaeological study of the sorts of society described in this chapter is Earle (1997), which adopts a comparative approach to the study of the ideology, economics, and politics of chiefly societies by comparing developments in Europe, the Pacific and South America. Earle's edited book *Chiefdoms: Power, Economy and Ideology* (1991) is also a very useful collection of case studies, while Kirch (1984) explores the range of social variations on the rank society theme which emerged as a result of the Polynesian colonization of the Pacific in the contexts of particular islands and their resources. In fact, most archaeological studies of prehistoric agricultural societies which were not states, all over the world, fall under the rubric of this chapter, while the papers in Brown and Price (1985) make the point emphasized in this chapter that agricultural subsistence was not a prerequisite. It seems that rank societies, like the bourgeoisie in more recent times, were always rising!

23

URBANIZATION AND STATE FORMATION

Simon Stoddart

INTRODUCTION

This chapter covers the development and maintenance of state-organized society in the pre-industrial era, concentrating on the earliest forms which took place some five millennia ago. In the writings of most social theorists (including archaeologists), this transformation is considered the most radical development since the transition to agriculture. Agriculture was generally a necessary precursor, since it provided the potential surplus production, once politically orchestrated, to maintain power over people and materials (see Chapter 21).

State formation has brought both the potential for well-being and opportunities for exploitation and disadvantage. Approaches to the question tend to emphasize beneficence or exploitation. For the first time in human development, many major achievements were possible, whether measured materially as expenditures of energy or conceptually in the form of new ideologies. The rate of innovation following the formation of the first state was much greater than before. Yet many of these early states were based on the mobilization of manpower where a few individuals managed to deprive the majority of the full benefits of the extracted surplus.

Only archaeology has the ability to examine the full chronological development of cities and states. Archaeological evidence—material culture—can be employed to register long-term change, appreciate spatial organization and penetrate periods before the development of informative literacy. Other disciplines are dependent on a type of literacy which itself remained in the hands of a few and then, as an informative source, only developed relatively late in the sequence of cities and states. The formation of cities and states is embedded in long political and economic sequences where textual data provide clarification of only discrete, limited zones in time and space. Archaeology, even though itself plagued with sampling problems, covers a much wider range of contexts.

It can perhaps even be argued that this long-term perspective provides a scenario of long-term trends which has implications for the world today. However, it needs to be stressed that, although there is archaeological evidence (material culture) of the modern world, the present chapter concentrates on the pre-industrial, pre-capitalist, versions of city and state and thus analyses constructs which have differences in character from the modern. One major difference is that of scale. Industrial scale of population is dependent on an industrial scale of communication which has only been developed in the last two centuries (Chapter 29). In particular, transport provided severe, but not insuperable, problems for the sustenance of large populations in pre-industrial periods (Fletcher 1995).

The two processes, urbanization and state formation, are too frequently employed as interchangeable in describing this radical change. It is correct that in most cases they are strongly interrelated, but, in fact, they refer to two different measures of socio-political development. The city is generally defined as a dense nucleated population. The state is generally defined as a hierarchical organization (both politically and administratively) set up to control large populations which may, or may not, be densely nucleated. Thus urbanization generally requires state formation for its successful long-term implementation. As a consequence, states can occur without cities, but cities tend to be highly unstable without states. At the most extreme, urbanism can be envisaged as merely subsidiary to state formation (Adams 1972). Ultimately, even this issue can be confused and clouded by differing definitions. Early settlements, such as seventh- to sixth-millennium BC Çatal Hüyûk in Anatolia, have been claimed to be towns, although never envisaged as states. The 'oppida' of first-millennium BC central Europe are further examples of low density urbanism on the definitional boundary (Collis 1984).

The definition of the city and the state is clearly key to the resolution of their origins. Is there a clear break between the pre-state/city and the state/city? How does this translate into rates of change? Which characteristics should be stressed—the quantitative, more positivistic components such as scale, or the qualitative, more humanistic, components such as ideology?

DEFINITIONS

As Wheatley (1972:601) has suggested, the term 'urbanism' changes character like a wild mythical animal. It is very difficult to define in terms that are acceptable across cultures and time. Consequently, many definitions of urbanism have been devised which vary in their specificity and degree of overlap, ranging between approaches based on dynamism, way of life, economics and demography.

A very common view of the city is that of an ideal type based on models derived from the classical world (Rykwert 1988). Ancient historians, in the tradition of Fustel de Coulanges (1883), tend to deal with rationalization of the city, not how it was actually built, as would be revealed by archaeology. Great emphasis is laid on the ideological component, starting with the foundation rites of the city. For instance, heroes are often cited as necessary founders of cities, under the guidance of divine inspiration. Less emphasis is laid on the material component, which took a less ordered or ideological form in many cities, except at major phases of reconstruction.

At the most general level there is a distinction of urban from non-urban which Wheatley (1972:602–5) defines as an *ideal type* definition. Such a distinction is found in many other cultures and reflects the organization of categories into paired opposites as recognized by structuralists. These definitions are, though, by their very nature difficult to transfer between different contexts. At a more theoretical level, Redfield was responsible for defining a pre-urban *folk* society from urban and peasant society. He also went further by attempting to distil the nature of urban societies from examples as disparate as the May an and Roman (Redfield 1968). His major contribution was to attempt to understand the nature of the rural and the urban which he successively understood as a dichotomy and then as a continuum.

One of the most dominant schools of urban study in archaeology has attempted to define relevant traits (Wheatley 1972:608–13). Childe in his seminal paper of 1950 selected ten indices based on Mesopotamian urbanism: the concentration of a relatively large number of people in a restricted area; craft specialization; the political appropriation of an economic surplus; monumental public architecture; developed social stratification; writing; exact and predictive sciences; naturalistic art; foreign trade; and group membership beyond kinship. In common with many descriptive approaches, this definition was very static and failed to examine the dynamic process of urbanism. Furthermore, even the static elements have proved to be inexact, since Childe, in spite of his Australian upbringing, was very much restricted to his European cultural origins, aided and abetted by his philological and classical training. The more recent global research of archaeology has shown that writing was not always used in cities (see p. 937) and that monuments were constructed by pre-urban societies.

A further major branch of urban studies has defined the city as a centre of power or dominance (Wheatley 1972:613–20). An influential, although controversial, geographical theory of this type was developed by Sjoberg (1960). In his account, the élite of pre-industrial cities were located close to the monumental architecture and the positions of power at the centre of the city. Other variation was, to his mind, less significant: in particular, he suggested that pre-industrial cities had little functional segregation (and correspondingly much overlap between workplace and residence) except with respect to the location of power. This generalization does not stand up to the range of archaeological evidence (McIntosh and McIntosh 1993).

Many archaeological studies of urbanism and state organization share the general interest in power and have borrowed heavily from spatial geography. These have developed models for the most efficient implementation of power from the urban centre over a dependent territory (see pp. 928–31) and compared them with archaeological reality. In this approach the function of the city is very important. The city secures resources (food, manpower and raw materials) from its territory and concentrates a range of specialist activities (administration, craft production, religion and trade regulation) in a city to work those resources efficiently. Within this definition, it is more easy to fit the distinction of city from town: the town is simply a smaller settlement under the political control of a major city.

The simplest approach to urbanism has been based on population size (Wheatley 1972:620–21). For the modern geographer armed with census returns, the advantages of easy quantification are obvious. A figure of 5,000 inhabitants can provide the easy, quantifiable, threshold. For the archaeologist, the approach has still proved attractive, although the problems are more complex. Population sizes have to be estimated from the size of settlements. Many archaeologists have rejected the simplicity of this type of definition and suggested that urbanism must be examined in a broader context (Alexander 1972:844).

A major problem with the concept of the town or city is the high degree of variation that it conceals. At an empirical level, major differences can be seen in the centres classified as urban in the archaeological world. Locally and internally perceived criteria vary greatly between cultural contexts. The Muslim city required a *jami* (mosque), *hammam* (public bath) and a *suq* (permanent market). Mayan cities were almost certainly defined by their ritual centres. The Moche city of Chan Chan in South America appears to have been principally connected with élite administration. The same degree of variation can be detected in the considerable range of density of population in urban centres (Fletcher 1995).

Origins of the term 'state'

The use of the state construct is by no means as new as that of other stages employed in neo-evolutionary theory, because it is a term borrowed from classical Antiquity. There exists a long tradition of use and an equally rich connotation of meaning by researchers of many and varied intellectual backgrounds (Engels [1884]1985; Finley 1963; Oppenheimer 1923). Many of these works are rooted in the classical or, at least European, political tradition. The fathers of political theory and sociology have, in turn, given their own gloss on the concept of the state. Marx emphasized the unequal control over the means of production. Weber emphasized central authority. The challenge for the archaeologist is that his or her laboratory is not simply a micro-region of historical heritage, such as Europe, but a much wider global setting. The archaeologist must not be bound by one particular cultural trajectory. In this respect the work of Lewis Henry Morgan was an important breakthrough by bringing anthropology into play and developing a sense of different stages of human development (Morgan 1877) which had a global range (see Chapter 12).

A revival of interest in the term 'state' took place in the United States under the influence of the neo-evolutionists in the 1960s (Service 1962; Fried 1967), inspired by the method, if not the full terminology, of Julian Steward (1949). The aim was to provide a cross-cultural framework for the new global level of research in the post-war period. Much prior research had been directed towards the study of alternative, but vaguer, constructs such as civilization and urbanism, which are ultimately culturally specific. The term 'civilization' suffers from too great a generality. The term 'urbanism' is too specific to a given cultural context. For example, it would be strange to exclude ancient Egypt, the Maya or some early African societies from the study of ancient complex society simply because they did not have urbanism in a western form, although none would deny them the status of a state. Equally, the term 'civilization' has been too widely employed (particularly in the French language) to allow a rigorous definition.

The term 'state' has a much wider acceptance than other neo-evolutionary constructs. It has a more acceptable coherence and cross-cultural application. As Tainter puts it, 'most anthropologists…feel comfortable with the term' (Tainter 1988:28). However, this very acceptance may be, according to some scholars (Gledhill 1988; Kohl 1987), because the state is part of our own culture and may consequently have provided a too rigid view of the past determined by the present. This view appears extreme to many, but does stress the need for caution in the use of the very terms with which we feel most comfortable.

THE HISTORY OF RESEARCH INTO STATE TRANSFORMATION

Historical trends can be noted in the development of theories for the development of the state. Many theories, until recently, assumed that a general theory of the origin of the state could be discovered. The first theories tended to emphasize the 'prime mover'; that is, a single principal cause of state formation. A number of archaeological studies in the 1970s were directed towards studying the validity of these prime movers, generally with negative results (Wright and Johnson 1975). By contrast, many theories have emphasized the multi-variant and the systemic. These theories may be considered less elegant because of their decreased simplicity, but potentially they cope better with the complexity of the evidence. They have in turn produced critiques particularly from Marxist-derived accounts, which sometimes share an evolutionary framework, but which criticize the positive attitude towards a beneficent, stable state. Some of the more influential approaches have laid stress on the power of social formations (Friedman and Rowlands 1977) rather than the simply materialistic.

Theories of the late 1980s and 1990s have sometimes moved away from general explanations, usually under the influence of Giddens (1984). The results are often pluralistic and relativistic, allowing a major role for historical contingency and the role of the actor. The emphasis on the actor is visible in many of the current schools of thought about state formation (Lewis 1981; Roscoe 1988). The most successful applications of the role of the actor in concrete case studies have, though, come from a background—the Midwest of the United States—which has generally professed the power of process. For example, the work of Kus in the study of Madagascar gives an active role to the individual (1989).

One alternative is a more synthetic approach which would give some role for the actor within the constraints of the wider processes of society. As Price (1993) points out, these constraints operate at different levels: the immediate present (registered by the individual) and the long-term systemic (not necessarily appreciated by the individual). An evolutionary approach still retains a profound influence on many explanations of social change and as such is the subject of much criticism (Shanks and Tilley 1987).

A cynical view notes that the early generalizing theories were heavily dependent on the primary research area of the scholar involved and generalized to cover other regions before the full development of archaeological research. Irrigation theories were developed in Mesopotamia where mobilization of manpower for such works was a preoccupation of early literacy and material evidence. Circumscription theories were developed in Peru, arguably the most geographically constrained location of early state formation. As archaeological research progressed, it has become apparent that the historical rules of one area cannot be strictly applied to another.

The state defined

In a definition of the state it is essential to go beyond a mere list of traits, or the definition will have the same weaknesses as some definitions of urbanism. In spite of this, it is worth beginning by listing some of the commonly stated characteristics, if not traits, of the state (Tainter 1988:29): ‘territorial organization, differentiation by class and occupation rather than by kinship, monopoly of force, authority to mobilize resources and personnel, and legal jurisdiction’. Roscoe (1993:113) has defined three analytically separate dimensions: political centralization (the concentration of power in the hands of the few); socio-economic differentiation (occupational specialization); and social stratification (the differentiation of status).

By contrast, the Mediterranean classical tradition, prioritized by its perceived great influence on the European politics, has emphasized the Greek definition of the state: 'a genuine political community to which men belonged by free choice as equal citizens and in which they shared a common life and a communal responsibility' (Finley 1963:38; Fig. 23.1). Unfortunately, not only is this a difficult definition to unearth archaeologically but, when unearthed, the surviving evidence is more likely to disprove than confirm the classicist's definition. Archaeology is likely to stress the disparity of wealth and power (including extensive slave ownership and low literacy), thus weakening the very definition itself. However, the Greek polis does provide an example of a small-scale state which fits uneasily within the definitions that have emphasized scale and centralization.

Definitions tend to emphasize the positive or negative attributes of the state (Cohen 1978; Haas 1982; Hayden and Gargett 1990; Service 1975; Tainter 1988). On the one hand, there are theorists who emphasize the great positive achievements of the state in providing a management of people and information, serving the needs of society. The needs serviced by society may include irrigation (Wittfogel 1957), redistribution (Sahlins 1963), exchange (Sanders and Price 1968) and information (Wright 1977). Definitions such as those of Wright (1977:383), which emphasize centralized decision-making accompanied by external and internal specialization, can be subsumed under this type of definition. The theoretical work of Johnson (1978) on horizontal and vertical specialization also links into this. As the scale of a society increases, so do the stresses within egalitarian society in controlling the individuals involved. Institutions have to be developed which efficiently control the interrelationships of individuals in an increasingly complex human environment. However, there are examples, such as the Greek polis, which developed state institutions without the stress of scale.

On the other hand there are those who emphasize exploitation and manipulation of people and information. An important approach within the study of negative attributes is to see the state as based on conflict. This has been an important part of, but not exclusive to, the Marxist approach to the state. Fried (1960:729; 1967:225) envisages the state as coterminous with stratification, or rather with the resolution of conflicts that are the consequences of stratification. The emphasis of Webster (1975) on the role of warfare in acquiring wealth is consistent with this more negative approach.

In reality, it is clear that both negative and positive elements occur in all states in varying measures. A simple conflict model, whilst providing the dynamic for the formation of the state, fails to consider adequately its maintenance and functioning. Stability is achieved through a combination of incentive and coercion. A model such as that presented by Service (1975:167) aims to achieve this compromise:

Figure 23.1 The Acropolis of Athens. Phocograph: S .Stoddart.

'bureaucratic governance by legaJ force'. Flannery (1972) also defines the scare as an entity thar combines government and force. A unifying theme of moar current approaches is that of power and its counterpart, domination: the means of imposing and implementing effective power over others (Cherry 1987; Giddens 1373,19S4).

The central question is how power came to be exercised and how it was maintained once in existence. A primary debate is about the relative emphasis on the material (economic) or on the social, cultural, and symbolic in the exercise of power.

Some traditions in the study of early state formation have also considered the state to be a too all-embracing term. Early distinctions defined dichotomies: the unitary and segmentary state (Southall 1956). More recent scholars (Claessen and Skalnik 1978) have divided early states into separate categories of increasing complexity: inchoate, typical early, and transitional early. Another distinction sometimes made is between primary and secondary state formation. Primary states are those which developed independently of any other (Mesopotamia, Egypt, China, Indus valley, Mexico and Peru). Secondary states are those of later date which can be considered to have been in some way affected by early developments. The leading question is whether these sub-categories share more similarities than dissimilarities.

THEORIES OF STATE FORMATION

The prime mover

The most famous prime mover, irrigation, is in fact the most culturally specific. Wittfogel (1957) considered water to be an essential, politically manipulable, resource. The creation of the state was inextricably linked to control of water by state authorities. However, subsequent research has shown that, where irrigation was important, it only developed on sufficient scale to require centralized authority once the state had formed. Furthermore, work outside the Mesopotamian area has demonstrated that large-scale irrigation is only required in certain ecological contexts and cannot be considered a general mechanism.

Population pressure has been singled out as another alternative prime mover (Sanders and Price 1968). This prime mover has the advantage of being a potential general mechanism for all social change, yet its very generality causes problems in explaining the lack of immediacy of state formation in all regions following agriculture. Alternatively, if there are cultural or natural mechanisms restraining population growth, then additional reasons need to be found to explain the release of population pressure. In reality, population pressure is often a response to other local factors which provide constraints.

Other potential prime movers suffer from similar problems. They are too difficult to isolate, are too specific to particular case studies, or are too general to society at all levels of complexity. Warfare has frequently been cited, but conflict has a much longer history than that of the state. Moreover, the periods of most intense conflict often follow the state rather than precede it. Nevertheless, conflict as an extension of competition remains an important factor in the development of states and is currently being reinvestigated as an important constituent of state formation (Marcus 1992a). The internalized warfare of class conflict is another suggested mechanism, but again its claimed generality can only with difficulty be applied exclusively to the period of state formation.

Trade is frequently advanced as one of the most important prime movers. For some it is considered the most likely activity to favour innovation, including state formation (Renfrew 1972:440). For others, it is an essential factor in maintaining integration (Friedman and Rowlands 1977:270). However, in the opinion of many this can be taken too far and should not replace a proper understanding of social change (Renfrew 1972:441). Much recent work has examined the relationship between state-organized and non-state-organized societies, leading in time to state formation amongst the latter. However, trade cannot operate in isolation. The trade must have its impact on a society already in some way prepared for change, but may provide the appropriate conditions. This type of approach has been much favoured in the study of relations between the Mediterranean and central Europe. Wells envisages entrepreneurs in first-millennium BC central Europe taking advantage of the opportunities for trade to accumulate wealth and political power (Wells 1984). In this case the consequent centralization was short-lived and the state apparatus never fully developed until just before the Roman conquest.

The systems approach

Systems theory was introduced into archaeology from engineering via anthropology (Rappaport 1971) in order to avoid the simplistic explanations of the prime mover. This approach envisaged humanity as a system and involved the breaking down of that system into defined component parts. The interrelationship of these component parts was also specified and considered to balance each other under normal conditions, leading to a stable operation of society. The difficulty occurred in trying to explain imbalance or change in the whole system.

The classic theoretical attempt to explain change is that of Flannery (1972; Fig. 23.2). He measured social complexity in terms of *segregation* (the amount of internal differentiation and specialization of sub-systems) and *centralization* (the degree of linkage between the various sub-systems and the highest-order controls in society). Change in these two processes represented state formation. He claimed universality for the processes and the mechanisms by which they took place. Yet he allowed local specificity for the socio-environmental stresses (in many cases the prime movers, population growth, social circumscription, warfare, irrigation, trade, and so on) which selected for the mechanisms.

In total, he envisaged a hierarchical system subject to change by transforming mechanisms. The hierarchical system was composed of higher-order control

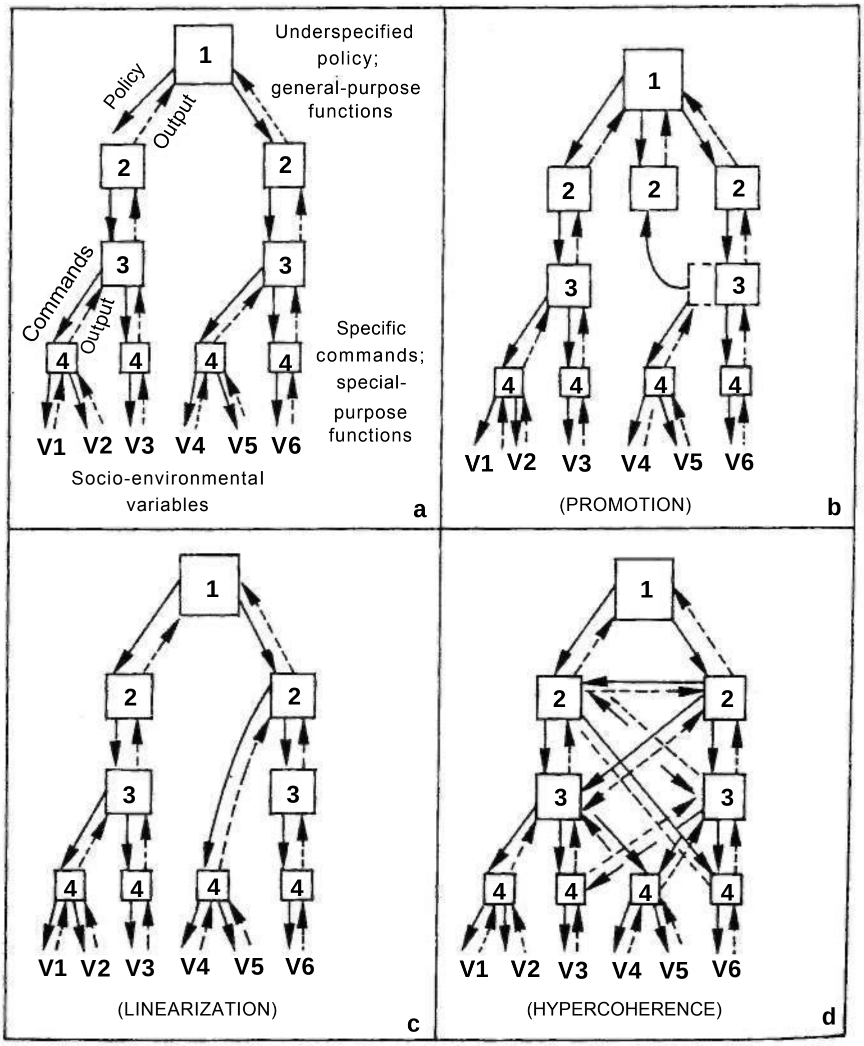

Figure 23.2 Models for the operation of control hierarchies; see text for explanation. Source: Flannery 1972.

engaged in general-purpose functions and lower-order control engaged in special-purpose functions. Two prominent mechanisms were identified, following Rappaport. The first, *promotion,* led to the move of a specific lower-order specialized institution to a generalized higher-order position. For instance, an informal headman might be promoted to a more permanent position. The second, *linearization,* led to the direct control of lower-order functions from the upper parts of the hierarchy. For instance, local irrigation might become directly administered from the centre. These mechanisms can lead to instability and stress, *usurpation* and *meddling*, respectively, which in turn may promote further change. On the other hand, too many interconnections may lead to *hypercoherence* and collapse of the whole system. The complete breakdown of local autonomy leads to too great a reliance on conditions in other parts of the state.

Flannery made this abstract model more understandable by an illustration from the recent ethnohistory of Mesoamerica. The rotating office for financial sponsorship of the local fiesta was subverted by a great family with the aid of the church, presumably under certain socio-environmental conditions (or stresses). In Flannery's judgement, a levelling mechanism was turned into a debt-creating mechanism. A lower-order specialist institution was promoted to a higher-order institution. Debt was manipulated by the great family and exchanged for control of land. The great family thus assumed control of the vast majority of land in the village. However, the whole process was cut short by the Mexican revolution at an even higher level, which led to the redistribution of land. This fruitful source of data has also been used by other authors (Hayden and Gargett 1990).

In summary, Flannery suggests that in certain socio-environmental conditions of stress, lower-order controls may prove insufficient and are subverted (through promotion or linearization) by higher-order controls. The cost of administration (processing information) is increased, as this process is repeated many times. *Centralization* and *segregation* increase, and at a certain threshold the state comes into existence.

One of the few elaborate archaeological attempts to use systems theory for the study of state formation (although classified as minor states or principalities) is that of Renfrew (1972). Renfrew envisaged the emergence of Aegean civilization from the third millennium BC 'in terms of positive interactions between the various subsystems' (Renfrew 1972:476). In the specific instance of the Aegean, Renfrew defined (1972:480–85) a redistributive system for subsistence commodities and the development of metallurgy and maritime trade as the key factors in the emergence of civilization and of stratified society, without considering any one component a prior event. Change in one sub-system stimulated change in another, which in turn stimulated change in the first. Production of new commodities led to new trade, which in turn stimulated new production. Indeed, Renfrew would argue that the different sub-systems would have to work in unison to achieve urbanization or civilization (1972:503).

The systems approach assumes stability of the system and subservience of the social actors. The approach has, therefore, been criticized principally on the grounds that some condition external to the system has to be devised to explain change (Shanks and Tilley 1987:138–43). These may be the socio-cultural stresses of Flannery or trade for Renfrew (1972).

Marxist approaches

In the modern pluralistic world it is increasingly difficult to isolate a purely Marxist approach. Many theories contain elements of class struggle, unequal access to resources, or competing interest groups, without earning a purely Marxist label. Early Marxist accounts tended to be determined by materialist concerns and productive forces. More recent approaches emphasize social or ideological relations. One influential approach, that of Friedman and Rowlands (1977), has been defined by the authors as 'epigenetic'. A general model is outlined which has different outcomes according to particular regional conditions; the framework is thus a multilinear evolutionary trajectory. The approach lays stress on an evolutionary methodology derived from Marxist analysis. Primacy is given to the socially determined set of productive relations. This contrasts with the emphasis given by some other Marxists to ideology on the one hand or productive forces on the other.

Under these circumstances, there are different forms of state determined by their social relations. The Asiatic, or conical clan, state, found in early stages, is characterized by the fact that noble lineages are defined by their kinship position to the royal line (Friedman and Rowlands 1977:216ff.). The state remains an enlarged version of the tribe and, therefore, cannot achieve the scale of later oriental despotic empires. Stronger political forces are required to retain the cohesion of larger units. The development of prestige-good systems was seen as a considerable step in this direction (Friedman and Rowlands 1977:225ff.). This in turn leads to the expansion of the trading system and the organization of territorial and city-states (1977: 232).

PREREQUISITES OF STATE FORMATION

Three powerful prerequisites are frequently defined as necessary for the development of states. First, there has to be a context of intensification of subsistence generally achieved through agriculture. Agriculture (including some types of pastoralism (Genito 1994)) provides a potential for producing a surplus which can be transferred away from the producers of subsistence. Second, there has to be what is frequently termed circumscription. This has been defined to describe the constraints of geography, society or resources (Carneiro 1970, 1988; Fig. 23.3). The society moving towards the state level of organization has to be subject to some form of constraint, making the constituent population unable to find some less-arduous solution. State formation has many material and less tangible costs which would not be taken on unless the position was circumscribed. Third, except in cases of extreme coercion, social formations need to be present which are receptive of state formation. Many early societies had checks and balances which prevented the

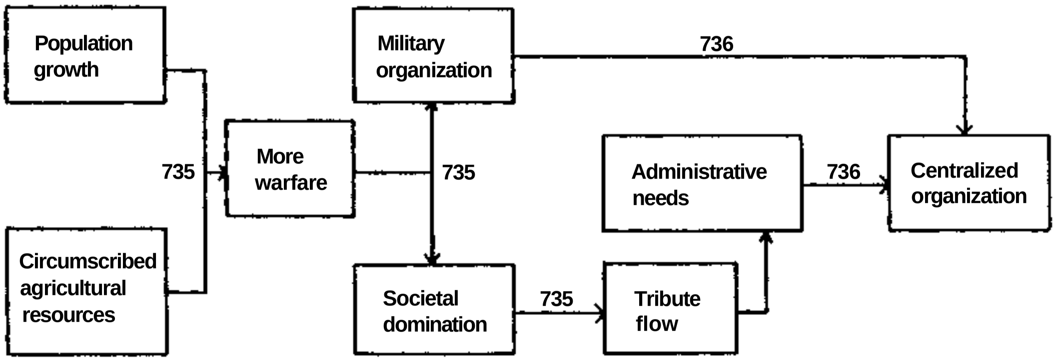

Figure 23.3 Flow diagram showing circumscription theory of Carneiro (1970). With permission, from the *Annual Review of Anthropology* 6, © by Annual Reviews Inc.

assumption of excessive power by sub-groups of society. Taking account of this third factor also acknowledges the importance of the local history of a particular area, reducing the impact of some theories based on simple cross-cultural generalization.

The importance of intensification of subsistence is twofold. First, agriculture realizes the potential for a surplus of produce, releasing certain sections of society for other specialized roles. Resources (measured in time and manpower) can be reallocated from subsistence production to political control. Second, intensification frequently has implications for investment which reinforce sedentary behaviour and can require protection (Gilman 1981). Intensification can involve the implementation of vulnerable, labour-intensive operations such as terracing, irrigation networks, and cultivation of slow-growing crops such as trees which take much time to nurture but which are quick to destroy if not protected by a regional authority.

Circumscription reinforces the conditions set by the intensification of production. In some cases this may take a geographical form. The dry valleys of coastal Peru, the location of the earliest states in South America, were sharply defined by high mountains. The island of Hawaii had a sharp maritime boundary (although it required an outside catalyst to produce a unified state). Carneiro (1970, 1988) also emphasizes two further factors of population and warfare. In other cases it may take a social form; in this there is no physical circumscription, but the local society has developed in such a way as to provide a cultural circumscription. The competitive emulation described by peer-polity interaction took place in a landscape of competing political centres (Renfrew and Cherry 1986) and thus provided a powerful force of circumscription. Relocation in these circumstances of circumscription has severe costs (Roscoe 1993:116) and, therefore, the move towards state formation becomes more acceptable to all in society as the less costly of alternatives.

The crucial phase of state formation may not be the implementation of the state itself but the development of important social changes prior to state formation (see Chapter 22). For many this is the more significant threshold (Hayden and Gargett 1990; Sahlins 1963; Wright 1984). Accumulation of wealth by Big Men, associated with competitive feasting, ritual display, and gift giving, can be seen in many regions of the world with emerging socio-economic differentiation (Hayden and Gargett 1990:7). This is also true of a number of archaeological contexts just prior to state formation, such as the Orientalizing period in the first-millennium BC Mediterranean. The crucial threshold is the level to which this differential accumulation of wealth was tolerated. The usual response is that it was tolerated in time of crisis. Ethnographic studies of the cargo system in Mesoamerica suggest that self-interest continues to operate in time of crisis and that individual advancement is available to those with energy, motivation, and skill (Hayden and Gargett 1990:7).

An illustration of a parallel type of development can be seen in Mesopotamia, although it is dangerous to construct general theories out of mere anecdotes.

Political power rested, from an early stage, in the hands of the king *(lugal)*. This figure may have become institutionalized out of a temporary role as head of an assembly set up on an *ad hoc* basis in moments of crisis (Jacobsen 1957). By preserving and enhancing temporary powers, the king may have consolidated his position in a pattern reminiscent of some of the Mesopotamian myths of the God Ninurta. He built on influence inherited from his father through his role as leader in war and administrator of justice. He then punished by death or severe penalties those who opposed his rule. The Mesopotamian epic tales centred on human heroes have an even more coercive feel. Cities are destroyed and water from canals is diverted towards the victors, recalling the tensions over the control of water in this region up to the present day. In these circumstances, administration became increasingly an extension of the king's household and thus under centralized political control.

Population pressure, population density, settlement nucleation and hierarchy

Social and cultural anthropologists have had considerable debate about the relationship between population size, density, and the degree of political development. Fortes and Evans-Pritchard, in a work originally published in 1940, suggested that a large population, a high degree of political centralization, and great density, were not necessarily related (Fortes and Evans-Pritchard [1940] 1975:7–8). Other, more extensive, cross-cultural studies by Carneiro (1967) have claimed to show a relationship between population size and the complexity of social organization. Stevenson (1968) reacted against the synchronic studies undertaken by the British social anthropologists (Fortes and Evans-Pritchard [1940] 1975) and took an explicitly historical and evolutionary approach. By extending the time depth he claimed to demonstrate the interrelationship of population density and state formation. Against this Cordy (1986), working on evidence from the island societies of the Pacific, has claimed to show a negative correlation between social stratification (not necessarily coterminous with the state) and population density. All these accounts have relied heavily on ethnographic or ethnohistoric data. Only archaeology can effectively study the timing of the relationship, although the close interlinkage of density, nucleation, and population pressure makes them very difficult to separate with archaeological chronologies.

One of the claimed achievements of archaeological research has been to show that population could be at a plateau or in decline at the time of state formation (Wright 1986; Wright and Johnson 1975), although this has since been disputed by Carneiro (1988). This possible exclusion of the role of high population pressure at the time of state formation does not exclude its part in the creation of pre-state, but nevertheless differentiated, social formations.

Alternatively, if population levels are generally low at the time of state formation, there is the possibility that labour shortage may be an important factor. In other words, it might not be pressure of too many people, but the stress of a lack of manpower to maintain the status quo which pressured those in political control. Under these conditions, the development of the institutionalized means to retain the available manpower could have been crucial and this might be most readily achieved by fostering nucleation and the state necessary to maintain it.

The change in population distribution at the time of state formation was frequently an increase in localized densities, otherwise defined as nucleation. One of the most extreme examples of this nucleation process is one of the earliest in its local region: Teotihuacán in the Valley of Mexico. The city was founded in 100 BC and grew to cover 20 square kilometres by AD 500, occupied by an estimated population of 125,000. This appears to have been an explicit political process, since the main avenues of the city were extended in preparation for an influx of population and the local countryside was drained of people by what must have been enforced or at least constrained immigration.

A more normal range of examples of this process can be seen in societies as widely separated as those from the Valley of Oaxaca (Mexico) and pre-Roman central Italy. In the Valley of Oaxaca, two cycles of population growth and nucleation took place up to and just beyond state formation: first around San José Mogote and then at the time of state formation around Monte Albán (Blanton *et al.* 1981:58–75; Fig. 23.4). Intensive field survey of the Oaxaca valley has shown the complexity of population distribution over time in different parts of this tripartite region (Feinman *et al.* 1985). In these cycles, nucleation appears to precede rural colonization, registered by decrease in the primacy index (Kowalewski *et al.* 1989: 510). In the first phase (between 700 and 500 BC), the valley had an estimated population of 2,500–5,000 housed in some eighty-five communities, controlled from about three centres. Between 500 and 300 BC, the whole valley was united under the control of a new foundation at Monte Albán, drawing political support from the three sectors of the valley (Marcus 1992a:399–401). This was the phase of greatest territorial control. A crucial debate is over the motivation of this nucleated state formation: iconographic evidence (see p. 939) suggests that the unification was not entirely voluntary. The growing nucleation continued long after the foundation of the state, while the exent of territorial control decreased (Marcus 1992a:400).

A similar sequence appears to have taken place in central Italy at the time of state formation between the first and second millennia BC. Population growth is detectable in the last centuries of the first millennium BC, succeeded by a possible drop in population levels and considerable nucleation in the ninth century BC. As at Monte Albán, the nucleation was the population base on which state formation was founded, but not clearly preceded by social ranking. As in the Valley of Oaxaca,

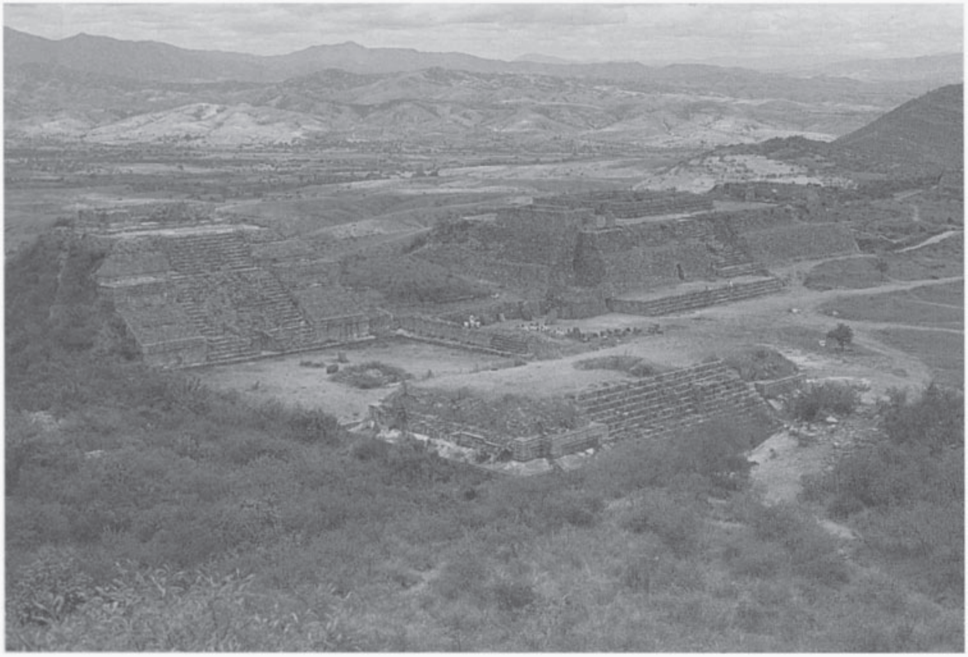

Figure 23.4 Monte Albán. Photograph: S.Stoddart.

it was also the basis for subsequent rural colonization, in this case in the seventh century BC, again registered by a decrease in the degree of primacy, but unlike the Valley of Oaxaca it entailed a strengthening of territorial control, in competition with closely placed, equally ranked centres, undergoing similar processes of nucleation and colonization.

Nucleation, however, appears to be but one route towards state formation. There is strong evidence from some regions of the world, less well-known archaeologically, that nucleation was not a necessary accompaniment of state formation. In some cases such as the Greek polis, nucleation was small scale. In other cases, the state based on a dispersed population was generally much more unstable (Genito 1994; Moses and Halkovic 1985:19–25). The nomads of the Asiatic steppes, the Maya in Mesoamerica, the Shang and the western Chou in China, Zimbabwe in central Africa and Angkor in Indo-China are examples of radically different distributions of population, suggesting considerably different mechanisms of state control, communications, and processes of formation. There is considerable current debate over the degree of centralization of groups such as the Maya (Fox *et al.* 1996).

Interaction

Interaction, in various levels of intensity, has always been an important constituent of theories of state formation. At the one extreme there are the mythical charters of the early states themselves, which give a simple picture of an exotic hero transforming society or of the arrival of society fully formed from some distant source. In some studies of state formation (central Italy, for example), such sources have been accepted literally until very recently. In others, diffusionism has been closely linked to trade. Even after the rejection of these extreme accounts, involving external interaction, interaction is still given a strong role in recent theories of 'peer-polity' interaction and 'core-periphery' relations.

Peer-polity interaction was established by its authors as a general theory of internal interaction affecting all forms of cultural organization, but has been most widely applied to complex societies (Renfrew 1982; Renfrew and Cherry 1986). The theory is based, at least in part, on the empirical generalization that states do not generally arise in isolation but in groups. The components of these groups are, it is claimed, competitive equals. It is the very process of competition and emulation between equal polities under conditions of intensification that leads to the growth of complexity and, at a later stage of development, to the formation of control hierarchies.

This approach has been explored in a number of different societies, but generally represents a simplification. Competition does not necessarily lead to precise emulation either of cultural practice or physical size. In some cases, the reverse can take place. To cite a few examples of this, Athens, in the mid-first millennium BC, employed writing extensively, whereas Sparta differentiated itself from its rivals by a public denial of literacy. In the Valley of Mexico, Teotihuacán was an unrivalled master of its region and considerably larger than any contemporary rival centre in Mesoamerica. In central Italy, approximately twelve city-states in the mid-first millennium BC competed with each other but varied considerably in size and cultural practice. Nevertheless, some types of state formation are much stimulated by the presence of rival communities developing at the same time.

Others have pointed out both practical and more theoretical difficulties (Cherry 1982). A major practical problem is establishing the independence of individual polities. Unless there are written sources, it is difficult to establish the political ranking or, conversely, the political rivalry of contemporary centres. However, in many cases of incipient state formation, the presence of incipient naturalistic iconography, early (even if politicized) literacy, and hints from later sources, have allowed the independence of centres to be established: examples include central Italy in the first millennium BC and the Maya lowlands in the first millennium AD. An associated theoretical problem is that the peer-polity interaction only explains change once the peer polities are in existence. How did the rival centres come into existence?

As repeated elsewhere in this chapter, and as discussed in Chapter 21, it is the appearance of pre-state social ranking that is perhaps the most difficult transition to explain: state formation is merely the culmination of process. The theory also has difficulty in explaining the timing and rate of change. State formation is frequently rapid. This rapidity may be inherent in competitive emulation, or it may simply be the only way that the stresses of an imposition of manifest inequality can be tolerated. Finally, the archaeological chronologies available do not always achieve the level of precision necessary to assess the contemporaneity of the emulation proposed by the model. Few archaeological chronologies approach the refinement of a generation, the time period over which some of the most rapid changes may have taken place.

The most current external interaction model is that of core-periphery (Champion 1989; Rowlands *et al.* 1987). This is a theoretical model borrowed from studies of the interconnectedness of world development since the sixteenth century (Wallerstein 1974). This analysis contrasts the consumers of the core/centre with the producers of the periphery constrained to meet the economic and political demands of the core/centre. Many archaeologists have ignored a further contrast made by Wallerstein (1974:348) between subsistence-based autonomous early empires, the subject of their investigations, and the Modern World Economy, based on the efficient location of production, which was the subject of Wallerstein's investigations. In other words, a model is drawn from its original application to a modern world economy and applied by archaeologists to a political economy that its original authors considered inappropriate! The approach has been extensively criticized as a eurocentric rationalization of the pre-modern world, imposing utilitarian principles where other value systems, particularly in connection with luxuries, may have been more appropriate. At its worst, it is diffusionism by a different name.

In spite of this basic difficulty, many archaeologists have applied the basic differentiation between core and periphery to many cases of secondary state formation (Champion 1989; Rowlands *et al.* 1987). The effects of the expanding Roman empire have been studied in this framework in Britain and Gaul (Haselgrove 1982, 1987). In the period before incorporation in the empire, there was frequently a phase of state formation in the buffer area between core and periphery. The phase was generally short-lived since it was truncated by incorporation in the empire, but its earlier development appears to have been inextricably related to interaction with the same empire that was later to destroy it.

CRITICAL CHARACTERISTICS OF THE STATE

Those who study state-organized societies, in spite of disagreements in detail, have isolated a number of dimensions which appear to be shared by all states. First, state-organized societies organize space in a strikingly different way from other forms of society. This organization of space forms the setting or context for all other characteristics of the state. Second, all states share highly developed levels of social stratification, economic specialization and politicized administration. Third, these elements are inextricably linked with a changed ideology. Finally, one of the frequent, but not necessary, changes in technology is related to changed ideology in the development of precise systems of measurement and communication, including most prominently writing.

Organization of space

In one sense it is self-evident to state that space or the landscape provides the essential setting of all other characteristics of the state, but less self-evidently this is a transformed setting. It was increasingly a cultural and political landscape which replaced the predominantly physical landscape that had provided the setting for other types of social formation. Many definitions of the state emphasize their 'territorial integrity' (Tainter 1988:27). Pre-state societies imprinted cultural categories on the physical landscape (Bradley 1993), but state societies brought the cultural landscape to a much more dominant position. The landscape is thus a very sensitive measure of political complexity, with a high rate of survival in the archaeological record.

In the zones as diverse in time and space as Mesopotamia and Etruria, cities were organized with respect to each other, creating their own political space rather than responding to the environment. The Uruk political environment was characterized by a series of competitive cores in fierce competition with each other and surrounded in turn by unoccupied buffer zones beyond (Algaze 1993: 115). The Etruscan city was surrounded by centrifugal zones of activity which had a political origin: funerary commemorative space, dependent agricultural space, subordinate settlements, and ritual boundaries (temples and emporia) (Fig. 23.5). In many states the organization of space was profoundly ideological. This ideological expression is most clearly seen in imperial states such as China and that of the Inca, where the capital formed the central focus of the known world beyond.

Some of the most effective advances in the state formation have been developed in the study of spatial organization and its relationship to the organization of power (Cherry 1987). This has taken two forms: the undertaking of large-scale field surveys of many of the key areas of the world where state formation has taken place, and the implementation of appropriate analytical techniques.

The success of field surveys is dependent on dry, open, conditions and an extensive regional method. This has been achieved most effectively in the Valleys of

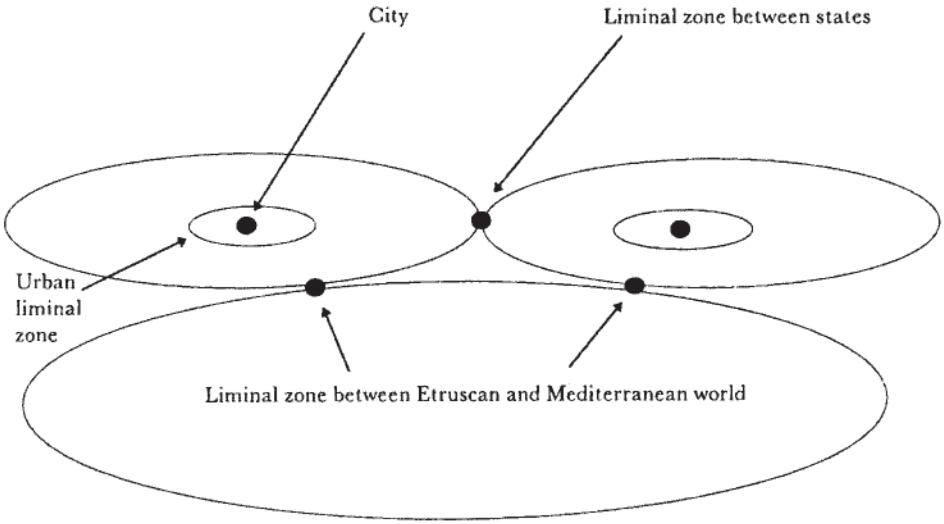

Figure 23.5 Ritualized boundaries around Etruscan city-states. Source: Accordia Research Centre, University of London.

Mexico (Parsons *et al.* 1982; Sanders *et al.* 1979) and Oaxaca (Kowalewski *et al.* 1989) in Mesoamerica, some of the coastal valleys of Peru (Wilson 1983), and in Mesopotamia (Adams 1981). All these regions are primary centres of state formation with good conditions for recovery. Furthermore, complete coverage was attempted, allowing the perception of the contrasting processes of nucleation of population and evacuation or desertion of space. Field surveys have been attempted in Greece (Bintliff and Snodgrass 1988) and Italy (Potter 1979), but recovery conditions have proved to be much more complex, although a very necessary complement to traditional studies of cemeteries and major settlements.

One major area of research is mapping the territorial extent of state power (Cherry 1987:152–59). These techniques have traditionally involved the use of historic or ethnohistoric sources, or employed other assumptions to match political boundaries and natural catchments. More recently, the techniques of spatial geography have been brought to bear. The simplest is the concept of the Thiessen polygon. This requires the simple, and equal, division of territory between centres. A weighting derived from the size of individual centres can also be added. A more dynamic approach is that of XTENT, which enables a developing landscape to be mimicked (Renfrew and Level 1979). The XTENT of territory is a mathematical expression determined principally by the size of the centre, but with other components which can be varied to extend the territory. These variations can mimic the full range of political development, from a virtually empty political territory through to a packed and competitive landscape.

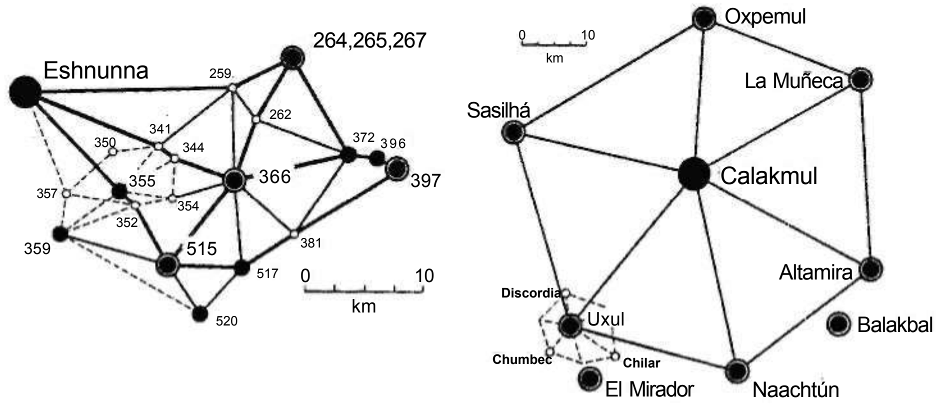

Figure 23.6 Comparative spatial characteristics of states. Reproduced with permission of J.Marcus and K.Flannery.

Once the territory has been mapped by whatever means, the hierarchy within that territory can be examined. Much of the work is heavily influenced by economic geography (Hodges 1987; Smith 1976a, 1976b), as a development of the work of Christaller (Fig. 23.6). In more strictly archaeological work, the simplest approach is to examine the quantity of sites of each size class (Fig. 23.7). This can establish a sense of the hierarchy of sites in any given area. A different approach is to arrange the sites in order of rank size. In modern studies of cities, the curves produced by such orders of rank size have been assumed to show different types of settlement system. The addition of archaeological evidence appears to show a typical development over the period of state formation from a convex curve through an intermediate stage of primacy of a number of principal nucleated centres towards a straight or lognormal distribution. These sequences have been explored very effectively in the earliest cases of state formation (Wright 1986) and in a number of cases of *secondary* state formation such as bronze age Levant (Falconer 1993) and iron age Etruria (Guidi 1985).

A critical problem remains. The scale of necessary spatial analysis is often beyond the range of a single survey: for example, the total territory covered by some Mesoamerican states (not empires) approached 100,000 square kilometres. Fluctuations of population density and political control must also be perceived at a broad scale (Marcus 1992a). In this sense, state formation in one region is related to the opportunities provided by state decline or collapse in another. In Mesoamerica, states seemed to have been formed as part of a competition between rival centres, where one centre became more successful than its neighbours and rapidly reached its greatest territorial extent by incorporation early in its trajectory. Subsequently, the mature state grew at its centre, whilst declining in territorial control at its periphery; investment shifted from expansion to centralization. Later, a peripheral

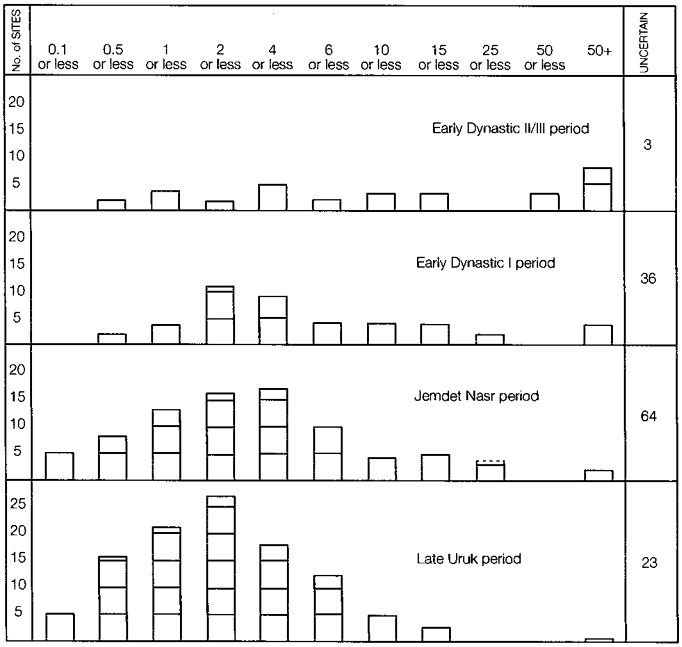

Figure 23.7 Site sizes in the Uruk countryside. Source: Adams and Nissen 1972.

area very often set up its own trajectory of expansion, or at least with allies managed to weaken the original successful centre.

The understanding of this type of development requires detailed survey in central and peripheral areas. Furthermore, these central and peripheral areas shifted through time as, for example, Teotihuacán at the centre was replaced by Tula, the latter originally on the periphery and one of a number of roughly equal centres. After a period of expansion, Tula itself was replaced by Azcapotzalco, again one of a number of rivals for power. Finally, Tenochtitlan surfaced from a number of rival centres and founded a state that became the well-known Atzec empire (Marcus 1992a:399). State formation here, therefore, was not aligned and synchronous, but composed of shifts of spatial focus which will require generations of archaeologists to unravel. A similar pattern is repeated in the Maya lowlands (Marcus 1992a: 406–8). Early states, particularly perhaps those in the New World with greater transport logistics (without the horse, for example), lacked the long-term spatial cohesion and effective control of their declared territories. In Italy, the relationship between the Latins and the Etruscans was not dissimilar: the Etruscans were the dominant political force in central Italy until the sixth century BC, until the hitherto peripheral town of Rome became dominant and toppled the neighbouring Etruscan polities.

Social stratification

Social stratification stands at the core of many definitions of the state (Fried 1967; Krader 1978). There are few early states which lack clear evidence (in terms of settlement structure and funerary remains) of distinctions in access to wealth between members of society. The major exception to this rule is the early civilization based in the Indus and Ghaggar-Hakra (Sarasvati) river systems in the third millennium BC (Kenoyer 1991). The cities lack clear internal differentiation along social lines and lack the evidence for prominent cemeteries so visible in other case studies. The ideology in this case was such that any differentiation in wealth and power was strictly controlled and sublimated. Miller (1985) has defined this society as authoritarian, but not ranked, providing an important contrast with many definitions of states.

Highly visible funerary remains were nevertheless the rule at the formative and transitional stages of state formation. Some societies, in particular, were preoccupied with the rituals of death and provide excellent studies of the sudden differentiation of access to wealth and power. The most notable case is that of ancient Egypt, where state unification was accompanied by a dramatic change in tomb construction (Kemp 1989:53–63). Whereas the predynastic tombs at Nagada and Hierakonpolis were modest constructions, tombs of the First Dynasty (early third millennium BC) suddenly combined monumental scale and distinctive architectural symbolism, with the niched and decorated façade of the tomb becoming a symbol of power. The step pyramid at Sakkara (*c.* 2695 BC) represented a further elaboration of burial monumentality, providing an appropriate setting for the pageantry surrounding the king; the true pyramids, constructed from the Fourth Dynasty onwards, reflected the increasing deification of the king (Fig. 23.8). Etruscan burials in central Italy reflect the same transitions on a lesser scale: the most prominent burials are precisely at the moment of state formation in the early seventh century BC.

Mortuary rites are thus a particularly prominent part of the display strategies of some early states. The most extreme example is elaborated through a linkage to coercion in the case of China. Whole retinues were interred with the dead ruler. China is a particularly fruitful case study since the process of state formation was based on the success of competing conical clans, each searching to make material expression of their power. The excavations at Erh-li-t'ou in early Shang China have begun to elucidate this process (Chang 1980). An earthen palace platform measuring 108 by 100 metres was placed at the centre of the settlement within a separate compound. Nearby are a number of burials, many clearly victims of socially embedded religious ceremonies, providing the ultimate distinction of social stratification: power over life and death. Recent discoveries in Mesoamerica suggest a similar powerful display. The dedication of the temple of the Feathered Serpent at

Figure 23.8 Egyptian pyramids. Photograph: S.Stoddart.

Teotihuacán contained the sacrifice of about 200 bound—and therefore captive—male warriors (Cabrera Castro *et al.* 1991).

Economic specialization

Division of the economy into specialist sectors is generally agreed to be an important constituent of state-organized society, even if the articulation of that specialization within complex society is more controversial and the importance of its role varies from society to society (Brumfiel and Earle 1987). In some models of specialization, the political intervention of the rulers is crucial to development. In many such cases, monopolies of production were established to control not only the necessities of life (such as subsistence products), but also the luxuries which became exclusively linked to political power.

State specialization in subsistence production can be a very effective support of the maintenance of political control which, when present, is strongly linked to the development of an effective administration (see pp. 934–35). Large aggregations of individuals in states and cities require feeding for survival, and specialization is one strategy for its effective implementation. Even so, many states developed without a major specialization in the sector of subsistence production (Brumfiel and Earle 1987:6–7); the problem was reduced if manpower was plentifully available.

Mesopotamia provides one of the clearest cases where specialization of subsistence production was developed (Galvin 1987; Zeder 1991). At a basic level, significant proportions of the population became involved in non-subsistence production, leaving livestock production as a segregated, specialized section of the economy. According to Galvin (1987), by 2100 BC specialization of livestock production was beginning to be established. Special livestock collection points, fattening establishments, and legal codes were developed. In a more detailed analysis of Banesh in levels as early as 3300 BC, Zeder (1991) claims to have found specialized systems of meat distribution among the élite. Through time, more complex and indirect processing systems appear to have been developed to channel animal products from the herds to the consumers.

State specialization in luxury production can be a very effective means for validating control. Specialization of luxury production was much more uniformly present in early state societies, but élites were not always successful in establishing monopoly positions (Brumfiel 1987). The Aztec and Inca states reserved certain materials for the use of the ruler. Cloth was particularly subject to these restrictions in upland South America (Earle 1987). One of the most striking studies of specialized craft production has been undertaken as part of the mapping project of the site of Teotihuacán in the Valley of Mexico (Millon 1981). Clear differentiation of obsidian and ceramic production zones as well as merchant quarters can be detected within the confines of this city of 20 square kilometres. Craft specialization is also prominent in the case of the Harappan civilization (Kenoyer 1991), providing one of the rare signs of differentiation in this society. Similar studies have also been undertaken at Doganella in Etruscan central Italy, exploring the internal economic differentiation of an important gateway settlement between two states (Perkins and Walker 1990).

Administration

A central element of any state was its administration; indeed this role is linked to many theories of state formation, particularly where administrative data are abundant (Wright 1969, 1977, 1978). The bureaucratic apparatus for the supply of food, the control of personnel, and the regulation of information, were essential for long-term stability and may have provided the motivation for the creation of the state.

The most influential studies of the administration within an early state have been based on the archives of early Mesopotamia. These place the temple at the centre of the urban community, buffering the effects of changing economic and political conditions. The temple was in a position to collect and distribute surpluses of produce. The temple also had an independence, based on wealth collected from gifts and offerings, its landed estates, and access to labour. A major subject of debate is the relative degree of involvement of the temple in the administration of the state (Postgate 1972). In Early Dynastic times (the early third millennium BC), the role was probably considerable, but reduced with the arrival of secular authority. It has now been conclusively shown that by 2500 BC the temple only owned a minority of the land, with the majority in the hands of the ruling family, palace administrators and priests (Diakonoff 1972).

Studies of the varying types of archives give a good impression of the interconnecting levels of administration. Foster (1982) has identified three types of archives in Sargonic Mesopotamia: family/private, household, and great household. The family archives are largely composed of round tablets, with varied handwriting covering local legal transactions of land and sale/purchase of goods, involving few individuals. Household archives have a principal administrator specializing in a principal subject important in the local area, such as agriculture (land management and food distribution). Draft copies appear to precede polished copies prepared for more central administration. Great household archives have a greater diversity of subjects (agriculture, industry, military) and complexity of filing. Political rulers appear as principal administrators or points of reference. Interlinkage between these levels provided the essence of administration.

Another well-researched classic case of the administration of what is generally considered a state-organized society is that of Minoan Crete. The tablets principally derive from three categories (Renfrew 1972:296–97): receipts of goods, disbursements of goods, and inventories. Payments out include rations for personnel and ritual gifts. Payments in include assessments of tribute. At the very least there is evidence here of the central control of information about subsistence products arriving at and leaving the palaces. This information, when combined with the level of nucleation, the local agricultural capacity, and the evidence of storage, strongly suggests that the central administration in the palaces was collecting a surplus to support a population too large to be supplied from local fields.

Ideology

A very important aspect of the maintenance of states is the definition, measurement, and control of commodities, both material and immaterial. Ideological requirements are shared by all complex societies, but the state needs a much more effective strategy commensurate with the greater differentiation of wealth and political power.

State-organized societies developed forms of standardized measurement as part of their mechanism of control: weights, volume, the law, and time. Calendars appear for the first time. Economical use of time became important and was marked as a resource in itself, under rigorous control. It also reinforced the preference towards nucleation of population which reduced the costs of distance. The control of time is thus a fundamental segment of state ideology, which was particularly emphasized beyond the boundary of directly experienced physiological time: the unexperienced time of the distant past. In state-organized societies the control of the content of the past allows the claim of continuity to be made when, in fact, major social and political changes had undoubtedly taken place. A new view of the past was created, but the novelty was disguised. In many societies, writing in the hands of the state authorities was employed to facilitate this process.

Ethnographic accounts allow exploration of this process. Those of the Asante state allow a fairly detailed appraisal. Control of time was highly visible. Any evidence for a separate origin of the constituent units of the state was consciously controlled, with 'the government politically undermining every monument, which records the distinct origins of their subjects' (Bowdich 1819:228). A taboo on the discussion of clan origins persisted until the time of the later ethnographer, Rattray (1929:65): 'one dares not discuss the origin of another'. In the place of the individual origins of the constituent parts, new forms of history were put in its place. At one level, the state was reported as merely the enlargement of an ancient relationship between housefather and family (Rattray 1929:105). The state's version of origins seems to have misled even the same respected ethnographer in a convincing demonstration of the power of this state's ideology: 'every germ of the more advanced system of government with which we have to deal already existed in this little family democracy' (Rattray 1929:403).

At another level, the historically imprecise ancestors of the non-elite were contrasted with the official ancestors of the state itself. All the sources, ancient and modern, refer to Osei Tuku (the Asantehene) and Okomfo Anokye (his priest) as the creators of all precedent, structural and ideological. This position was also given a point of reference in material culture that emphasized the 'enlargement of the ancient relationship between housefather and family'. The Golden Stool was the extrapolation of an image that pervaded the whole of Asante life to the highest of hierarchical levels. Each individual, however humble his office, had a stool that mimicked the highest ideal of the state. By this technique, the state could claim that it was no more than a logical culmination of preceding existence, even if, in fact, it represented enormous innovation.

Archaic Greece provides a wealth of similar evidence of respect for the past through the cult activities at the tombs of the earlier bronze age dead. These have been collectively classified as hero cults (Whitley 1988), although it may be too simple to see these as part of a wider pattern of ancestor respect linked to early states. The important emphasis is on the right of burial within a demarcated cemetery earned as a member of the citizen body of the state. In ancient

Mesopotamia, some research into the past by the rulers of states almost has an archaeological dimension to it (Schnapp 1993; and see Chapter 1). Narbonides was very conscious that he followed a long line of rulers and examined the material culture of the past—stelae, clay tablets—to allow the proper restoration of a lost cult (Reiner 1985). This gave his rule in the present the necessary legitimacy.

Writing and literacy

Writing, the material counterpart of language, is not a prerequisite of state organization in spite of the emphasis given to it by Gordon Childe (1950), or indeed dependent on state formation for its development (Marcus 1992b:32). It is rather a technology adopted by some states for practical and ideological purposes. A number of state-organized societies, notably the Yoruba and the three major civilizations of Peru (the Moche, the Chimu and the Inca), employed no writing system. Others, such as those based on Teotihuacán and Sparta, made minimal use of it, in spite of, or perhaps because of, its prominence in neighbouring societies.

The development of scripts is no longer seen as simple progression from pictures to signs, to syllables and then to the supreme achievement of the alphabet (Whitehouse and Wilkins 1986:130–31). Formalization, a necessary ingredient of a usable writing system, took place at a very early stage. An examination of New World writing systems shows the heterogeneity of writing, the combination of pictographic, logographic/ideographic and phonetic elements in the choice of component parts. Writing developed in the late fourth millennium BC in both Egypt and Mesopotamia, where good preservation of papyri and clay tablets respectively has allowed detailed study to be made of the strikingly different uses of literacy in these two early societies. Writing only developed in Mesoamerica from *c.* 700–400 BC.

The treatment of literacy has varied in its emphasis on its technological effects (Goody 1968) and its social implications (Street 1984). As a technology, writing stores information and allows transfer of that information over large distances independently of individual personalities. The implications of writing depend heavily on the social context where it is employed. Wherever it is used it can be very effectively exercised for display and propaganda even for those unable to penetrate its meaning.

Literacy was highly restricted before the advent of the printing press. In most early states, the political élite saw to it that literacy remained their closely guarded monopoly. The restricted access to literacy was aided by the complexity of the scripts of early states, which required extensive training to allow competent use: the Mayan and Egyptian writing systems, for example, employed 700–1,000 signs. Access to literacy was not, though, simply a matter of technical proficiency. The more simple alphabetic script may have enabled, but never led to, extensive literacy (Harris 1989;

Stoddart and Whitley 1988), until the state-developed systems of mass education of the modern era.

Many studies of state formation and writing have stressed the bureaucratic concerns of scribes and priests. In Mesopotamia, the painstaking records were made to record movement of commodities and were thus essentially economic. The Mesopotamian temple is the institution where the earliest collections of written documents have been found. They comprise two types: lexical texts or reference works and administrative documents. The lexical texts supported the unilateral nature of this type of literacy, the primary aim of which was to service the large estates as recorded in the administrative documents (Postgate 1984). This was an internalized administrative system, allowing transport of information through time rather than space. The Mesopotamian system was, though, greatly extended in the succeeding centuries (Postgate 1984): the new roles included many aspects of law, particularly land transactions, business records, letters, and literary texts. Literate administration was even transacted at the household level, suggesting a quite considerable distribution of literacy (Foster 1982).

The Mesopotamian use of writing does, however, appear to be exceptional and uses in other early states depended greatly on the social and political context. In China, the early use of writing was strongly connected to social identification rather than to the economy. Kinship was the key to early Chinese society and this is reflected in writing itself (Chang 1980:247–48). A similar pattern is visible in the early use of writing in Etruria, where writing was initially restricted to an élite engaged in ritualistic gift exchange (Cristofani 1975; Stoddart and Whitley 1988). The situation was not even straightforward in the early Greek states: writing was sometimes associated with barbarians and one state, Sparta, wielded immense political power without visibly adopting the literacy of its neighbours (Thomas 1992:130–31).

Public display of literacy appears to be a unifying theme of many early states, often linking the figurative to the literate. The fifth-century BC state of Athens took great care to display tribute lists. The early Cretan city-states displayed their laws (Stoddart and Whitley 1988). Literacy was public and monumental. In many cases, it was linked to public rituals where the act of writing was as important as the content (Beard 1985).

The most evident use of writing as political display can be seen in the Mesoamerican and Egyptian state-organized societies (Marcus 1992b; Fig. 23.9). The visual effect of symmetry and balance was as important as the content. In Mesoamerican cases, myth, history and propaganda were combined in the annotated images of the political élite. The concept of time was radically different to the linearity which we employ today. Historical events were woven into cycles of natural phenomena which had the predictability so much required by the political élite.

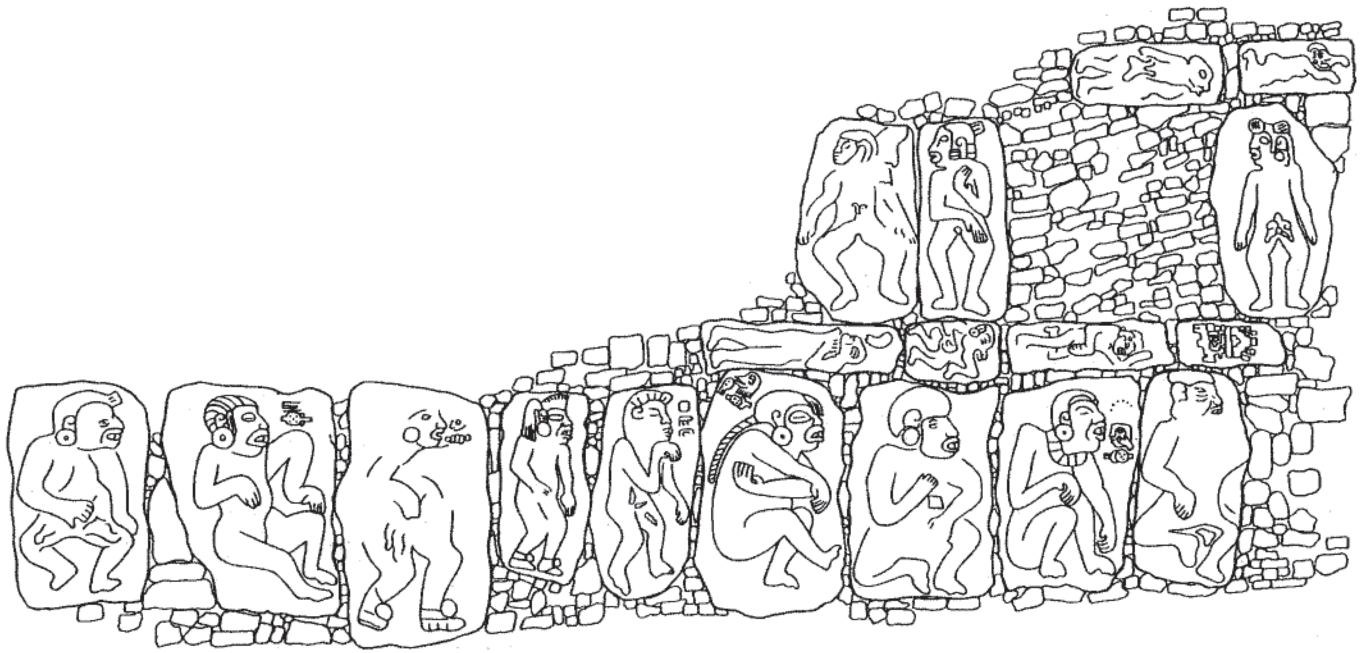

Figure 23.9. Stone sculptures at Monte Albán. The lowest row of victims features individuals whose hieroglyphic names could be read by persons standing close to the gallery; all those individuals face to the viewer's right. The second row shows corpses in a horizontal position. The third row shows victims facing to the viewer's left; the fourth row again shows horizontal corpses. Source: Marcus 1992b.

Truth was defined with reference to the political present. As Marcus (1992b: 15–16) explains, this covered a wide field: the identification of vanquished individuals and places and the resulting limits of political territory; the nodal points of genealogy (ancestors, birth, marriage and titles); and damage, obliteration of rivals and reworking of time to cover the gaps. In Mesoamerica, the most prominent example of rewriting history is that of the Mexica in the reign of Itzcoatl (*c.* AD 1428–40), who as founders of the Aztec state required a more substantial past. Similar strategies were employed in ancient Egypt. The most famous, if indeed exceptional, case here is that of Amenhotep, who started deliberate political action against the priests of Amun and set in train a series of fluctuating political processes over the period *c.* 1450–1300 BC. Amenhotep changed his name to Akhenaten and moved his capital to Akhetaten from Thebes. His successor was Tutankhaten, better known as Tutankhamun because he reversed the process to protect his political position. Their successors attempted to erase these political aberrations from history. At each stage, inscriptions were remodelled to reflect the political present.

Visual display was often the counterpart of coercion, although completely absent from the material culture of some state-organized societies such as those of the Indus. An extreme expression of the interlinkage of writing, iconography, and coercion is the prisoner staircase at Tamarindito, one of a number of Maya sites, where bound, almost naked, prisoners form the steps, crushed by the victorious élite. An even more emphatic monument was set up at Monte Albán in the Valley of Oaxaca between 500 and 400 BC at the transition to state formation. This monument provides a display of some 300 naked corpses (Fig. 23.9), with mutilated bodies arranged in awkward positions and the most eminent identified by name. A later building on the same site appears to record fifty localities or landmarks on the boundaries of conquered territory to a limit of 50–150 kilometres from the central place (Marcus 1992b:394–400). Other Mesoamerican maps do not necessarily show accurate measurement, but the political map as the state wished it to be conceived. Political dependency was the key information.

Many of the monumental inscriptions fall within the class of vertical propaganda, devised by the élite for viewing by the majority. These were displayed in prominent positions and had to be impressive visually since literacy would not have been widely available. Some were coercive as described above. Others simply provided the authority of codified law and other public statements. In other cases the propaganda had a more private audience of the élite itself and can be classified as horizontal propaganda. This type of propaganda was employed in Mesoamerica, for instance at the Maya site of Palenque: in the Temple of the Inscriptions, the depiction of the dead ruler's fictive genealogy in iconographic form could only have been seen by an élite few. The same is particularly true of the paintings of Etruscan tombs, to which only a restricted group belonging to the élite family would have gained access.

The balance between public and private propaganda reflected the type of political structure of the individual state. In Mesoamerica, the Aztec emphasized the public monuments, whereas the Mixtec concentrated on relatively private codices. The Zapotec and the Maya combined both techniques. In Archaic Crete, the only form of literacy that has survived was inscribed as public law codes. In Athens, a much wider use of literacy has been preserved.

Coercion

The ultimate sanction of any state was the implementation of force. It is very easy to interpret visible fortifications and panoplies of military hardware in élite graves as the operation of this final sanction. In reality, such material culture may be more a sign of the vertical propaganda already discussed.

The use of force is perhaps better conceived as a failure of other means to achieve the same ends: the control of the large populations by relatively few. Undoubtedly, coercion was more frequently threatened than activated, but certain cultural traditions of state organization resorted to such methods more frequently: Mesoamerican and Chinese societies certainly give an impression that violent warfare was a frequently employed method of control of large populations.

Generally, however, coercion is more often a product of major transitions: formation and collapse (Chapter 25). If coercion was used repeatedly, the state would simply have ceased to exist, since over the extensive territory controlled by a state it would have been impractical to use it simultaneously. The energies of the state would have been too much distracted from other activities. In some societies, such as Mesoamerica, where coercion does appear to have been extensively used, early states appear to have fragmented at their margins because of the impossibility of bringing coercion to bear at the geographical limits of physical power.

CONCLUSION

State organization brings advantages and disadvantages. The study of the collapse of states and empires is covered in Chapter 25, but it is worth pointing out here that states and empires close to collapse often expose more readily their mechanisms for maintenance, shifting the balance from advantage to disadvantage. One only has to read the moving accounts of Ethiopia in the last days of Haile Selassie to see the increasingly ineffective and visible mechanisms for the maintenance of a state: in particular, attempts by the state to secure information and respond to it with increasingly weak coercion. These mechanisms would have remained concealed if all was well.

Many authors have pointed out the disadvantages of civilization even when functioning effectively. The primary area of disadvantage is that of exploitation. The organizers of many early states made successful attempts to extract labour from the majority. Many of the characteristics of states described above derive directly or indirectly from this basic characteristic. There are many consequences. One prominent area is that of the well-being of the population, which can be calibrated by the simple measure of physical health. Increased population density has provided fertile ground for the development of diseases which differentially affected those at a material disadvantage; an infectious disease such as tuberculosis benefited greatly from the development of urbanism and the differentiation presented by the state apparatus (Blakely and Mathews 1986).

The presence of the state is, therefore, a dynamic balance between the imposition of taxes (in the broadest sense) and the benefits of services and security. The limit of tolerance, if that formula went awry, varied between different societies. Many early states were under pressure to expand and extract more from the majority, producing tensions between the rulers and the ruled. For the majority of the population, this would have disturbed the stable equation of advantage and disadvantage. Thus in most early states, long-term trajectories were in the minority, since there were always potential tensions leading towards decline and collapse.

In the final analysis, state formation is no more than the climax of a longer process where social inequality is held more firmly in place. Some of the formative phases prior to state formation have already been explored in the two previous chapters. It is the development of the effective institutions of control and coercion, not just in the urban centre but in the whole landscape, seeking to provide more stable and resolute political power, that lies at the heart of the state. In reality, this control was never absolute and states exhibit varying control over space and through time. Considerable wealth differentiation may seem a very efficient implementation of power in the short term but may present a less stable political trajectory in the long term. This is perhaps the simple lesson that the knowledge of long-term trends from archaeology can provide for certain parts of the modern world.

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The 1970s provided a number of abstract accounts of state formation, attempting all-embracing cross-cultural explanations of the rise of complexity. One of the seminal approaches is that of Flannery (1972), employing systems theory. A further influential branch is that of Wright (1977, 1978), who aimed to dissect changing variables and causes of state formation. A contrasting Marxist approach was contributed by Friedman and Rowlands (1977). In the 1980s and 1990s, often after regional research projects generated by general theory, explanations of local and regional sequences have become more prominent, although many of the best of these are visibly aware of the importance of comparison. Blanton *et al.* (1981) provide an overview of Mesoamerican state formation, but recent works, particularly from the Maya area, show that much debate over the interpretation of evidence still remains (Fox *et al.* 1996; Marcus 1992b). Kemp (1989) provides an important account of Egypt which goes beyond the hieroglyphic detail. For Mesopotamia, Redman (1978) still provides an effective balance between archaeology and textual information, and Adams (1981) gives an excellent account of the spatial dynamics. Work in the Indus valley has seen many recent advances and these are summarized in Kenoyer (1991). Work in China is more difficult to assess and the successive editions of Chang remain one of the best sources (1980). Wright (1986) has written an excellent overview of all the evidence then available to allow a comparison of the major early states. The different cultural and developmental characteristics of Greek state formation are covered by Morris (1987), whereas similar coverage of the central Italian evidence is more difficult to achieve without knowledge of the Italian language, although Bietti Sestieri (1992) and Spivey and Stoddart (1990) make a contribution.

24

THE DEVELOPMENT OF EMPIRES

Stephen L.Dyson

BACKGROUND AND DEFINITIONS

The conquest and subjection of other social and political groups has been a process in human history ever since the appearance of *Homo sapiens*. Most of those conquests have been savage, but transitory. The concept of empire implies a systematic, long-term organization of that conquest. This organization developed around a series of institutions that allowed the initial domination to turn into stable control based on a whole variety of exploitations. Among these were systems of military control such as forts and garrisons, the extraction of economic resources in the form of tribute and taxation, trade dominated by the imperial power, the purposeful spread of the political, social and economic institutions of the imperial society into the conquered areas, and systematic efforts to acculturate at least members of the conquered élite into the dominant society.

The history of empires has been mainly studied through written documents, both official and unofficial, and, in the case of more recent empires, through oral history and contemporary accounts. This documentary approach reflects the tendency of historians to base their research on the written word; but the perspective on any form of imperialism derived from written documents is often a limited one: written texts largely reflect the views and bias of the ruling social and political élite within the dominant power. Written accounts illuminate only parts of the imperial process. They emphasize military and administrative developments over long-term social and cultural change. The world of the governor-general is represented more than that of the conquered warrior, the slave, or even the lower class members of the imperial society. This élite view of history is no longer acceptable at a time when scholars seek to understand the 'forgotten' in history and look at the history of imperialism through the post-colonial perspective of the colonized rather than the colonizer (Tiffin and Lawson 1994; Woolf 1992). Other historical sources need to be found, which will provide information on these other individuals and groups which are under-reported or unreported in the traditional histories.

Archaeology has a key role to play in this search for a fuller history of empire. Archaeology deals in physical monuments, and many imperial governments have been great builders. The Great Wall of China, Hadrian's Wall in Britain, the Roman roads found all over western Europe and the Mediterranean, and Inca roads in Peru, substantiate this connection between empire and engineering. However, the political and economic impact of empires is also represented by more humble objects, be they a Staffordshire plate in a British frontier fort on the Great Lakes or a piece of Roman silver in the grave of a German prince. Archaeologists today use in their reconstructions of past societies the full range of surviving objects, including such humble items as cooking pots and chewed animal bones. Such artefacts sometimes provide the only information that we have on groups like slaves and peasants, who played an important, if oppressed, role in the imperial process.

The archaeology of empires, like all branches of historical studies, has changed dramatically over the last one hundred years. For a long time the research of such archaeologists centred on military questions. They excavated forts, located battlefields and combined forces with document-based historians to reconstruct the advance of empires and the campaigns of famous generals like Julius Caesar and the first-century AD Roman governor of Britain Agricola (Hanson 1987; Le Gall 1990; Pinon 1991). The archaeological study of the Roman empire can trace many of its roots back to nineteenth-century research in military archaeology carried out in France by the emperor Napoleon III on the battlefields of Julius Caesar, along the Roman Rhine frontier in Germany and on Hadrian's Wall in Britain (Birley 1961; Pinon 1991; Schleiermacher 1961).

Changing scholarly and social values and a different concept of colonialism and imperialism have moved both historical and archaeological studies beyond a focus on the administrative acts of proconsuls and the developmental history of forts, roads and marching camps. The study of empire has become more holistic, considering the full range of impacts, political, social, economic, intellectual, ecological, and biological that the imperial process had on the conquering as well as the conquered (Cooper and Stoler 1997; Crosby 1975, 1986; Greenblatt 1991). More emphasis has been placed on considering all the different aspects of imperialism from conquest to trade and ecological change. Many historians of imperialism, influenced by the views of Immanuel Wallerstein on the development of early modern empires (Wallerstein 1974), emphasize the unequal development that took place between the imperial core and its provincial peripheries and the high level of social and especially economic dependency which that created. Others have argued that Wallerstein's theories exaggerate this dependency and underestimate the ability of the conquered to resist and adjust to imperial exploitation (Stern 1988; Williams 1992). Archaeology, with its ability to represent those outside of the written record, can contribute significantly to this debate. However, this means that the archaeology of empire must also be an archaeology of trade, of rural development, of ecology, of disease, and of slavery.

An archaeological approach is theoretically applicable to any past imperial system. However, most archaeological research has been centred on a limited number of well-known empires. Rome has received special attention. Imperial systems associated with other ancient Mediterranean civilizations such as Mesopotamia, Egypt, Greece, and Phoenicia, have also been the objects of considerable research. In the New World, the empires of Mesoamerica and South America, especially of the Aztecs and Incas, have been extensively studied (Conrad and Demarest 1984; Hyslop 1984; Smith and Berdan 1992). Much less archaeological work has been done on other imperial systems, such as those of China and Islam.

Historical archaeology has become an important field of study in North America since the 1950s, and historical archaeologists there have centred much of their research on the colonial and post-colonial eras of the sixteenth century to the mid-nineteenth (see Chapter 28). This has meant the development of an archaeology of early modern European imperialism. For a long time this research was almost totally concentrated on eastern North America and was concerned mainly with the results of British imperialism. More recently, this archaeology of European empires has been extended not only to Spanish, French, and Dutch colonialism in North America, but also to other parts of the imperial network in places like Australia and South Africa (Schrire 1988). Since these early modern imperial systems had world-wide impacts, the need is to develop a global archaeology to study the material remains of this colonial process and evaluate their material impact on different cultures (Falk 1991).

This chapter will apply such a holistic approach to the archaeology of empires. It will consider military archaeology, but also the archaeology of acculturation, trade, rural change, and slavery. Most examples will be drawn from the better investigated imperial systems of Rome and the Americas. It does not claim to be comprehensive, but aims to provide an overview and indicate some promising areas for future archaeological research.

THE ARCHAEOLOGY OF IMPERIAL INSTITUTIONS

Empires are often best remembered by the structures and monuments that they left behind. These can range from Hadrian's Wall in the north of England to the railroad stations of the British Raj in India (Davies 1987). They represent efforts by the imperial power to impose military and political control, improve trade and communications, and acculturate the conquered to the conqueror by symbolic manipulation and the radical restructuring of the belief structures of the natives.

Military archaeology

Military archaeology has been central to the archaeological investigation of empires and has contributed in important ways to the origins of the discipline. Antiquarian studies on Hadrian's Wall in Britain began in the sixteenth century, reaching their height in the eighteenth and nineteenth centuries (Birley 1961). In the later nineteenth century frontier archaeology, especially in Germany and Austria, became more scientific. This research was designated *Limesstudien* from the Roman name for border or frontier. German and Austrian scholars undertook a long-term programme of archaeological research on the Roman frontier forts along the Rhine and the Danube (Fig. 24.1). In the systematic manner of the epoch, great effort was devoted to the identification and mapping of the forts, towns, roads, and walls that were part of the Roman border defence system, the careful excavation of military sites, and the study of their material culture. A strong interest in connecting the archaeological discoveries with historical events known from the ancient writers led to an emphasis on the precise dating of the occupation phases of sites through pottery and coins (Schleiermacher 1961). Many of the sites investigated had long been known through their striking visible remains. Others had been discovered by accident through farming activities, building construction or through the patient on-the-ground investigations of generations of antiquaries.

The development of aerial photography provided an important new tool for frontier research. Archaeological photographs made visible the plans of sites, which had left little or no trace above ground. New information on roads, camps, and field systems became especially abundant. Much of the pioneering research was done by O.G.S.Crawford between the world wars, flying over the grassy, open countryside of much of southern England, a landscape that proved especially suitable for this type of research (Crawford 1928). These investigations expanded dramatically after the Second World War, stimulated in part by the thousands of air photographs taken during the war (Bradford 1957). It has proved especially useful for the investigation of inaccessible Roman frontier zones in areas like North Africa (Baradez 1949) and the Middle East (Kennedy and Riley 1990). It has also allowed the development of an overview of frontier systems that is not possible even with the best ground research conditions. In countries like Great Britain and France, aerial photography has continued to produce abundant new information on certain types of military sites such as turf- and wood-built forts and marching camps that were occupied for only a brief period of time and left little or no surface remains (Welfare and Swan 1995).

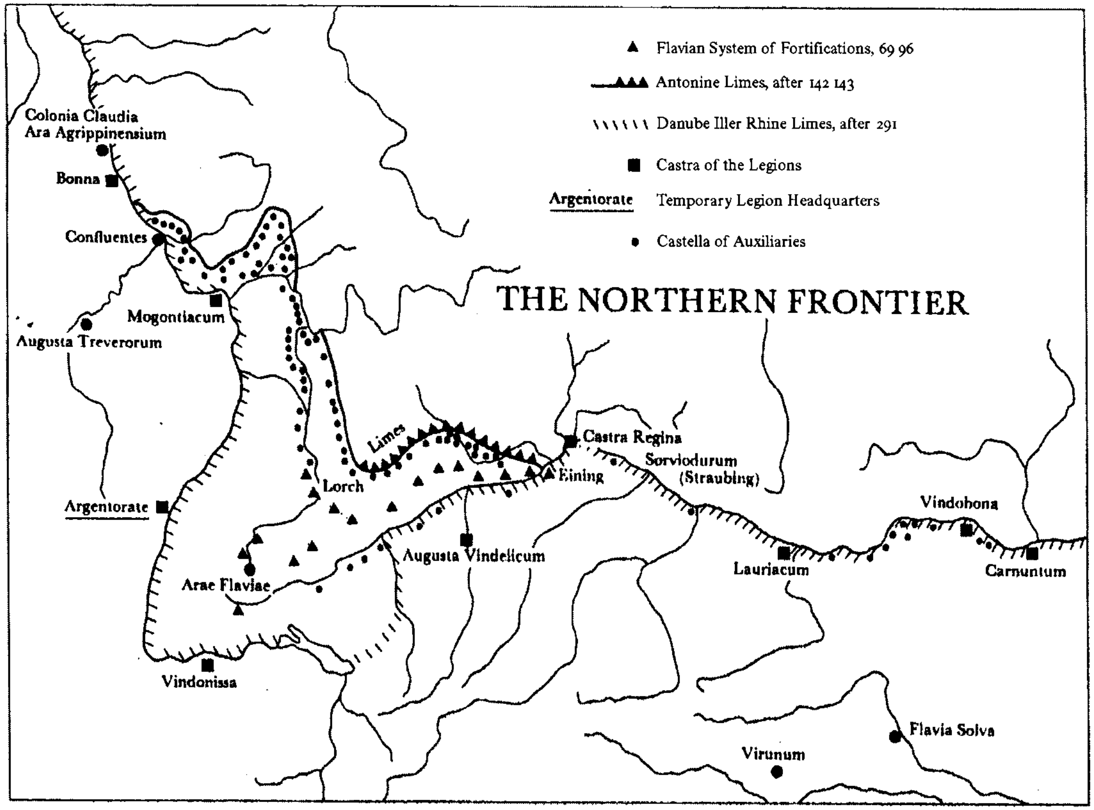

Figure 24.1 Map of the Roman *limes*. This map shows the basic disposition of Roman military forces on the Rhine and upper Danube frontier in the later first and second centuries AD. The major legionary bases were connected by a line of small unit, auxiliary forts. Source: H.Schutz (1985) *The Romans in Central Europe* (New Haven and London: Yale University Press).

Air research always has to be coordinated with ground survey and excavation. Seldom can sites like Roman camps be dated solely on the basis of their plans: information on occupation history must be obtained through the collection of surface material like pottery and through excavation. These newly discovered and dated sites, which range from the short-term marching camps regularly built by the Roman army, through forts in wood and turf designed for intermediate-term occupation, to permanent stone facilities, can then be related to military campaigns known from the ancient Roman historians. Much of this research in Northern Britain and Scotland has concentrated on the reconstruction of campaigns, such as those of the Roman general Agricola during the AD 80s (Hanson 1987) and the Roman emperor Septimius Severus in the early third century AD (Breeze 1993). A well-preserved and studied example of this type of temporary fort was the legionary camp at Inchtuthil in Scotland erected during the Agricolan campaigns and abandoned shortly thereafter (Fig. 24.2).

Many of the Roman garrison camps were occupied for long periods of time, and developed into complex military-civilian societies. The soldiers not only drilled and fought, but also worshipped their own gods, raised food, produced manufactured goods like tiles and pottery, founded families, and enjoyed the non-military aspects of life.

The complex realities of military life on the British frontier have recently been illustrated by the discovery of written documents at Vindolanda, a fort near Hadrian's Wall. The damp, oxygen-free soil at the fort site preserved objects in wood and leather that normally do not survive from the Roman period. Among the unusual finds at Vindolanda were letters and official documents written on thin sheets of wood. They ranged from muster rolls of the army unit stationed at Vindolanda in the late first century AD to an invitation to a birthday party from one garrison commander's wife to another. They tell much about the often-gritty realities of garrison life and society in north Britain under the Roman empire that would not be found in other sources (Birley 1987; Bowman 1994).

Around many of the forts small civilian communities or *vici* developed (Fig. 24.3). Their shops, taverns, and brothels serviced many of the needs of the military. Their populations were swelled by the legal and extra-legal families of soldiers and by retired veterans. Most of these villages did not survive the life of the garrison. Others became important Roman and post-Roman cities: Cologne in Germany and York in England are good examples of this process (Ottaway 1993; Woolf 1981). This social and economic aspect of garrison and civilian life, as illustrated by the remains found in the communities outside the fort walls, has received increasing archaeological attention. It not only provides insight into the civil side of soldiers' lives, but also documents their interactions with local native communities (Whittaker 1994).

The interaction of Roman soldier and civilian was even more complex when a military garrison was imposed on an already existing community. This was the case

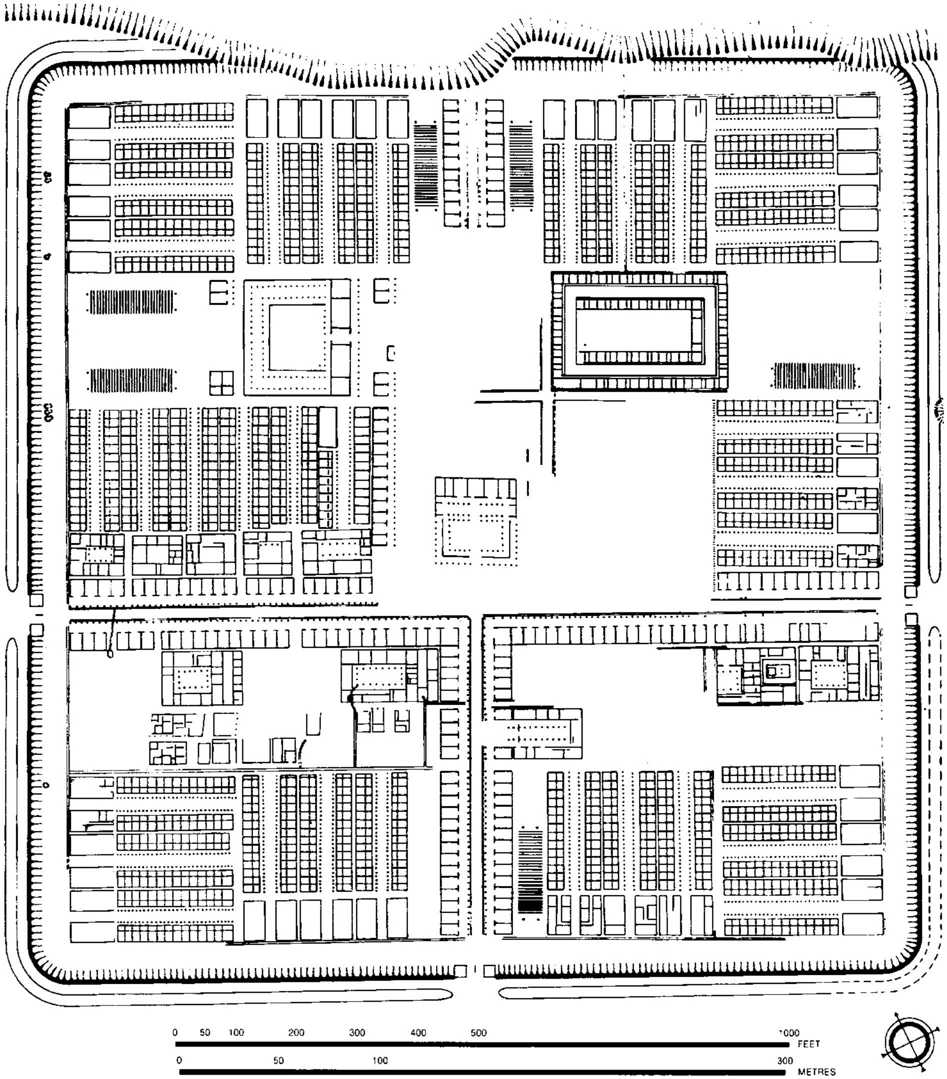

Figure 24.2 Inchtuthil Roman fort. Inchtuthil was a legionary fortress in southern Scotland that was occupied briefly in the later years of the first century AD. Aerial photography and careful excavation allowed reconstruction of the plan of the fort with headquarters building, barracks, workshops and storage facilities. Source: Breeze 1993.

at Dura Europos on the upper Euphrates river. Excavations there during the 1920s and 1930s revealed a city that was first Greek, then Persian and finally a Roman garrison town. In the AD 250s it was besieged by the neighbouring Persians and

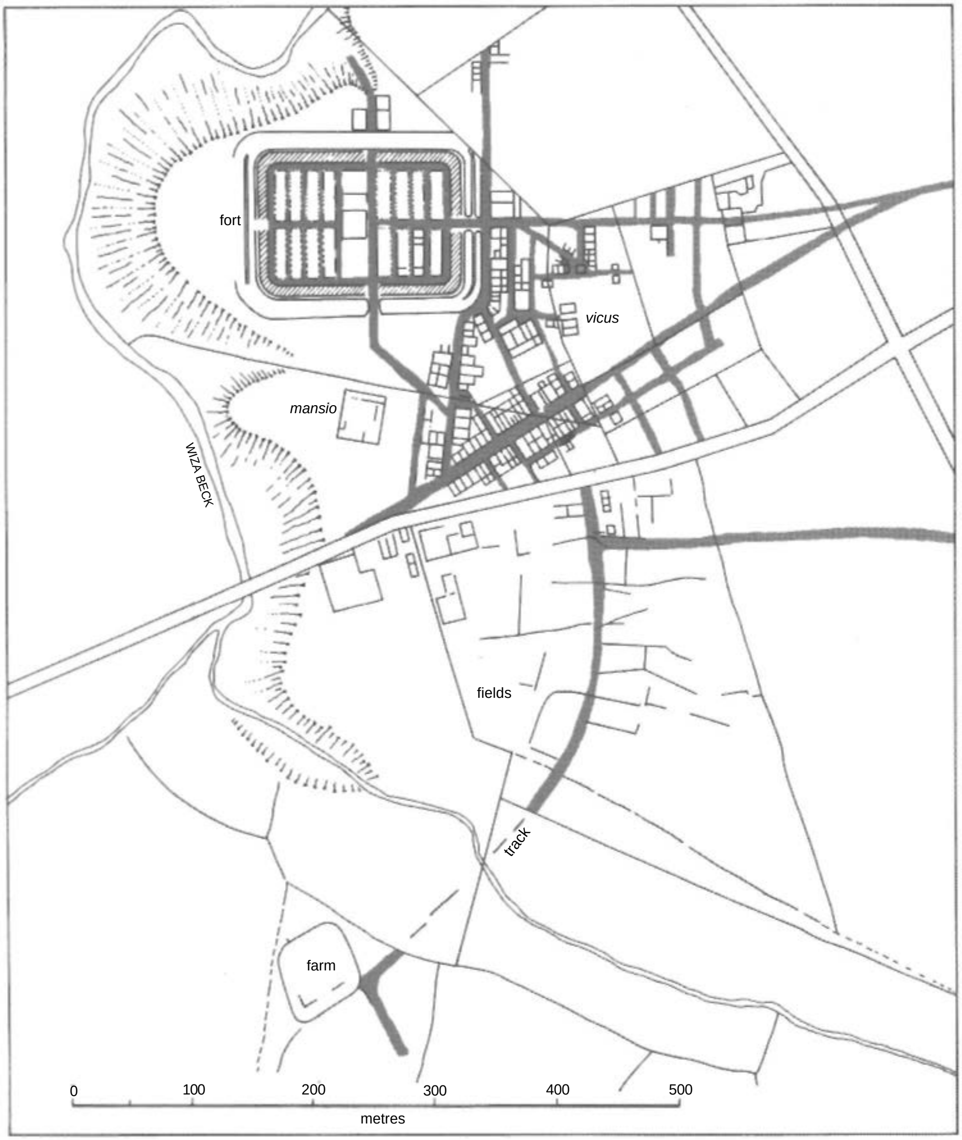

Figure 24.3 Old Carlisle, northern England: fort, *vicus* and farmstead. Source: Jones and Mattingly 1993.

either captured or abandoned. The burial of part of the residential area by siege works, the rapid abandonment after the capture of the city, and the dry desert climate, combined to preserve not only military artefacts and written records, but also a range of archaeological indications of an ethnically complex civilian and military community. This complexity was illustrated by the discovery of a temple of the Persian god Mithras, a Jewish synagogue and a Christian chapel in one neighbourhood behind the wall (Hopkins 1979; Perkins 1973).

Archaeological research on colonial military sites has not been limited to the Roman empire. On the upper Nile in modern Sudan, a series of forts dating to the period of the Middle Kingdom pharaohs (*c.* 2000 BC) were initially seen as instruments of frontier control and protection of Egyptian traders moving up and down the Nile. The original excavators interpreted these as outposts of the Egyptian empire, manned by Egyptian officials who at times adopted certain aspects of the local culture including human sacrifice. Current interpretation sees them initially at least as isolated Egyptian trading outposts in what was one of the earliest complex African political organizations (Connah 1988:35–40). The Great Wall of China, built in the third century BC, is the greatest and possibly the most famous archaeological monument known from any civilization, although it has received relatively little systematic archaeological research (Waldron 1990:4–6, 17, 21). Medieval castles, many of which were built to consolidate expanding spheres of control, be they on the Welsh and Scottish borders of Britain, or the crusader regions of Palestine, have increasingly attracted archaeological interest (Brown 1980; Fig. 26.1).

Much of the archaeology at North American colonial sites has been military archaeology. The British, French, Spanish and Dutch all built forts to protect their often small and threatened territories (Fig. 28.9). Initially such research concentrated on the location of seventeenth- and eighteenth-century fort sites known from historical accounts and on the use of archaeological investigations to aid in their physical reconstruction as historical tourist centres. Excavation concentrated on the recovery of ground plans and of military artefacts. As has been the case with Roman frontier archaeology, however, a growing interest in social and economic history has led to a concentration of research on the illumination of daily life aspects of garrison life. This has been much of the focus for the excavations at the eighteenth-century French and British fort at Michilimackinac in northern Michigan (Peterson 1964; Stone 1974; Fig. 24.4). Finds of items like Chinese porcelain illustrate the complexity of life on the North American frontier, where rough, whiskey-drinking fur traders intermingled with British officers who drank their tea out of porcelain tea cups. A similar blend of European sophistication and frontier roughness characterized other frontier outposts, such as those of the French in northern Maine (Faulkner 1992).

Imperialism has not been limited to Rome and early modern Europe and the Americas. The Aztecs and the Incas of the New World developed impressive imperial systems. The Incas, especially, developed physical instruments of control and exploitation such as roads, forts and supply depots, which allowed them to control extensive territories in rough, mountainous terrain. They also undertook terracing and canalization schemes which allowed them to enhance the productivity of

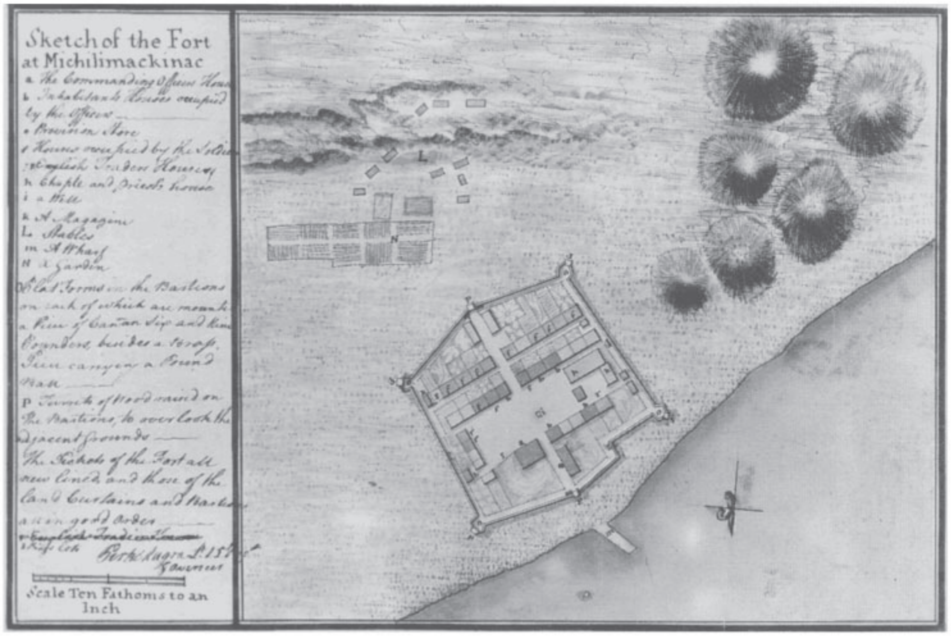

Figure 24.4 This 1766 plan of Fort Michilimackinac shows the fort shortly after the British seized it from the French. Located at the Straits of Mackinac between Lake Michigan and Lake Huron, the fort played an important part in the eighteenth-century European struggle to control the upper Great Lakes. Source: Stone 1974, fig. 4. Reproduced with permission of the William L.Clements Library, University of Michigan.

conquered lands. These have become the object of systematic research by archaeologists using the same combination of document analysis, air photography, survey and excavation as has been employed at Roman sites.

Walls, forts, and garrisons could hold conquered territory and defend it from external forces. However, the long-term success of most empires depended on the ability of the ruling élite to create institutions, both physical and cultural, which would facilitate the integration of the conquered peoples into the larger imperial system. Towns and religious centres have been used extensively for this purpose.

Cities and towns

Newly founded cities have been major instruments of imperial administrators from Greek and Roman Antiquity to the British and French empires of the nineteenth century. Cities not only promoted economic growth and social change, but also provided locales where natives could learn imperial ways. Greek colonies fulfilled this role when the Greeks were extending their control of territory in the Mediterranean. During the eighth, seventh and sixth centuries BC, these new foundations were established by the dozen on locations from Spain on the west to the Black Sea on the east (Boardman 1980). While the Greek mother cities exercised very limited direct political control over the colonial territories, they nevertheless represented a very dynamic ethnic, cultural, and economic imperialism. Greek language and culture spread to the new areas, and the indigenous populations often faced the choice of accommodation or extinction.

The temples that the Greek colonists erected to their gods are today the most visible monuments at such sites as Paestum in southern Italy and Agrigento and Selinus in Sicily. They have long been known to archaeologists. More recent archaeological research, however, has illustrated the complex planning processes that involved a grid-like layout of both the city centres and the surrounding countryside (Greco 1992). Air photographs taken at sites like ancient Metaponton in southern Italy have revealed a grid pattern of fields extending far into the countryside, marking the plots of land assigned to the settler farmers, much as it was done in the Midwest of the United States. Excavations have produced abundant evidence for the farmhouses, shrines, and cemeteries of these early Greek rural settlers.

Archaeology has also illustrated the complex interaction that these Greek colonists had with the native populations. Like historians of the American frontier, Greek archaeologists long considered these natives as expendable elements in the process of the advance of civilization, but changing judgements about imperialism have produced a growing interest in how the indigenous societies reacted to Greek colonization. Sicily and southern Italy (known as Magna Graecia in Antiquity) both provide good evidence for this process of interaction between Greeks and natives: it is reflected not only by the presence of Greek goods in indigenous burials, but also by a complex blend of native and Greek elements in habitation sites and shrines (Greco 1992; Hollo way 1991). As will be seen elsewhere in the colonial process, archaeology is increasingly demonstrating that imperialism produced a complex interaction between two dynamic societies, rather than the inevitable replacement of an inferior by a superior social and economic order. This was especially true in an area like southern France, where the Greeks controlled only a small coastal hinterland but traded extensively with the Celtic groups in the interior. The dynamics of this trade produced major internal changes within Celtic society, which continued until the Roman conquest (Wells 1980, 1984).

The successors of Alexander the Great in the later fourth and third centuries BC were also great founders of cities which were to be used as instruments of imperialism. The Hellenistic Middle East was dotted with cities bearing names like Alexandria, Antioch and Seleucia, testaments to the urbanistic activities of the Hellenistic kings (Rostovtzeff 1941). However, these centres played a rather different role from the early Greek colonies. The new cities were located in newly established empires that were much more tightly administered than the domains of the original Greek colonies. They were generally founded in densely populated areas with ancient and distinguished, but non-Greek, civilizations. Some of the recently conquered territories had long-standing urban traditions; others, such as Egypt, did not. The new cities served partly as centres of power, but also as foci of Hellenization. Many of these urban ventures were short-lived. At other places such as Dura Europos, archaeological research has demonstrated how the new Greek foundation gradually evolved into a typical Mesopotamian city. Other centres like Antioch in Syria and Alexandria in Egypt grew to become the largest cities in the Hellenistic and Roman world.

The Greeks were not the only colonizers in the early Mediterranean. Beginning shortly after 1000 BC, traders from Phoenicia moved westward, founding small trading colonies to serve their commercial needs. These tended to be small centres, located on offshore islands or on easily defended protected peninsulas. Motya in Sicily and Tharros in Sardinia are good examples of these. Initially, these Phoenician settlements lived in good symbiotic relationships with the indigenous groups. Later, Carthage, the most successful of these Phoenician colonies, established its own empire based on more aggressive conquest and exploitation of local mineral and agricultural resources. At its height in the sixth, fifth and fourth centuries BC, Carthage controlled considerable territories in Spain, Sicily, North Africa, and Sardinia. Phoenician cities expanded under Carthaginian rule. In Sardinia, there is even evidence for systematic frontier fortification (Barreca 1986; Sherratt and Sherratt 1993).

The Etruscans, whose civilization dominated central Italy contemporary with the Greek colonies of Magna Graecia, also used colonies as an instrument of political and economic expansion: this is particularly well illustrated by the excavated site of Etruscan Marzabotto near Bologna, with its grid of streets and well-ordered houses (Spivey and Stoddart 1990; Fig. 24.5). It was designed to expand Etruscan influences and trading contacts across the Apennine mountains into the upper Po valley.

The Romans drew inspiration from the colonizing activities of the Greeks, the Hellenistic kings, and their neighbours, the Etruscans. During the fourth, third, and second centuries BC, as part of the process of consolidating their Italian empire, they founded colonies which recalled the Greek colonies in that they were intended as economically self-sustaining urban-rural garrison centres. However, the Romans maintained much tighter control over their colonies than the Greeks ever did and, in fact, used them as models of Romanization for the local natives (Salmon 1970).

The well-excavated Roman site of Cosa located in Tuscany some one hundred miles north of Rome provides a good illustration of this (F.Brown 1980). It was founded in 273 BC as a fortified garrison centre. The streets within the walls were laid out at regular intervals and the countryside around the city was divided into plots, which were distributed to the colonists. As the colonists prospered, they added

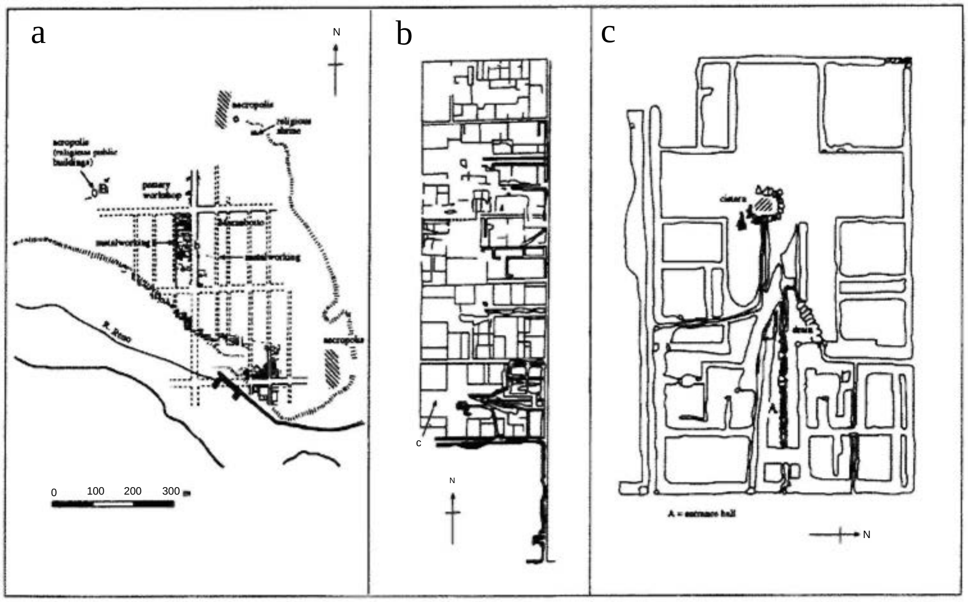

Figure 24.5 The fifth-century BC Etruscan city of Marzabotto, showing (a) its overall structure, (b) the ground-plan of one of the *insulae,* and (c) one of the houses within this *insula*. (After Barker and Rasmussen 1993:172.) Source: A.Pekins, *The Art of Dura-Europos* (Oxford: OUP, 1973).

temples and a forum with shops and public meeting places, including a basilica and a local senate house. These civic and religious buildings were modelled on similar structures in Rome and remind us of the role that colonies played in spreading Roman values throughout the empire.

The Romans founded new planned cities like Cosa throughout their empire. They were especially important in the area of modern western Europe, where there had not been a tradition of urban development. Some of these colonies replaced military camps, abandoned as the frontier advanced. Others replaced native centres. In some cases, the Romans forced the natives to abandon their hill-forts and settle in new, lowland locations which could be more easily controlled. In other instances, the transition from hill-fort to Roman town was a gradual one, stimulated by the development of greater local security and changes in transportation systems and social and economic life (Burnham and Wacher 1990; Wells 1984).

In all instances, the new settlements served as foci for Romanization. Some, like Cosa, had a limited period of usefulness and prosperity and then slid into decline. However, the success of many of these experiments is shown by the fact that great European cities such as London, Paris and Cologne have developed over Roman

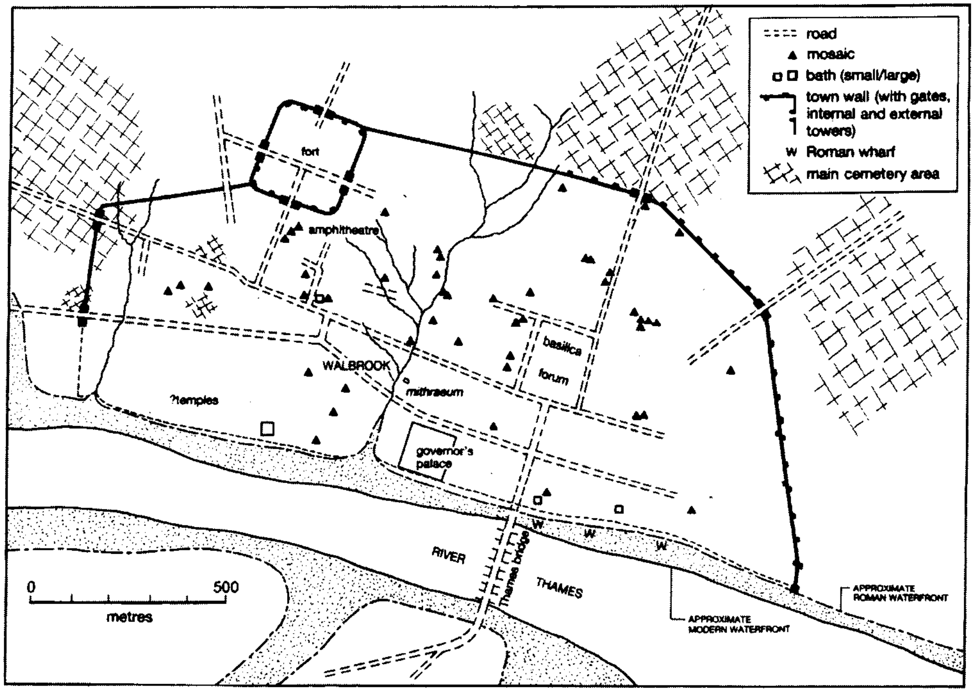

Figure 24.6 Roman London. Source: Jones and Mattingly 1993.

urban centres. One of the most active areas of archaeology since the Second World War has centred on the investigation of the Roman remains of cities like London and Cologne (Carver 1987:22–39; Fig. 24.6). This was necessitated by the destruction caused by the war and the massive rebuilding that followed. Archaeologists have been able to reconstruct the evolution of Roman cities like London in England and Amiens in France from their foundation to the late Roman period and even into the early Middle Ages (Marsden 1986; Massy 1979).

Colonial foundations with a military and acculturative function were not limited to the Mediterranean empires. The Han emperors of China used such settlements to consolidate their hold on Korea (Pai 1992). Modern European imperialists drew inspiration from the Romans in their use of city foundations as an instrument of colonial control and acculturation (Wright 1991). The Spanish led the way, establishing dozens of cities in North and South America (Kubler 1985:88–110). In some instances like St Augustine, these were totally new foundations; in other cases, as with Mexico City, they represented the reuse of Native American urban centres. The more successful foundations like Mexico City remain flourishing urban centres and, as is the case with London and Paris, only limited archaeological research can be undertaken there today. As has happened with Roman colonies, the less successful Spanish foundations offer the best archaeological possibilities.

This is the case with St Augustine in Florida, which was founded in 1565, and where the modern city has not overwhelmed the colonial centre, making extensive archaeological research possible (Deagan 1991). The research at St Augustine has combined architectural archaeology, useful to the development of the city as a tourist site, with social archaeology, which aimed at reconstructing the complex mix of Spanish and native elements that went into the early city. For instance, analysis of excavated ceramics has shown the presence of tablewares that were mainly imported from Spain, but food processing wares that were local. This provides insights into gender distinctions in the community, where Spanish men were incorporating native women into their households (Deagan 1991; McEwan 1991a, 1992–3).

The Dutch and the English were also great founders of towns and cities in the New World. Again successful centres like Boston and New York have buried and largely destroyed their own past. However, luck and archaeological skill occasionally produce evidence of colonial or early post-colonial settlement in such places as Philadelphia or New York (Cotter *et al.* 1993). One of the most dramatic recent finds in New York was that of an early African-American cemetery, discovered largely intact in the midst of the heavily developed financial district (Harrington 1993).

Again, cities with a more limited period of prosperity and later decline serve the archaeologist better. This has been the case with colonial Williamsburg, which was for a brief period in the eighteenth century the capital of Virginia and one of the most important centres in British North America. The capital of Virginia moved to Richmond shortly after the American Revolution, and Williamsburg became a sleepy southern town. The decision to make Williamsburg into a major reconstructed historical tourist centre, combined with generous support from the Rockefeller family, has led to large-scale archaeological research (Kopper 1986). Excavation was used first to assist in the restoration of the historical structures and in their accurate refurnishing. This assisted in the accurate reconstruction of structures like the Governor's Palace, of which only foundations survived. More recent archaeological research has focused on the reconstruction of a broader picture of daily life and society in the colonial city (Noel Hume 1968; and see Chapter 28).

Religious structures

Religion has long been a force closely associated with the imperial process, and it is no accident that temples are today the most striking ruins at many Greek colonial sites, especially those in Sicily and southern Italy. They reflect not only the wealth of the new settlements, but also the role that religion played in enhancing community cohesion in a strange and hostile land. Anglican churches and French cathedrals in India and Tunisia recall a similar interconnection between religion and the colonial experience.

Religion was also used as a force to integrate the conquered into the world of the conquerer. The Romans employed first their own traditional cults (like that of Jupiter) and later newly created religious institutions (like the worship of the emperor) to rally the colonial élites of the new empire to the Roman cause (Fishwick 1987). Temples to the emperors were established in new urban centres, and more Romanized members of the native aristocracy were made into priests of this cult. Remains of the large temple dedicated to the Emperor Claudius have been excavated at Colchester in Britain, the first capital of the province that he conquered and organized (Lewis 1966:61–64).

With the creation of the early modern Christian empires, this use of religion as an instrument of acculturation was joined with a desire to save souls. Preachers generally arrived with the soldiers and the administrators. In the Americas both Protestant English and Catholic French and Spanish engaged in mission activities, but it was the Spanish whose missions were most successful and who created physical as well as social and spiritual forms that survive and provide evidence for the archaeologists. The Spanish missions in Florida, the American Southwest and California were formed for the purpose of spiritual conversion, but they also served as instruments for social and economic change. In areas like California, the indigenous populations, who had been largely hunter-gatherers, were forced to settle in the vicinity of missions, adopt their lifestyle, and adapt their productive activities to European ways. Missions were intended not only as places of worship but also as productive centres that would turn the Native Americans into European-style peasants (McEwan 1991b; Thomas 1988).

Few of the Spanish missions are active today. Some, like the Jesuit missions of Paraguay, are now picturesque ruins that have been little studied (Blanch 1982). Others, such as those of California, Florida, and the American Southwest, have become the objects of increasing archaeological and documentary research (Chapter 28; Fig, 28.10). Starting as exercises in architectural archaeology (again often to aid in the restoration of the missions as historical sites), this research has turned more to a consideration of the way that the mission community, whose population was generally overwhelmingly Native American, integrated European and native values. The material culture often reflects this complex blending of Spanish with native ways. Imported pottery, beads, and building techniques appear. However, important categories of archaeological material like ceramics remain overwhelmingly native (Farnsworth 1992; McEwan 1991b).

TRADE

Trade has been intimately connected with the development of empire throughout history. Traders often preceded military forces, providing intelligence and at times softening the native societies for conquest. Archaeology provides important evidence for this economic imperialism, well beyond the area of political control. Roman pottery and coins have been found in wide areas of Europe that the Romans never conquered (Wells 1992; Wheeler 1954). Much of this trade was in the hands of individual entrepreneurs and even native middlemen. In other instances formal outposts or enclaves were established that provided continuity and security to the external traders. Such mercantile colonies or emporia are known from a number of contexts: among the earliest were Assyrian trading centres established in what is now eastern Turkey. Both objects and written texts showed Assyrian traders living in enclaves in close association with the native élite (Lloyd 1989:26–27, 35–38).

The impact of this advance guard of imperialism was complex and often devastating, especially in modern times. In North America, the most immediate impact was biological, with the spread of previously unknown diseases that devastated the indigenous populations and facilitated European settlement and conquest. However, the disruptive impact of this early trans-frontier trade was also cultural, as studies of institutions like the fur trade have shown. Competition to control sources of furs and access to the colonial trading centres led to fierce indigenous rivalries similar to those that changed Celtic Europe. Some of these processes can be reconstructed only through the colonial written records. However, archaeological research has increasingly focused on contact sites, settlements inhabited by indigenous groups during the early stages of imperial contact. There, the relation between European and indigenous material culture can be employed to analyse continuity and change in native life (Fitzhugh 1985).

In the development of empires, the traders have often led the way in turning the conquered areas into sources of raw materials and markets for finished goods. This is what is called a core-periphery relationship, in which the colonial zones supply raw materials to sustain the core industrial production units. (Wallerstein 1974). This model of colonial development was developed to explain aspects of the early modern colonial experience, but it has a certain relevance for earlier periods as well (Rowlands *et al.* 1987; Santley and Alexander 1992), though it has to be used with caution in dealing with the early modern and especially with the pre-modern colonial world. In the latter case, the ability of the imperial groups to project power was much more limited. The example of the Greeks and Celtic Europe has already been cited. Greek painted pottery, wine jars and bronze drinking vessels have been found on sites scattered from the Black Sea to the Paris basin. While the Greeks had some military superiority and some advantages in production methods and distribution networks, both sides in the trading process worked as relative equals, meeting mutual economic and social needs.

With the development of the Roman empire the power balance changed to a certain degree. The Romans developed a large politically stable empire, which lasted for centuries. They created a complex currency, with units in gold, silver and bronze that facilitated trading at all levels of society. They also had the ability to produce consumer goods in large quantities. Cheap, attractive products like ceramic lamps, decorated pottery and glass vessels made their way into most households in the provinces and were carried in large numbers beyond the imperial frontiers. Roman decorated ceramics show up in native sites from northern Scotland to India (Fig. 24.7).

Archaeologists have researched many aspects of this economic imperialism within the Roman world and beyond (Greene 1986). The most brutal economic burden

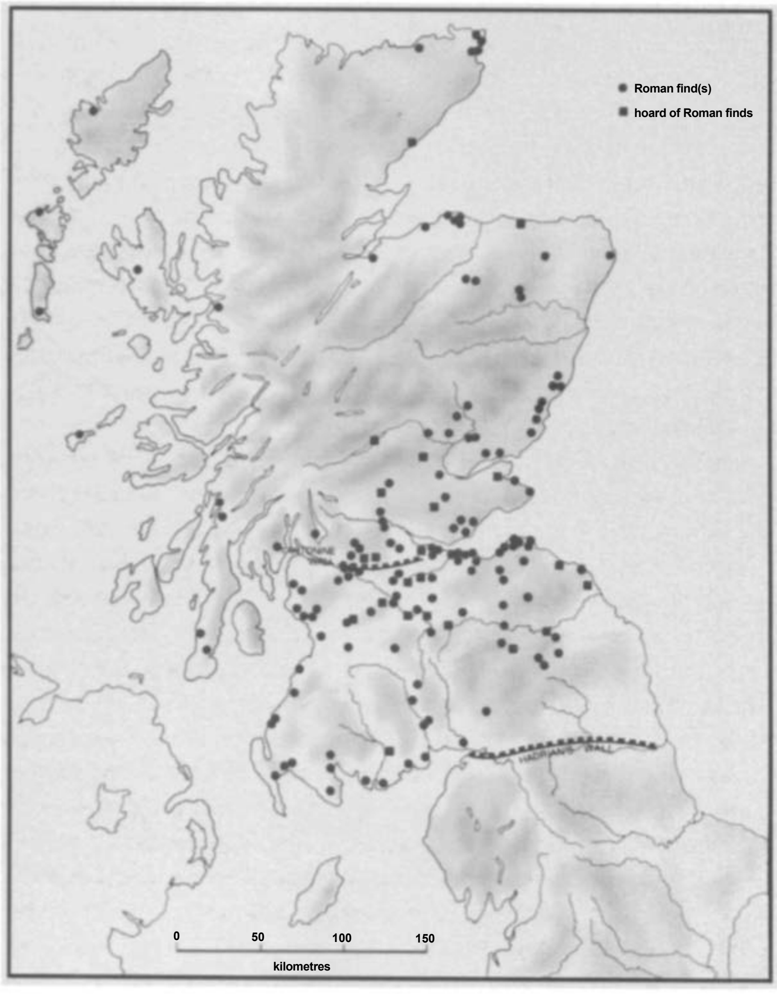

Figure 24.7 Roman finds from non-Roman sites in Scotland in the second century AD. Source: Jones and Mattingly 1993.

placed on the provinces was the mining for precious metals and quarrying for building stones. Some Roman mining sites in Spain and Britain have been investigated archaeologically (Davies 1935; Keay 1988). The circulation of metals such as lead (a by-product of silver mining) has been reconstructed through finds of stamped metal ingots. Most of the stones used by the Romans in their buildings and their sculptural decoration came from quarries outside of Italy. Their mining, shipping and finishing became complex economic activities. Systematic research on quarries and quarrying is just beginning, with special emphasis on sites in Egypt and North Africa. Underwater archaeology, through the discovery of wrecked ships loaded with building stone and statuary, has provided important information on the movement of stone and stone products during the Roman period.

Roman production facilities, especially for ceramics, have been identified and studied. Numerous kiln sites have been excavated. Scientific analysis (see Chapter 9) has provided precise information on which pots came from which kilns, allowing the reconstruction of the circulation of goods (Peacock 1982). The Roman economy was a pre-industrial one, where transport costs were high and investment in capital equipment limited (Duncan-Jones 1982, 1990). However, the relocation of the heavy, complicated, production machinery characteristic of modern industry was generally not a problem. If basic raw materials like clay were available, craftsmen like potters with their tools and moulds could move to new locations, build kilns and soon be in business. This meant that manufacturers could move their production centres closer to major markets. These movements can be reconstructed for the red glazed pottery known as *terra sigillata* or Arretine, which was in common use during the first, second and third centuries AD. The first *terra sigillata* potteries were located at Arezzo in Tuscany, but by the early imperial period most had moved, first to southern and then to central France. This allowed them to supply more efficiently not only the rich provinces of Gaul and Britain, but also the large armies located on the Rhine. By the second century AD these *terra sigillata* production centres were challenged and then replaced in the Mediterranean by the massive output of glazed pottery in North Africa. This simpler, red-orange glazed pottery remained the dominant luxury pottery in the Mediterranean until the end of the Roman empire (Hayes 1972).

More utilitarian ceramic objects have also proved useful to the archaeologist in reconstructing the Roman economy. During Antiquity, bulk goods like wine, olive oil, and even grain were generally shipped in large ceramic containers known as amphorae. The shape of the amphorae used varied from place to place and over time. The dates of production and places of origins can thus be determined from those variations in shape. Massive quantities of amphorae were discarded after the agricultural products had arrived at their destination. At Rome there is an artificial hill called Monte Testaccio formed from the sherds of thousands of broken Roman amphorae. Statistical study of amphora remains at sites like Monte Testaccio allows the reconstruction of shifting trade patterns in essential items like wine and olive oil

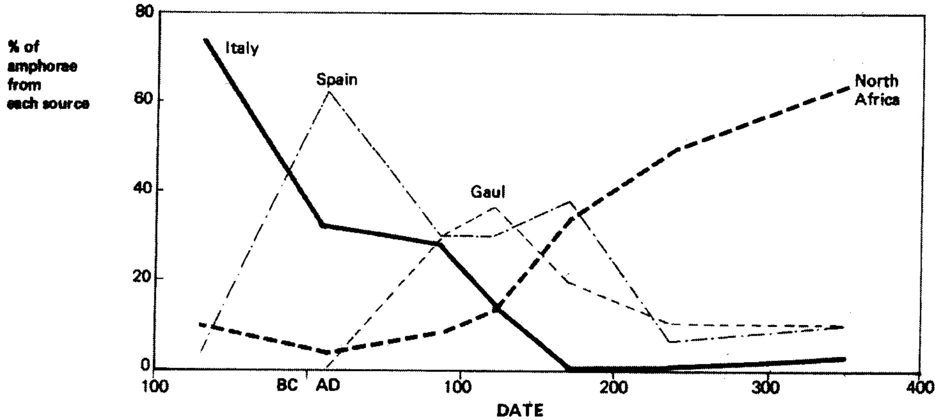

Figure 24.8 Changing frequencies of amphorae at Rome's port of Ostia. (After Greene 1986:15.) Source: K.Greene, with permission of the Audio Visual Centre, University of Newcastle.

and can be related to the rise and fall of agricultural economies in Roman Italy, Spain, and North Africa (Carandini 1989; Fig. 24.8).

This land-based research has been complemented in recent years by underwater archaeology (Bass 1966, Muckelroy 1980). Since the Second World War, divers using aqualungs have identified hundreds of wrecks in the Mediterranean and elsewhere, many of which date to the Roman period. Very recently, submarines have begun to be used to recover ancient deep-water wrecks. The cargoes preserved on such wrecks, which range from wine and olive oil amphorae to stone coffins and columns, provide information on the complex and changing economic relationships between Rome and her provinces.

Such underwater discoveries have not been limited to the Roman period. In the Mediterranean, for example, bronze age, Greek, and Islamic wrecks have all been excavated. Elsewhere, among the most interesting recent discoveries have been Chinese wrecks off the Philippines, which illustrate the range and power of that commercial empire. The coasts of North America are dotted with submerged vessels of Spanish, French, and British origins.

The early modern colonial empires were started in the pre-industrial era, though in a period when trade and mercantile activity were rapidly expanding (see Chapter 28). Each national empire had a very different attitude towards commercial activity. For the Spaniards, empire was to be used for the extraction of precious metals, and then for settlement: the natives were first looted and then forced to supply the labour for the mines that produced the gold and other precious metals and then for the agricultural estates. This was often an élite settler empire, where transplanted Iberians became an increasingly important force both in the towns and in the countryside. A major aim of the settlers was to produce agricultural wealth through cheap native labour. There was a low level of industrial production and commercial development. The middle class was small and markers for local goods limited. This is reflected in the limited Iberian material culture found at Spanish-American archaeological sites. Imported pottery and glass were present in some quantities, especially in the towns, although less than at Anglo-American sites (Deagan 1991).

Very different was the French imperial system established in North America during the seventeenth and eighteenth centuries (Walthall 1991). It was an empire based on limited political and military control, religious conversion, and on the development of complex trading networks centred on the acquisition of furs. French agents, both secular and religious, traversed large areas of north-eastern and north-central North America, exchanging European goods for animal furs and other forest products, cementing political alliances with the Native Americans against the British and other imperial powers, and spreading the Roman Catholic faith. They established a relatively limited number of small military and civic centres on the borders of the vast territory that was theoretically their domain.

Many of these French settlements were short lived. Some were abandoned or destroyed by indigenous groups. Others were replaced or overwhelmed by the more complex and successful British settlements. French colonial material culture in North America was relatively also limited in quantity and variety. They included practical trade objects such as guns and iron pots. Others consisted of decorations for clothing, and luxury utensils used for eating and drinking. Some of these objects reflected the desire of the Frenchmen to maintain their sense of European civilization and status on the frontier. Distinctive trade goods such as the Jesuit rings distributed by the missionaries do allow the French presence to be documented at native sites (Walthall 1991). However, the fact that the trade was often in perishable items like furs and that the French, like the Spanish, did not develop a large consumer goods industry, means that archaeology cannot provide a full picture of the extent and the complexity of the French imperial effort in North America.

With the British, the relation between trade and empire for the first time reached a complexity that equalled and then surpassed that of Rome. The British not only traded, but they also produced: in fact, the Industrial Revolution was beginning as the British empire was being established (see Chapter 29). Much of this new industrial production took the form of durable goods like ceramics which are well preserved at archaeological sites. The great potteries founded by Josiah Wedgwood and other ceramic manufacturers in the Staffordshire area of Britain during the eighteenth century manufactured a great range of attractive and relatively inexpensive pottery vessels that were well suited to the taste and purses of a growing middle class in both England and the colonies. Decorative styles were changed rapidly to stimulate the market and this allows these wares to provide precise dates for archaeological sites. The creamwares and pearlwares of the English Midlands allowed England to dominate the international ceramics markets. Like the Roman *terra sigillata* eighteen centuries before, these new ceramics became indicators of the spread of British influence, both within her empire and beyond. They appeared on the shores of West Africa, in South Africa, and in Australia. Chris Gosden in Chapter 12 describes a remarkable example of this phenomenon: Port Essington near Darwin in northern Australia, a short-lived outpost in the nineteenth century (Fig. 12.6), where the inhabitants were at the extreme end of a trade system that brought British goods first to Sydney and eventually to them another 4,000 kilometres away on the other side of the continent (Allen 1973).

CHANGES IN THE LAND

Before the nineteenth century all societies were basically agricultural. Acquisition of land and the wealth that could come from agricultural and pastoral production were major incentives for imperialism. This meant that the creation of any empire was bound to produce major reorganizations in the countryside of the conquered and colonized territories. Production was often intensified to provide food for the new cities and garrisons. New crops and animals were introduced. This was especially evident in the Americas, where there was no tradition of large domestic animals. Increased farming and grazing produced ecological changes like deforestation and erosion. Historians and archaeologists are just beginning to realize the full impact of this part of the imperial and colonial process (Cronon 1983).

These rural settlement changes affected people as well as land. Scattered rural populations were concentrated in village communities to facilitate political control and the collection of taxes. Great estates or plantations were established dominated by a new rural élite and often staffed by either slaves or dependent peasant labour. However, these rural changes brought about by the creation of empires have not received the attention they deserve. Historians, both past and present, have tended to be urbano-centred in their research and have shown limited understanding of and concern for the countryside. This has been especially true for societies like ancient Greece or Rome, where the written sources say little about country life and other records are sparse. This means that it is left to the archaeologists to provide much of the basic evidence for life and change in the countryside during the past.

For archaeologists, the rural history and archaeology of empire have long centred on the study of the major estates which dominated rural life in the new colonial empires: investigations have focused on the great villas of the Roman provinces, the haciendas of New Spain, and the plantations of colonial Virginia and South Africa (Burke 1978; Deetz 1993; Kelso and Most 1990; Markell *et al.* 1995; Percival 1976). Several reasons explain this emphasis. Such establishments were major reorganizing forces in the new imperial countryside. They linked city and countryside and provided insight into the lives of the élite, the slaves and the peasants. They offered a better possibility of finding objects of value and beauty: they were centres of wealth and display, so impressive and interesting physical remains and many fragments of decoration survive.

Early interest in the villas of Roman provinces like Britain centred on the recovery of mosaics, and a number of treasures of Roman silver plate have come from villa sites. Relatively well-preserved remains encouraged the excavation of villas, many of which in Britain, France, Germany, and Spain have become important tourist centres (Percival 1976). Fishbourne in southern England, a villa probably built in the first century AD for a Romano-British client king, is an excellent example of this phenomenon (Cunliffe 1971).

Historical archaeologists in the United States turned early to the excavations of plantations in the American South. The purpose of many of these excavations was to provide information for the restoration of buildings, their accurate furnishing and the reconstruction of daily life (Noel Hume 1963, 1974, 1982; and see Chapter 28 and Fig. 28.6). These plantations had strong nostalgic associations for many Americans, and they have become prime tourist centres. Displays tended to feature the artefacts and lifestyle of the élite, with little said about the slave and peasant labour which made such displays of conspicuous consumption possible.

Changing social values have produced changes in rural historical and archaeological research. Estate archaeology in recent years has no longer concentrated just on the lives of the rural élite. Both plantation excavations in North America and villa excavations in the Roman provinces have expanded their horizons, studying not only grand architecture and luxury items like fancy pottery and glass but also the houses of slaves and peasants, facilities involved in rural production like olive and wine presses, and even items like seeds and animal bones, which provide information on differences in diet and eating habits among the various classes in rural society (Adams and Boling 1989; Ferguson 1991; and see Chapter 14). Villas and plantations are investigated as total social and economic units, and all of their components are of interest to the archaeologist (Fig. 24.9).

Archaeologists are also attempting to reconstruct the larger rural settlement context in which these estates existed, which included other major establishments, smaller farms and homesteads, field systems and the landscape itself (see Chapter 13). The reconstruction of these broad patterns requires the use of a range of archaeological techniques besides excavation, two of the most useful of which have been aerial photography and surface survey. The use of air photography in Roman military archaeology has already been discussed. Roman villa sites show up as clearly in the air photographs as do the Roman camps. Aerial surveys of certain regions like the Somme valley of France and the south-east of Britain have revealed a density of rural sites not previously expected (Agache 1978).

Again, as is the case with military sites, the villas discovered through air photographs cannot usually be dated solely on the basis of the plans. It is necessary

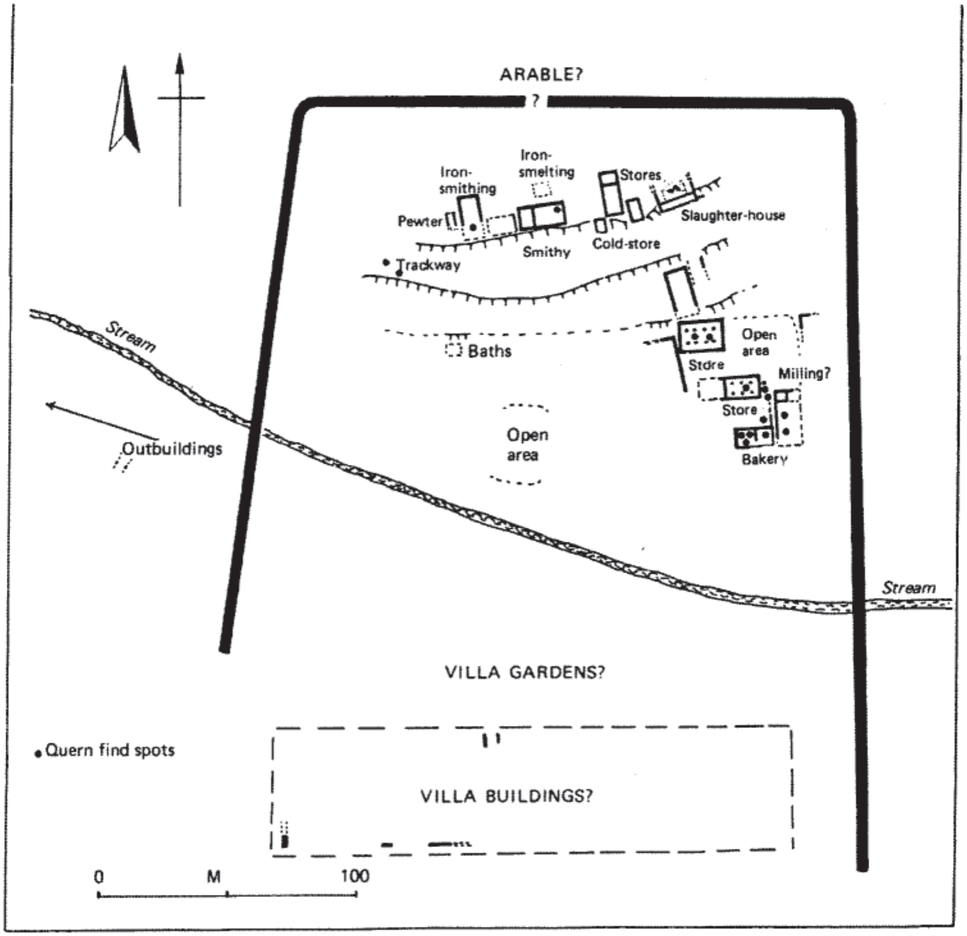

Figure 24.9 Gatcombe Roman villa, southern England, an example of a modern investigation of the working part of a Roman villa. Source: Greene 1986, with permission of the Audio Visual Centre, University of Newcastle.

to visit the sites, search for surface material, and even to conduct excavations. Surface survey is also needed to investigate large sections of countryside, searching for sites that are not known either from their standing remains or from techniques like air photographs. Survey emphasizes field-walking and the collection of artefacts like pottery fragments and tiles which have been revealed by frost, ploughing or other human or natural actions. While this method usually provides only limited information about dates of occupation and general size for any one site, it does allow the investigation of a total landscape area, the discovery of a large number

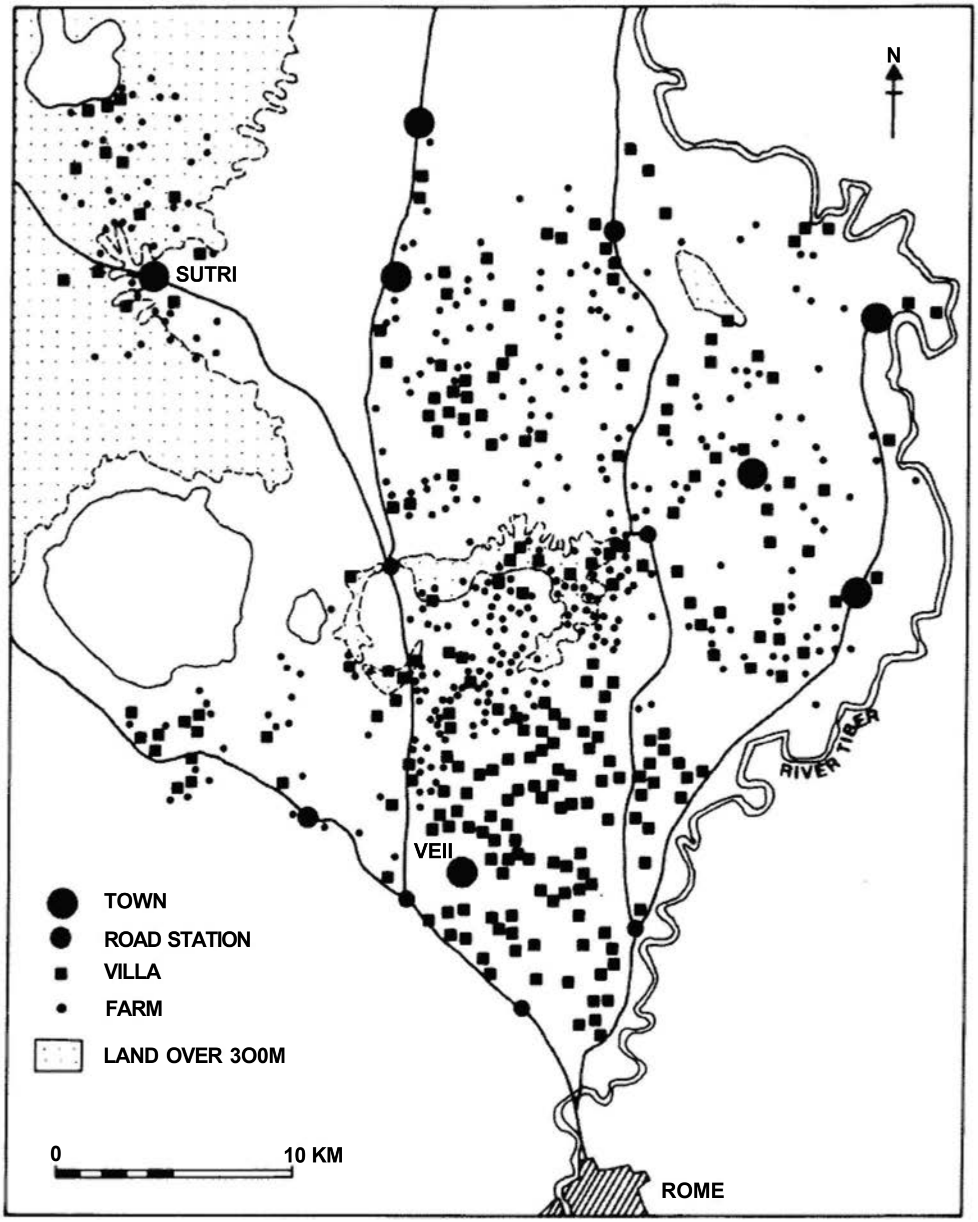

Figure 24.10 The Roman landscape of South Etruria *c*. AD 100, revealed by systematic field survey. Source: Barker 1995.

of sites, and the use of that information to develop large-scale reconstructions of rural settlement history (Barker and Lloyd 1991).

Intensive surface survey of this type was pioneered by British archaeologists in the countryside around Rome shortly after the Second World War (Potter 1979; Fig. 24.10). Changes in that countryside including building construction and the introduction of mechanical agriculture with its deeper ploughing resulted in the discovery of hundreds of previously unknown sites. It also led to their rapid destruction, lending a certain urgency to survey research. Survey work was shown to be an effective and relatively inexpensive way not only of mapping large numbers of sites, but also of reconstructing the changing organization and use of a landscape over long periods of time. For archaeologists of empire, it meant that one could understand the structure of an area before conquest, document the effect of conquest, and also document the limits of imperial transformations. For instance, in Roman Britain distribution maps show that the development of the villa system was largely confined to the south-east sections of the province and in other areas, probably pre-Roman, systems of agricultural production dominated (Fig. 24.11).

Contemporaneous with the British rural research near Rome, Gordon Willey of Harvard University was undertaking very similar survey-settlement investigations in the Viru valley of Peru (Willey 1953). His aim, too, was to study changes in rural settlement and land organization over time and to document the relation of that valley's settlement history to the rise and fall of large imperial systems in Peru.

Combinations of air and ground survey research have now been undertaken in many sections of Europe and the Mediterranean, and in Mesoamerica and South America (Barker and Lloyd 1991; Parsons 1982). In north-eastern France, the dramatic increase of villas has been linked to the need to supply the Roman frontier armies with grain (Agache 1978). In North Africa, survey research has documented the way that incorporation of the countryside into the larger Roman economic system led to the spread of farmsteads engaged in specialized types of agricultural activities like olive oil production (Barker and Reynolds 1985—and see the case study described in Chapter 14; Hitchner 1990). In the central valley of Mexico, the ebb and flow of centralized political power and outside imperial control are reflected in the centralization and decentralization of rural life (Sanders *et al.* 1979; Parsons 1982).

Rural archaeologists studying the impact of empire have been researching ways that political and economic changes produced by the creation of empires impacted not only on settlement form and distribution, but also on the organization and use of the land itself. Aerial photographs have been especially useful in providing information on such large-scale changes in land use. An example of this is the identification of Roman land organizational patterns. The Romans, as part of rural reorganization after conquest, undertook a process of division known as centuriation (Dilke 1971). Land that had been seized from conquered peoples was surveyed, divided into regular plots, the boundaries marked, and units allotted to the new

Figure 24.11 Romano-British villa distribution. This map shows the relative density of known Roman villa sites in Britain. The heaviest densities were in the south-east of Britain, where the agricultural land was best and the process of Romanization started earliest. Source: Hingley 1989, fig. 68.

settlers. The process recalls the system of land division used in many parts of the mid-western United States as the American empire spread westward. High-level air photographs, many of them taken during the bombing runs of the Second World War, have revealed many traces of these Roman centuriation grids surviving in the modern field systems of Europe and the Mediterranean (Bradford 1957). Italy has provided the most abundant evidence, but centuriation grids are now known from France, Spain, North Africa and other sections of the Roman world. Nor was the Roman empire the first colonial system associated with such radical reorganizations of the countryside: aerial photographs have also shown similar large reorganization schemes in southern Italy associated with Greek colonies like Metaponto.

SLAVERY

Imperial advance has often been associated with slavery and the slave trade. Individuals and whole groups were enslaved, and slave labour has played a major role in most imperial systems. The empires of Rome and early modern Europe provide well-documented examples of the relation between slavery and empire. Much of the rural labour in both Roman Italy and the provinces and in the post-conquest Americas was provided by slaves. In the Roman empire the slaves came first from conquest and then increasingly from trade with groups beyond the borders of the empire (Bradley 1987). In the Americas, the enslavement of the indigenous population was soon replaced by the importation of captives from Africa. Historical research on slavery in any society is inherently biased by the fact that most written information comes from the masters and reflects their views of the slaves and slave society. The slaves themselves have only a limited voice in that written testimony. Here the archaeologists have an important role to play. While it is true that most slaves had only a few material goods, they could and did use what they had in ways that reflected their own lifestyles and expressed their own cultural values (Ferguson 1991).

Research on the plantations of the American South and the West Indies has proved especially fruitful for an understanding of the complex relationship between the culture of the dominant group and that of the oppressed (Handler and Lange 1978; Singleton 1985; and see Chapter 28). Written documents and estate maps provide information on the location of slave quarters, which can then be excavated (Higman 1988). Sites like Monticello, the home of Thomas Jefferson, have yielded considerable information on slave life. Information comes from finds ranging from cabin plans to slave-made ceramics to animal bone fragments. Combinations of studies in materials like ceramics and animal bones allow not only the identification of the meats eaten by the slaves but also the reconstruction of complex eating rituals which served to distinguish the ways of the slaves from those of the masters (Grader 1990; Ferguson 1991:31–37; Kelso 1986). Heated debates have arisen about the relation of this material evidence to large questions of the treatment and condition of slaves on *antebellum* plantations.

Roman archaeologists have also become increasingly interested in research on rural slavery, reflecting a growing intellectual and ideological debate among Romanists about the nature and impact of slavery in Roman society (Bradley 1987; Finley 1980). Villa excavators in particular have tried to identify slave quarters and highlight slave activities. The best example of this type of research has been the Italian excavations at the Roman villa at Sette Finestre in Tuscany (Carandini *et al.* 1985; Fig. 24.12). However, Roman archaeologists face special research problems,

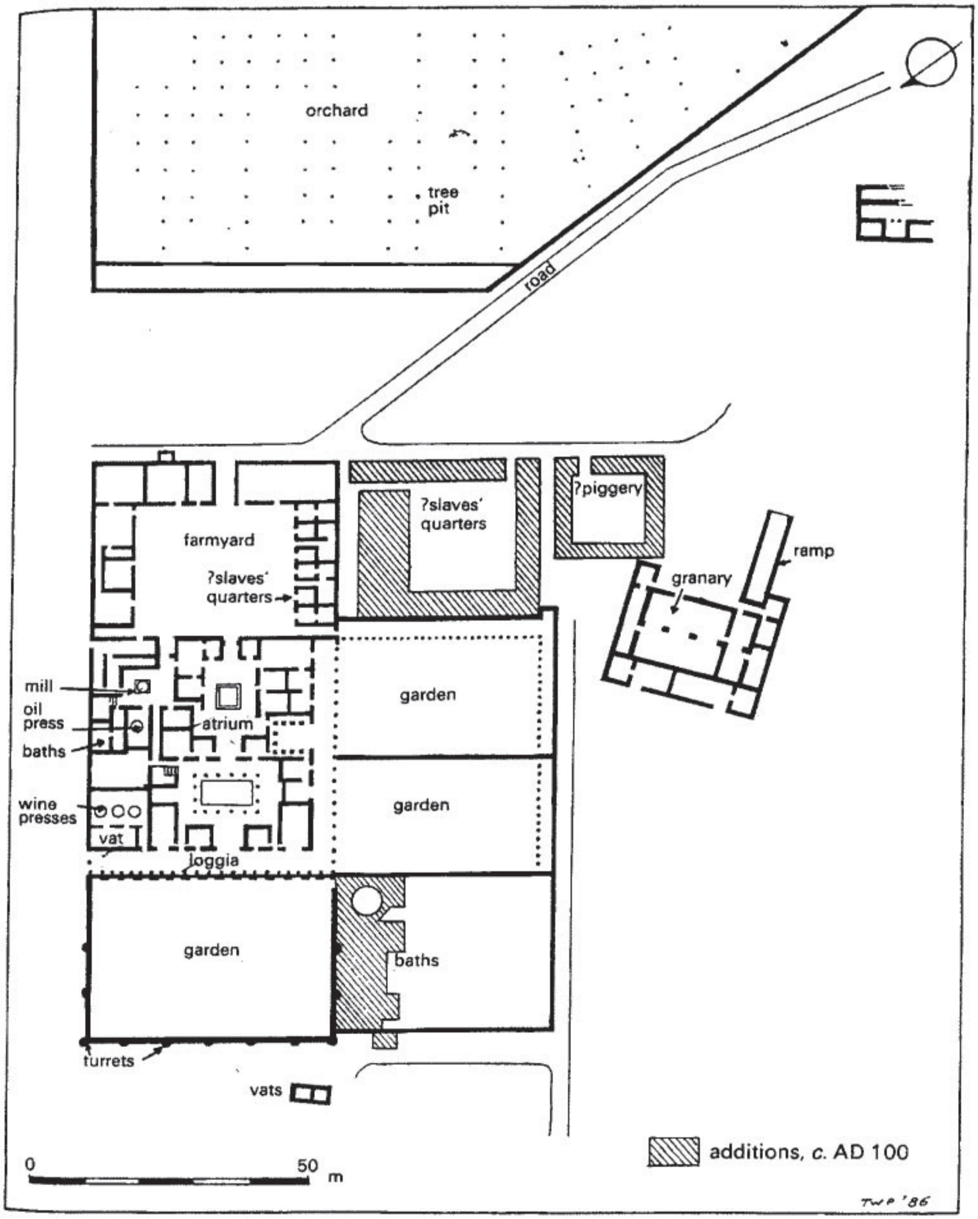

Figure 24.12 The Roman villa at Sette Finestre near Cosa in southern Tuscany represents the best excavated example of an élite rural residence of the late Republic and early Empire. It included not only elegant living quarters, but also work areas and probably slave quarters. Source: T.Potter (1987) *Roman Italy,* London: British Museum Press.

which make the reconstruction of slave activities very difficult. They do not have the type of detailed written documentation about individual estates that North American historical archaeologists possess. This makes the identification of features like slave quarters rather more problematic. There is also the danger that an emphasis on slavery may lead both archaeologists and historians to underestimate the complexity of the social and economic make-up of the countryside, and underplay the role of free and freed farmers in agricultural production (Dyson 1992). This concern applies to both the Roman and the *antebellum* North American world.

ASSIMILATION AND RESISTANCE

Influenced by the imperialistic values of the nineteenth century, archaeologists of empire have long tended to stress the overwhelming success of various colonial ventures. This has been especially true of the Roman empire, where the remains both in the towns and in the countryside suggested that the imperial system had triumphed and that those natives who had not perished had been turned into good Romans. A historical scenario was reconstructed in which the indigenous élites abandoned their farmsteads and hill-forts, moved into villas and town houses, learned Latin, and adopted Roman ways. In the colonial Americas, the processes were seen as both more simple and more complex. The Anglo-America frontier areas of North America saw either the extermination or the marginalization of the native population, and the creation of a new society. For much of Spanish America, the situation was different, since the Native American population was too numerous to exterminate totally. However, the native civilization and the élite that maintained it were destroyed and the surviving natives marginalized. Study of their culture became the task of anthropologists and folklorists and not of historians of empire and archaeologists specializing in high culture.

The conquered natives had not been totally forgotten. European nationalism of the nineteenth century first focused archaeological interest on questions of resistance to Roman expansion. Sites like Numantia in Spain, Alesia in France, and the Teutoberger Forest in Germany, which were associated with local Celtic and German resistance to the advance of Rome, have long been objects of research. The nineteenth-century French emperor Napoleon III sponsored excavations at Alesia, the site associated with the doomed stand of Vercingetorix and his Gauls against the army of Julius Caesar (Le Gall 1990). German antiquarians and archaeologists have long been engaged in a search for the location of the battle site in the Teutoberger Forest where the German forces under Arminius destroyed the three legions of the Roman general Varus in AD 9. In the late nineteenth century a massive monument to Arminius was erected at one of the presumed sites of the battle. Very recently German archaeologists seem to have definitely located the site of the battle at another location nearby, a claim apparently confirmed by the discovery of Roman military artefacts there (Dornberg 1992).

Decolonization and the growing interest of groups like Native Americans and Afro-Americans in asserting their own cultural continuity and identity have led both historians and archaeologists to reassess their views about the relation between colonialism and the survival of native social and cultural values (Deagan 1991; Mattingly 1997; Simmons 1986; Webster and Cooper 1996). Archaeologists have focused special attention on two areas of research. One is the countryside, where more unacculturated natives might be expected to survive. This research was modelled on the example of Latin America, where native languages and thinly veiled native ways survive in many rural areas (Farnsworth 1992). In the Roman empire, fieldwork has turned from the investigation of those symbols of successful Romanization, the villas, to the search for survivals of pre-Roman settlements and rural ways of life. Increasing evidence for such survivals is emerging. In Britain, for instance, archaeologists have increasingly stressed the geographical limitations of the villa culture: in areas like the Midlands, few villas were built and native rural community organization and lifeways seem to have persisted (Hingley 1989). In rural Sardinia, one of the oldest provinces in the Roman empire, many of the pre-Roman towered sites called *nuraghi* continued to be inhabited throughout the Roman period and few villas or rural towns were built (Dyson and Rowland 1992). Such research is still in its early stages, but it is clear that a new version which stresses the limitations of Romanization in the countryside will emerge.

Another fruitful area of research has focused on the study of symbolic systems, as they are reflected in areas like religion. Here the researches of the field archaeologist merge with those of the art-historical archaeologist (Henig and King 1986; Salomon 1987). Contemporary advertising and the use of symbols for political control have made scholars more aware of the importance of the use of symbolic control in the past. Archaeologists who have until recently been concerned with social and economic studies are now paying more attention to the role of past symbolic systems. Important studies of the relation between political symbolism and imperial power have been done for empires as diverse as the Mayas (Marcus 1976) and the Rome of Augustus (Zanker 1988). Clearly complex imperial systems like to control political symbolism, from the statues of emperors in Roman provincial towns to statues of Queen Victoria in British India.

Religion provides a more complex example of conflict and compromise between colonial control and native resistance (Webster 1997). Both ancient Romans and early modern Spaniards used religion as an instrument of domination. The Romans only suppressed those elements of the native religions that provided a focus for resistance to their rule. This explains their violence against the Celtic Druids (Piggott 1975). It is clear that they encouraged the natives to adapt Roman religious ways: the major religious centres, especially in the towns, bear witness to their success

(Henig and King 1986). However, in both the names of gods and the iconography of religious activities, the study of less official and more rural religion shows a much more complex interaction of Roman and native culture with a high level of native survival: Celtic deities not only retain their own names, but are depicted in ways that bear little resemblance to the high culture art values of Rome (Webster 1997).

The Spanish were much more rigorous in their reinforcement of religious conformity: native religious sites and institutions were destroyed and forceable conversion dominated (Stern 1982, 1987). A Roman Catholic religious hierarchy complete with an Inquisition was established throughout Spanish America. Native artists and artisans were trained in the European manner. Yet the anthropologists who study religious ritual or the art historians who study iconography, especially in the rural areas of modern Mesoamerica, rapidly note the degree to which there is continuity from the pre-Roman Catholic past (Stern 1982, 1987).

Since imperial history has largely been written by those closely associated with the imperial powers, there has been even less emphasis on successful resistance to imperial expansion. For internal political reasons, the Germans have taken great pride in their repulse of Rome. Other, more recent, examples exist: one of the most interesting is the long successful resistance by the natives of Madagascar to various European colonial efforts.

CONCLUSION

It was noted at the beginning of this chapter that a contemporary archaeology of empire has to reflect a very complex historical view of the imperial process. No longer can it be just a military or colonial élite archaeology: it has to reflect the relation between imperialism and trade, the way that empire reorganized social, productive, and symbolic systems, and the ability of the natives to resist and survive imperial advance. Some areas of research like military archaeology have a long history, whereas archaeological research in areas like slavery and resistance is just beginning. A gender-orientated archaeology of empire hardly exists.

The archaeology of empire offers not only challenges but also opportunities to the discipline as a whole. It provides a range of stimulating challenges. The complex intersection of written records and diverse material cultures sharpens interpretive skills. The wide commonality of imperial processes across time and space provides an opportunity for the archaeologist to move beyond specific cultural areas and adopt a more holistic view of the imperial process. The new archaeology of empire, with its concern with all actors in the imperial process, requires the development of both new research techniques and new paradigms of interpretation. Methods as diverse as field survey and botanical and faunal analysis have already demonstrated their worth in recreating the history of ordinary people caught up in the imperial process. More complex may be the determination of the questions to be asked. The archaeologists have long tended to come from the élite, male, ranks of the old imperial societies: a re-thought archaeology of empire is going to have to involve all groups and genders that were caught up in the imperial process.

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The literature on the Roman Empire is vast. The archaeology has to be studied on a regional basis. Good recent studies of parts of the western empire include Keay (1988) and King (1990). For an effort to see the archaeology of modern colonialism in a world-wide context, see Falk (1991), and for the archaeology of North American plantation life and slavery, see Singleton (1985) and Ferguson (1992).

25

POST-COLLAPSE SOCIETIES

Joseph A.Tainter

INTRODUCTION

If there is a historical generalization that is widely considered true, it is that human societies tend to become larger and more complex, but a corollary equally true is that complex societies often collapse. Collapses are a paradox: they are common enough to warrant systematic study, yet are usually seen as an aberration of social evolution.

Complex societies have been collapsing nearly as long as they have existed, yet this process and its aftermath are poorly understood. This stems in part from a paucity of material remains of post-collapse societies, but the bigger obstacle is our intellectual prejudice. There is genuine bias against so-called 'Dark Ages', a bias instilled by a pejorative label, and by texts that portray such periods as times of disorder, poverty, and unrelieved bleakness. Even scholars who study post-collapse societies are vulnerable to this prejudice, as in the following characterizations of the Greek Dark Ages.

> From the point of view of material culture, the Greek Dark Ages have little to offer or excite…One has…the feeling of depressed isolation…At first sight, the overall impression of Athens in the Dark Ages is not a very exciting one.
>
> (Desborough 1972:12, 77, 157)

> Apart from pottery, the archaeological evidence for the next two or three centuries [after the Mycenaean collapse] is very thin and unrevealing in any positive sense…[A] uniform dullness sets in everywhere…
>
> (Finley 1981:65, 70)

Post-collapse societies are to many scholars an annoying interlude, their study a chore necessary to understand the renaissance that follows. One problem is the paucity of material remains, but there are also conceptual reasons for this bias: post-collapse societies violate both the nineteenth-century belief in unilineal 'progress', and the twentieth-century assumption that societies evolve inexorably to greater complexity. Moreover, when a complex society collapses it may take with it those trappings of complexity that form the popular image of a civilization: great traditions of art, architecture, and literature. Most people believe that great complexity (that is, civilization) is a desirable condition of human affairs. Civilization is commonly seen as the ultimate accomplishment of the human species, and industrial civilization as the culmination of history. Adopting such a view, which most of us assimilate when young, collapse seems a catastrophe.

In contrast, this chapter argues that complexity is rare in human history. It is a costly mode of organization that must be constantly maintained. Collapse is in fact normal and expectable in the evolution of complexity. As a recurrent phenomenon, post-collapse societies must be included in historical studies. While each post-collapse society has its own characteristics, many show recurrent patterns. These patterns mean that many aspects of post-collapse societies should be amenable to generalization and explanation.

DEFINITIONS

The concept of complexity is straightforward and potentially quantifiable: complexity refers to the size of a society, the number of its parts and their distinctiveness, the variety of specialized roles, the number of distinct social personalities, and the number and effectiveness of mechanisms for integrating these into a functioning whole. Increasing any of these factors increases the complexity of a society (Tainter 1988:23, 1996:4–7). Thus hunter-gatherer societies are composed of no more than a few dozen social personalities, whereas modern European censuses recognize 10,000 to 20,000 distinct occupations, and industrial societies may overall embody more than a million different social personalities (McGuire 1983:115). As another example, ethnographers documented among the native peoples of western North America some 3,000 to 6,000 cultural elements, including technology, ideology, and social relations, yet when US military forces landed at Casablanca in the Second World War, they brought with them more than 500,000 artefact types (Steward 1955:81), and a corresponding logistical service.

Collapse too is a straightforward concept, and pertains also to quantifiable social dimensions: *collapse is a rapid, significant, loss of an established level of socio-political complexity* (Tainter 1988:4). Collapse is fundamentally a matter of the socio-political sphere. It may and frequently does have consequences in such areas as art, architecture, and literature but, contrary to widespread belief, these are not its essence. It is incorrect to speak of a civilization collapsing, though this is commonly done. A civilization (that is, a great tradition of art, architecture, and literature) is the cultural system of a complex society (Tainter 1988:41). What is called civilization is an epiphenomenon or product of complexity. Great traditions of art, architecture, and literature emerge to serve social and economic classes, and social and economic purposes, that exist only in complex societies. Civilization emerges with socio-political complexity, exists because of it, and disappears when complexity disappears. Civilizations do not collapse; specific political structures do.

The only societies that can collapse are ones that have existed at a level of complexity, or have been evolving towards higher complexity, for more than a few generations. The demise of a short-lived entity such as the Carolingian empire is not a collapse, merely an unsuccessful attempt at empire building. A collapse, moreover, must be quick, taking no more than a few decades, and it must entail a substantial loss of socio-political structure. Cases of prolonged weakness and territorial loss, such as the Byzantine and Ottoman empires, are not examples of collapse (Tainter 1988:4). Figure 25.1 shows a clear collapse, the rapid abandonment of major Mayan political centres at the end of the Late Classic period.

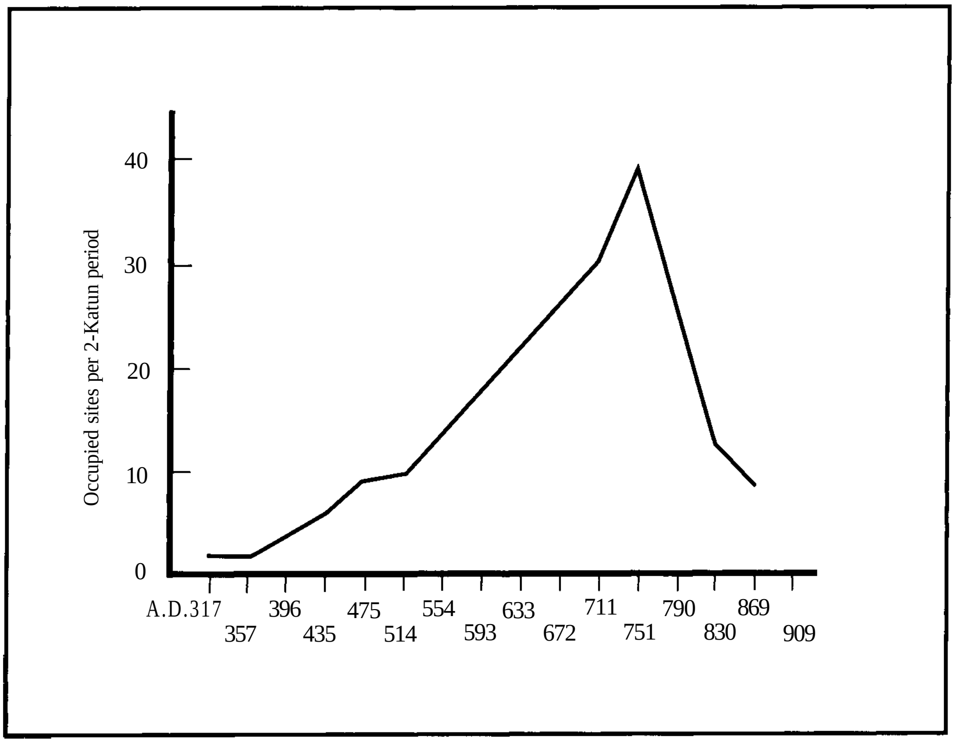

Figure 25.1 Occupation of Classic Maya centres; one *katun* is approximately twenty years. Adapted from Erickson 1975:40. Source: J.Tainter. Redrawn by D.Miles-Williams.

While it is common to think of collapse as something that afflicts only states and empires, in fact any kind of society can collapse, even fairly simple ones. Societies vary along a continuous scale, and any society can increase or decrease in complexity along the progression of this scale. Collapse is relative to the complexity of the society. Mid-range societies, such as the prehistoric Chacoans of what is now the south-western United States, or even foragers like the Ik of northern Uganda, have been known to collapse (Tainter 1988:4–5, 14–15, 17–18). This discussion will not concentrate on such examples, but it is important to understand that collapse is a universal process that can affect virtually any society.

THE COSTS OF COMPLEXITY

The citizens of modern industrial states are taught that their societies are the normal form of human organization. In fact we are an anomaly. Throughout several million years of human existence, the common political unit was the small, autonomous community, making decisions and acting independently, and largely self-sufficient. Carneiro estimates that such communities were the dominant political form for 99.8 per cent of our history (1978:219). Truly complex societies, those organized as hierarchical, centralized states, have emerged only within the last 6,000 years or so. Complex societies are thus historically rare, and statistically are an unusual form of organization. In this sense post-collapse societies are not aberrations, but represent a return to the usual condition of low cultural complexity.

A matter typically overlooked in the study of cultural evolution is that complexity costs: more complex societies are more expensive to maintain than simpler ones, and require greater support levels per capita (Tainter 1988:91–92). In a society that is more complex there are more groups and social roles; there are more networks among individuals and groups; there are more controls, both horizontal and hierarchical; more information is processed; there is more centralization of information; and there are more specialists who are not engaged directly in producing resources (Johnson 1978, 1982; McGuire 1983; Tainter 1988:91). Correspondingly, while a simple cultural system activated primarily by human energy requires only about one-twentieth horsepower per capita per year (White 1949:369, 1959:41– 42), industrial societies depend on hundreds to thousands of horsepower per capita per year. Not only can complex societies utilize more energy, they require it. In the days before fossil fuels and industrial technologies, the higher cost of supporting a more complex society typically meant that people worked harder.

The costs of complexity do much to explain why it is rare. At one point most archaeologists and historians assumed that human societies have a latent tendency towards complexity, that it is the inevitable result of surplus food, leisure time, and human creativity. Some scholars still believe this scenario, and it is widespread among the public. In fact, the costs of becoming more complex have always restrained growth in complexity. Peasants particularly bear the cost of supporting complex institutions, through taxation or direct requisitioning of their labour. Participating in a complex society is a benefit/cost equation. While peasants may lack the option not to participate, their participation is not irrational. When supporting complex institutions becomes too high in cost or too low in benefits, peasants have historically responded with degrees of resistance ranging from apathy to rebellion (Eisenstadt 1963:209; Wolf 1969).

Two points emerge from this. First, since complexity is costly and may be resisted by the support population, it must emerge under conditions of compelling need or perceived benefit. Scholars have identified a number of factors that contribute to the emergence of complex institutions: (1) the need to mobilize labour for public works, such as irrigation (Wittfogel 1957); (2) the need to centralize and process information (Johnson 1978; Wright 1969); (3) the need to manage internal and external economies (Isbell 1978; Raish 1992; Rathje 1971); (4) the need to regulate conflict within a society (Childe 1951:181–82; Fried 1967); (5) the need to organize for military operations (Carneiro 1970; Webster 1975); or (6) cumulative and interactive effects among these factors (Renfrew 1972:27). Complexity, in other words, is a problem-solving strategy.

Second, complexity must constantly be maintained. Complex societies are, as Simon has labelled them, 'nearly decomposable systems' (1965:70). They are built up of political units (villages, cities, ethnic groups, smaller states) that were at one time independent, and could become so again. To the extent that these 'building blocks' of complexity retain the potential for independent action, the administrators of a complex society must work continuously to assure their allegiance. Recent developments in the former USSR illustrate this point as forcefully as any historical example.

Membership in a complex polity can be maintained through coercion, or by incorporation as full members of the dominant system. Both courses have been employed. Often the incorporation of smaller political units into an overarching system, such as an empire, involves coercion initially followed by incorporation. The classic example is the Roman empire. In AD 212 the emperor Caracalla extended Roman citizenship to all free inhabitants of the empire. In the later empire provincials from such places as North Africa, Thrace, Syria, and Illyria aspired to, and regularly achieved, the highest office, and even Germans and Huns wielded power.

Coercion is an expensive and ineffective strategy, and must eventually be replaced by legitimacy, the belief that rule is proper and valid. This requires not only ideology and manipulation of symbols, but real returns of goods and services to the populace (Easton 1965). Both coercion and legitimacy require leaders continuously to amass resources, and to expend these to maintain the political order. Should they fail to do so, the society will 'decompose' to the 'building blocks' out of which it was created.

BENEFITS AND COSTS IN THE EVOLUTION OF COMPLEXITY

Complexity is clearly an investment, in which costs are assumed and benefits obtained. As with any economic activity, the efficiency of investing in complexity must be gauged by weighing the costs against the benefits.

To the extent that they have the information to do so, human populations will usually seek a rational return on expenditures of labour and other resources: that is, they will attempt to keep costs at an acceptable level, while obtaining a desired return of goods and services. Thus people initially use sources of food, energy, and raw materials that meet their needs at a reasonable level of effort. When such resources are no longer sufficient, people turn to secondary sources: foods, energy, and raw materials that are costlier to acquire, extract, process, and distribute, while perhaps yielding no higher returns (Asch *et al.* 1972; Boserup 1965; Clark and Haswell 1966; Wilkinson 1973). This yields the situation that economists refer to as the 'point of diminishing returns', where the cost of an investment rises but the return fails to grow proportionately.

Investment in complex social and political institutions follows the same pattern. In the growth of complexity, less costly social features are logically adopted before more costly ones. For example, part-time leaders have preceded those employed full-time. Generalized administration has given way to specialized. Whereas at one time many administrative functions may be fulfilled by a single individual, it is common in human societies to respond to problems by appointing specialized administrators, and by engaging more of the population in administrative tasks.

Organizational developments, moreover, tend to be cumulative. Complex social features are rarely dropped. In any complex organization there seems always to be more information to process. It is rare for the number of specialists to decline. Social welfare and political legitimization are unending requirements. Military forces typically do not get simpler or less costly. The compensation of élites usually moves upward. Complex societies create ever more public monuments, each requiring maintenance. The lesson is that when there is growth of complexity it tends to be exponential, always increasing by a proportion of an already inflated size.

As more parts are added to any system, the possible interactions among them increase factorially. Complex systems generate more complexity simply by being diversified. For example, in contemporary societies taxes are established and regulations are issued. Lobbyists seek loopholes, and administrators try to close these. There unfolds a potentially unending spiral of loophole discovery and closure, in which complexity and costs grow (Olson 1982:69–73). The administrators of any complex system must set aside resources—not only to solve the real problems the society faces but also to solve the problems created by their own existence, and by overall societal complexity (Tainter 1988:115–16).

The growth of socio-political complexity also yields benefits, such as producing and managing resources, internal order and external defence, processing information, and public works. As low-cost solutions to societal needs are adopted first, the benefit/cost ratio for investment in complexity may at first increase favourably. The Romans, for example, in the course of their expansion, engaged subject Italian peoples to assist them in their military campaigns, and later employed the wealth of conquered nations to finance further expansion (Jones 1974:114–15). As the empire reached its maximum extent, costs were minimized by creating a buffer of client states as Rome's first line of defence (Luttwak 1976). It was a strategy of empire-building that yielded high returns for minimal Roman expenditures.

Yet while a society's first investments in growing complexity may be rational and productive, that is a state of affairs which cannot last. As the least-costly organizational solutions are exhausted, requirements for further growth in complexity elicit more costly responses. As the cost of organizational solutions grows, the point is reached where greater investments do not yield a proportionate return. This is the point of diminishing returns to complexity. The benefits per unit of investment in complexity start to drop. Constant or increasing investments yield static or decreasing returns.

Stresses and challenges are inevitable, and no society can avoid adjusting continuously to its circumstances. As stresses arise, new organizational solutions must often be adopted, which involve increasing costs and diminishing returns. What economists would call the marginal return on investment in complexity (that is, the return per extra unit of investment) starts to decline. This may be so slight at first that it is hardly noticed. Ultimately marginal returns decline with accelerated force, and the decline becomes evident. At this point a complex society starts to become vulnerable to collapse.

Two general problems make a society vulnerable to collapse at this point. First, as the marginal return on investment in complexity declines, the society becomes economically weakened. As the society invests more heavily in a strategy with proportionately less return, excess productive capacity and financial reserves may be allocated to current operations. When major stresses arise there is little or no reserve for countering them. If the challenge is surmounted, the society may be so weakened economically that it is vulnerable to the next crisis. Thus older, established societies sometimes succumb to problems that they might have overcome when their return on investment in complexity was growing. Rome, for instance, was able to withstand major military disasters at the start of the Second Punic War (218–201 BC), and still went on to ultimate victory, yet in AD 378 a much larger, wealthier, and more powerful Roman empire was badly weakened at the Battle of Adrianople by losses that were comparatively less severe.

Second, diminishing returns make complexity an unattractive strategy. As costs rise and there is less return to the local level, the 'building blocks' of a complex system (villages, cities, ethnic groups, small states) perceive that independence would be more advantageous. They may passively or actively resist, or overtly attempt to break away. In the later Roman Empire local insurrections lasted for decades; many citizens offered no resistance to the German invaders, while others actively welcomed the intruders (Tainter 1988:118–23, 195–96, 1994:1248). Gunderson suggests that for many late Roman provincials 'the net value of local autonomy exceeded that of membership in the Empire' (1976:61).

Complex societies faced with external threats, or internal dissension, or both, have often yielded to the temptation to expand territorially, producing an economic windfall of agricultural produce and peasant populations, but new provinces and their populations must be controlled, administered, garrisoned, and defended. Subject populations become citizens, and so less suitable for exploitation. The subsidy obtained from a conquest is highest initially, due to plunder, but then declines as occupation and administrative costs rise, and as provincials gain political rights and benefits. Rome, for a one-time infusion of wealth from each conquered province, had to undertake administrative and military responsibilities that lasted centuries. Ultimately the marginal return on being an empire starts to drop, whereupon the society is back to its previous predicament. Territorial expansion provides only a temporary respite from diminishing returns to complexity. What it does ensure is that collapse, when it finally occurs, affects a wider territory and a larger population in a more devastating manner than would otherwise have been the case (Tainter 1988:124–26).

A recent survey disclosed nearly two dozen cases of collapse, known historically or archaeologically or both, ranging from the very simplest societies, such as the Ik of Uganda, to the great empires of the ancient world (Tainter 1988:5–18). Given that small to mid-range societies are prone to collapse, and rarely developed writing, there must have been dozens or hundreds of collapses that have not been discerned archaeologically, though gradually these are being recognized (for example, Mathers and Stoddart 1994). In the remainder of this chapter I focus on twelve well-documented post-collapse societies, though as post-collapse societies cannot be understood without knowing the contexts from which they developed, each case study will cover both pre- and post-collapse characteristics.

THE ROMAN EMPIRE AND POST-ROMAN EUROPE

The Roman empire reached its logical extent with the conquest of the Mediterranean basin. During the sailing months, the Mediterranean provided efficient transport and rapid communication, both vital to maintaining the empire. Julius Caesar's conquest of central and northern Gaul (58–51 BC) was not a logical extension of the Mediterranean conquests, but the Romans appreciated it none the less: Gauls had often been a threat. Later conquests, of Britain by Claudius (AD 41–54) and of Dacia by Trajan (98–117), may not have paid for themselves, for these were poor frontier provinces at a great distance from the capital (Hammond 1946:75–76). The Romans held Britain and Dacia through recurrent crises, but abandoned them when they proved indefensible. Trajan's conquests in Assyria and Mesopotamia (AD 115) were wisely relinquished by his successor, Hadrian (117–38).

Despite fiscal difficulties, resulting in a progressive debasement of the silver coinage (by increasing the proportion of copper), the early empire was peaceful and successful. Significant stresses appeared in the reign of Marcus Aurelius (161–80), when a devastating plague coincided with serious Germanic incursions. The empire's first life-threatening challenges came in the third century AD, and particularly in the half century from 235 to 284. This was a time of unparalleled crisis, during which the empire nearly came to an end. There were frequent barbarian incursions and foreign conflicts, punctuated by civil wars. Many provinces were devastated. The army and bureaucracy grew. The government's response produced financial distress and higher taxes, great debasement of the currency, and unparalleled inflation. The average reign during this period was only a few months. In a fifty-year period there were at least twenty-seven recognized emperors, and so many usurpers that the number of emperors and pretenders averages out to one per year for half a century.

The situation was rescued for a time by reforming emperors, beginning with Gallienus (253–68) and Aurelian (270–75), though the major work was done by Diocletian (284–305) and Constantine (306–37). The solution was larger government, greater power, and higher complexity. The empire that was redesigned under Diocletian and Constantine was larger, more complex, and more highly organized. It commanded military forces more than double the previous size. It taxed more heavily, conscripted citizens' labour, and regulated lives and occupations. The empire became a coercive organization that intruded into and subdued individual interests for one paramount goal: the survival of the state.

As the Roman empire became more complex, it naturally became more costly. Each citizen, each guild, and each locality was expected to produce what the empire needed. Taxes were raised to the point where they threatened the capital resources of taxpayers. Diocletian's tax was a flat rate levied on the land and on the number of residents. It did not accommodate variations in the quality of land or fluctuations in yield. The land tax had to be paid whether a parcel was cultivated or not. If a farmer could not be found, an uncultivated parcel was assigned to other landowners, to all local landowners, or to municipalities for payment of taxes. Even if a crop was poor, the tax had to be paid, whether or not enough was left for the farmer and his family. People who couldn't meet their taxes were jailed, sold their children into slavery, or abandoned their homes and fields. Yet the state always had a back-up, extending tax obligations to widows or children, even to dowries.

Under such circumstances marginal land went out of production, as too often it could not yield enough for taxes and a surplus. The population of the empire had been declining for some time under the pressures of plagues and wars. The former population could not be re-established, as conditions were most unfavourable for the formation of large families. Acute shortages of agricultural labour resulted in imperial legislation tying farmers to the soil. As smallholders could not pay their taxes or their debts, they abandoned their farms and fled to large landowners. Tied by law to large estates, effectively they became serfs, and the forerunners of the feudal structure of the Middle Ages (Chapter 27). None the less, many late Roman peasants found rent-paying more attractive than tax-paying, and both peasants and landlords chose feudal social relations rather than a state-centred society (Wickham 1984:17–18).

It was not only the countryside that suffered. In Gaul the cities of the later empire shrank, sometimes to the size of earlier villages. Vienne, for example, declined from 200 to about 20 hectares, Lyon from about 160 to 20, and Autun from about 200 to 10 hectares (Hodgett 1972:36; Randsborg 1991:91).

The Roman government's response to crisis was to increase its size, complexity, and costliness, but this was undertaken only to maintain the *status quo*. No new lands were conquered and no major booty was won. Costs rose precipitously, benefits at best remained level or even declined, and the return on maintaining the Roman empire plummeted. By the fifth century AD the Roman empire survived by consuming its capital resources: producing lands and peasant population. The decreased wealth and manpower of the western empire contributed to the military successes of the invaders. Military disasters in turn weakened finances, as productive provinces were plundered or stripped away. A downward spiral began, and ultimately the shrunken state was unable to pay its German mercenaries, who demanded one-third of the land of Italy in lieu of payment. This being refused, they revolted, elected as their king a commander named Odovacer, and deposed the last emperor of the west, Romulus Augustulus, in AD 476. A small section of northern Gaul remained under Roman administration for another ten years, until annexed by the Franks. Its leader, Syagrius, was styled the 'Roman King of Soissons' —that is, just another petty chieftain (Barker 1924:425; Brown 1971; Duncan-Jones 1974; Finley 1973; Frank 1940; Gibbon 1776–88; Gunderson 1976; Hammond 1946;

Heichelheim 1970; Jones 1964, 1974; Levy 1967; Luttwak 1976; MacMullen 1976; Mazzarino 1966; Rostovtzeff 1926; Russell 1958; Tainter 1988: 128–48, 1994).

Most of the western provinces had been lost to Roman control before 476, and were divided among the Germanic invaders. In Gaul at least the process was not significantly resisted. Wickham argues that in the fifth century many landowners preferred the Germanic successor states to the financial structure and taxes of the Roman state (1984:16). Some Gallic towns (or what was left of them) actually invited the invaders to occupy territory. In 378 Balkan miners went over to the Visigoths *en masse*. '[By] the fifth century', concludes R.M.Adams, 'men were ready to abandon civilization itself in order to escape the fearful load of taxes' (1983:47).

The invaders appropriated up to one-half of the lands they occupied. Since the later empire had lost population, and formerly cultivated lands were abandoned, this caused less impact than one might expect. The appropriated lands were in some cases owned by the Roman state, and in others were parts of privately held estates. In many instances, though, Roman landowners were evicted altogether, and among the landowning class there was hardship. Some Roman landowners adapted wisely to the new realities, changing their names to Germanic forms, and even commanding German armies (Wickham 1984:30).

The cultural traditions that survived the Roman collapse were those supportable by land ownership. The Merovingian dynasty of Gaul (AD 428–751) still taxed land, and people still complained, but the levy was much reduced. Late Roman taxes had taken from one-fourth to one-third of gross yields, and thus from one-half to two-thirds of what was left after paying rent. Now taxes were reduced to perhaps under 10 per cent, and taxation no longer dominated the economy. The legitimacy of taxation declined, as its main purpose was to enrich the Merovingian kings. Taxes declined primarily because there was less to spend money on. The main expense of the Roman empire had been the army. That cost was now virtually gone since Frankish warriors provided their own equipment and sustained themselves from their estates. When troubles arose, troops were raised locally: the standing force was very small.

The king's expenses were limited to maintaining his court and giving donations to leading men and the churches. These expenses were covered by revenues from the royal domains. Court officials had no salaries, but received the revenues of certain estates. When the king and his officials travelled, private persons were obliged to furnish food, lodging, and transport. Initially some Roman imposts were kept, such as customs dues. By Carolingian times (beginning AD 751) all that was left of the land tax was an assortment of fragments with regional names, whose origins were lost to memory (Pfister 1913; Vinogradoff 1913; Wickham 1984).

In the later sixth century AD, Gregory of Tours used the term 'Senator' for any major Gallo-Roman landowner—the original meaning of the term had been forgotten, although the Roman Senate survived until about 600. Hierarchies were simplified and authority greatly reduced. Merovingian society had definite gradations, but initially no hereditary nobility. Aristocrats were those who owned great estates. Offices were valued because they conveyed land. Aristocrats were not bound to the state by abstract concepts of obligation or duty. The king distributed land to obligate leading men to himself, expecting military service in return (Pfister 1913; Wickham 1981, 1984).

There was no remedy against autocratic rule but revolt or assassination, and Pfister has described the Merovingian government as ‘a despotism tempered by assassination’ (1913:135). Still, royal authority was limited by the tribal social relations from which it had sprung. At the conquest of Soissons (AD 486), Clovis tried to save a precious chalice for the church. He appropriated it as an extra share of loot, whereupon a common soldier, so as not to allow the king an extra privilege, chopped the chalice in two. Clovis, realizing that the soldier’s comrades would feel similarly, took no immediate action; at the next review, though, he cut the man’s skull in two (Vinogradoff 1913:640).

In the late Merovingian period an annual spring assembly was held, which by the Carolingian era was the most important part of government. The assembly was an army, a council, a legal tribunal, and a source of revenue. The assembly decided the king’s recommendation whether to go to war. Those summoned to the assembly brought gifts of money and food, which became the state’s principal source of revenue (Pfister 1913:135, 140). Feudalism continued to develop at the opposite end of the social hierarchy. Troubled times in the seventh century kept poor freemen on protracted military duty. Once again patron-client relations developed, as poor freeholders commended themselves and their land to large proprietors, both lay and clerical, in exchange for the right of occupancy. The number of smallholdings declined while estates grew (Pfister 1913:151–52; Vinogradoff 1913:649).

From the mid-fourth century few monumental buildings were erected in Gaul other than churches. Decaying masonry buildings were patched up, or demolished and replaced in timber. Many ancient monuments were destroyed in the invasions and those remaining were typically mined for building materials. Towns took on a country-like atmosphere: they were sparsely populated and had much cultivated land within their walls. The only substantial buildings were churches, and many ‘towns’ consisted of little other than monasteries. The Roman roads still converged on such places, so they retained their names and in some cases a small measure of centrality. While there is evidence for industry within the former cities, they had become primarily administrative and ecclesiastical centres, where bishops tried to carry on a semblance of Roman tradition. After 600 there is little archaeological evidence for continuity of towns, and a strong case can be made for discontinuity. In the Carolingian period, while settlements grew and came to resemble villages, the major locations were monasteries, royal centres, and trade emporia (Hodges and Whitehouse 1983:83–86; Pfister 1913:155; Randsborg 1991:20, 69; Wickham 1984:27).

Both the Merovingians of Gaul and the Lombards of Italy initially minted only gold coins. These were supplemented by a Merovingian silver coin introduced in the 670s and 680s, but silver was not reintroduced to Italy until the Carolingian period. This must indicate growing commerce and a need for smaller-unit currency. Yet silver coins were still too valuable for peasants. Money was available but not widely employed: it would have served as a standard of comparison rather than a medium of exchange, although peasants could have sold their produce for coins to pay rents. Landowners, who participated in urban markets, would have used coins in a more recognizably commercial manner (Hodges and Whitehouse 1983:93–94; Wickham 1981:113).

In Italy, although the western Roman empire was gone, there was initially no collapse. The late imperial administration was continued under Odovacer (AD 476–93), and the Ostrogothic king Theodoric (490–526) and his successors. The latter had at his command all the cultural resources of late Roman society and used them effectively. His palace at Ravenna dwarfed that built by Charlemagne at Aachen nearly 300 years later. The power of the state over the Italian economy was not broken until the wars of 535 to 605. Lombard Italy, like Merovingian Gaul, was supported by settlement on the land. The land tax disappeared. Landowning became the source of power, and the state depended on the consent of powerful landowners. In the seventh century the army was transformed into a landowning aristocracy, in both Lombard and Byzantine Italy.

By AD 700 each zone of Italy had its own customs and idiosyncracies in social hierarchy, legal formulae, and weights and measures. By 900 Italy was a complex ethnic mosaic. The bulk of the population was Roman (themselves, by late Antiquity, a complex ethnic mixture), but there were also Lombards, Franks, Alemans, some Burgundians and Bavarians, and Byzantine Greeks. The Lombards themselves numbered about 200,000 persons, only 5–8 per cent of the population in their territory. Not surprisingly, the Lombards lost their language by 700. The Ostrogoths are heard of little more after the Byzantine conquest.

Urban settlement never disappeared from Italy, but it was seriously impaired by the weakening and collapse of the empire. The fortunes of Rome are illustrative. From the first century BC until AD 367 it was an enormous city, holding a million people. Then in less than a century, by 452, it had declined to about 400,000, and in the next few centuries it dwindled to a few tens of thousands, standing at perhaps 30,000 in the tenth century. Where Rome had once been fed from Egypt, North Africa, and Sicily, its needs could now be met by farms within a few kilometres. The ancient monuments were converted into fortresses or mined for building materials, and the forum reverted to swamp.

To the north of Rome, settlement patterns in the *Ager Faliscus* testify to the insecurity of the times: the number of open country settlements dropped and, particularly in the last quarter of the first millennium AD, many hilltop villages were founded (Fig. 25.2). The latter continue to dominate the Italian landscape. As in Gaul there was sometimes farming within city walls. Large, state-organized projects came to an end, so that the drainage systems of the Po and Arno valleys were allowed to decay (Burns 1984; Hodges and Whitehouse 1983; Randsborg 1991; Wickham 1984).

Post-Roman Europe is the era for which the term ‘Dark Age’ was coined. While literacy had never been widespread even in classical times, certainly after the Roman collapse even fewer people could read and write. The paucity of original literature is striking. Gregory of Tours was almost the only historian of the sixth century,

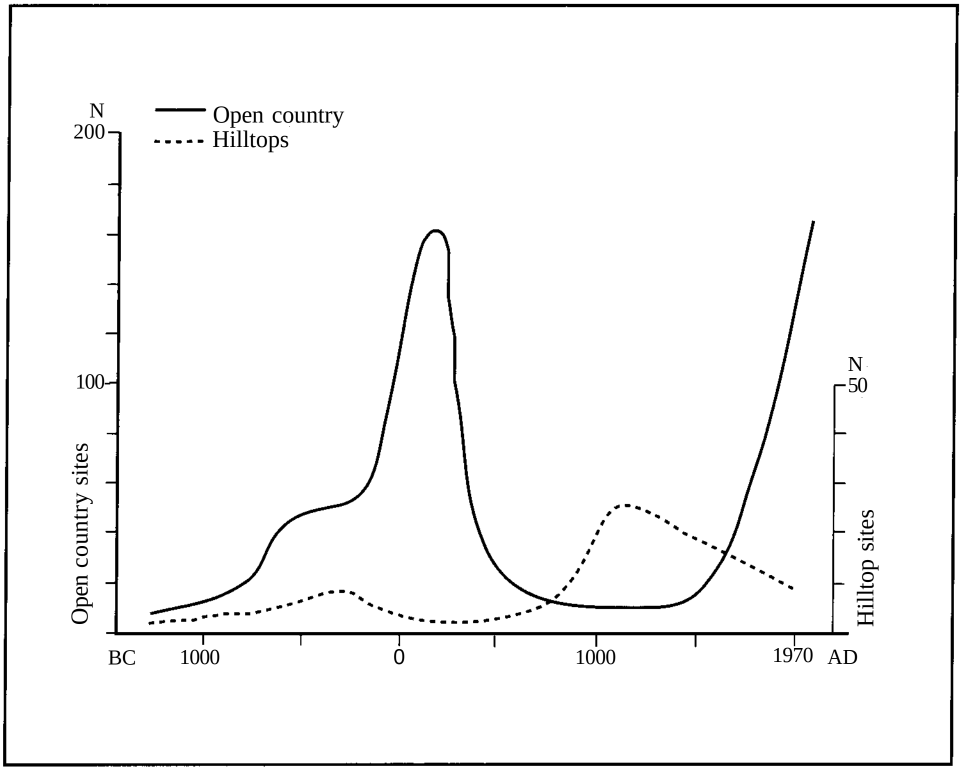

Figure 25.2 Changing settlement patterns in the *Ager Faliscus*, north of Rome in central Italy; note the shift to hilltop settlement in the second half of the first millennium AD. Adapted from Potter 1976:214 as modified by Randsborg 1991:71. Source: J.Tainter. Redrawn by D.Miles-Williams.

and he could not understand much of what was happening to his world. After him there is nothing of real history, merely some scraps attributed to a chronicler named Fredegar. The sole poet of the era was Fortunatus. After them there is only a monotonous series of lives of saints, most of which read alike (Pfister 1913:156–57).

The picture may seem bleak indeed: decaying monuments and public works, cities given over to cultivation, political simplification, disintegration, illiteracy, and depopulation. Yet there were developments that are significant for understanding the process and aftermath of collapse. The Germanic states that succeeded Roman rule were more successful at resisting further invasions (for example of Huns and Arabs) than had been the later empire. Theodoric was the most successful ruler of Italy since Valentinian (364–75), yet he held it with an army of only 25,000 to 30,000 and gave peace and prosperity. While some Romans disliked his Ostrogothic mannerisms, most approved of his rule. If there are fewer monuments to marvel at today, it is because buildings were economical and appropriate to the scale of the society. If Gallic and Italian aristocrats were less wealthy than their late Roman counterparts, peasants farmed better land and enjoyed higher productivity to their labour (Burns 1984; Carr 1992:208; Hodges and Whitehouse 1983:106; Weber 1976:389; Wickham 1981:21, 1984:30). Such developments are among the paradoxes of collapse.

CHINA: THE WESTERN AND EASTERN CHOU

The collapse of the Western Chou dynasty (771 BC) marked the end of Chinese unity and the beginning of protracted fragmentation. The period of the Eastern Chou dynasty (770–256 BC) was a post-collapse phase, for the complex governmental apparatus and territorial unity of the Western Chou were gone. It represents, though, one extreme of the collapse process, for the independent polities which succeeded the Western Chou were well-integrated states. They were certainly more complex than the states of post-Roman Europe. The drop in complexity at the end of the Western Chou was much less than after the fall of the western Roman empire (Hsu and Linduff 1988).

The Chou were preceded by the Shang (*c.* 1766–1122 BC), China's first historical dynasty. The Shang are poorly known from isolated bronzes, so-called 'oracle bones', and unreliable writings of later times, though fortunately they are beginning to be better known archaeologically. The Shang ran a well-integrated empire, and were capable of impressive labour organization. Around 1500 BC their city of Cheng-chou was surrounded by walls of pounded earth 28 kilometres long. These walls contain 870,000 cubic metres of earth, and would have taken 13 million working days to complete—four years' work for a force of 10,000 labourers.

To overcome this powerful state the Chou, then a small peripheral people in the west of China, gradually encircled the Shang, or forged encircling alliances. Chou foot-soldiers had body armour and bronze swords that gave superiority over Shang forces. At the climactic battle of Mu-yeh, the Shang forces were drawn into rough terrain, where their advantage in chariots was negated, and where the clumsy formations of the Shang infantry worked to their disadvantage. The Chou could not hold China with their small forces, and to maintain their rule they developed two strategies. The first was to rule through a feudal hierarchy, with power devolving on regional leaders. This proved ultimately to be part of their undoing, and laid the structure for China's eventual fragmentation.

The second strategy was sacred legitimization, which was to have a lasting effect. Shang religious practices had been pantheistic and shamanistic. The Chou asserted stronger sacred legitimization: they claimed to have the 'Mandate of Heaven', a charter from *T'ien* (roughly 'the solemnity of the dome of the sky') to rule in the interests of the people. This was a brilliant manoeuvre which influenced much subsequent Chinese history: when a Chinese dynasty would grow corrupt, or fail to serve the needs of the people, rivals would claim that the Mandate of Heaven had devolved on them. This provided a legitimate basis for challenging established authority.

The Western Chou campaigned to expand their empire to the east and south, achieving some success and establishing an eastern administrative centre at Loyang. They also fought frequently with northern nomadic peoples, yet within a few centuries their power started to decline. The royal house began to lose authority as early as the tenth century BC, and by the ninth century their expansion may have stopped, weakened by the wars with the nomads and by the burden of sustaining large defensive forces. Chou expansion in the south was challenged by rebellion. In their waning years the Western Chou faced a number of concurrent problems: drought and famine, perhaps earthquakes, injustice and incompetent administration, encroachment of nomads, loss of population, vagrancy, and general disintegration of the social order. An excerpt from the contemporary poem *Shao-min* seems to express the multitudinous problems of the times.

> Compassionate Heaven is arrayed in anger
> Heaven is indeed sending down rain,
> Afflicting us with famine,
> So that the people are all wandering fugitives;
> In the settled regions and on the border all is desolation.
> Heaven sends down its web of crime;
> Devouring insects weary and confuse men's minds,
> Ignorant, oppressive, negligent,
> Breeders of confusion, utterly perverse;
> These are the men employed to tranquilize our country.
> A pool becomes dry;
> Is it not because no water comes to it from its banks?
> A spring becomes dry,
> Is it because no water rises in it from itself?

Great is the injury (all about),
So that my anxious sorrow is increased:
Will not calamity light on my person?
Formerly when the former Kings received their mandates,
There were such ministers as the Duke of Shao,
Who would in a day enlarge the kingdom a hundred *li*.
Now it is contracted in a day a hundred *li*.
Oh! Alas!
Among the men of the present day,
Are there not still some with the old virtue?
(Hsu and Linduff 1988:283–84)

Finally an allied force of several northern Jung groups invaded the district of the capital city, Hao. In 771 BC the last Western Chou ruler, King Yu, was killed and the city sacked.

The Western Chou conquests had increased the importance of the eastern administrative centre, Loyang. After the disaster the capital was moved here, and the Eastern Chou dynasty established (770–256 BC). Chinese unity, however, effectively collapsed with the Western Chou. Regional leaders owed nominal allegiance, but the Eastern Chou were powerless figureheads. Subsequent Chou rulers were kept primarily to perform sacrifices legitimately. Real power shifted to the vassal states.

The post-collapse phase is conventionally divided into the Spring and Autumn (770–464 BC) and Warring States (463–222) periods. After the fall of the Western Chou there was a period of social upheavals: power was usurped by lords and ministers who arranged complex, shifting alliances, and strong states subjugated weaker ones as the powerful became more so. A later Chinese saying asserted that 'during the Spring and Autumn period, no wars were righteous' (Xueqin 1985:7).

The most important states of the Spring and Autumn period were Lu, Ch'i, Chin, Ch'in, Ch'u, Sung, Zheng, Wu, and Yue (Fig. 25.3). The so-called Hua Xia states, in the central Chinese plains, were distinguished from the peripheral states, Ch'u, Wu, Yue, and Ch'in, which were regarded as barbarians. The latter group had the great competitive advantage of almost unlimited ability to expand at the expense of the tribal groups surrounding China. The Ch'in in particular honed their military capabilities in battles with the nomads on China's western and north-western frontiers. In 678 BC an alliance was formed of the central states, with Ch'i paramount, for protection against the southern state of Ch'u. During the Spring and Autumn period Ch'u absorbed forty to fifty other states. Competitors were attempting to do likewise. The Ch'in moved their capital frequently, generally towards the east, as their conquests led in this direction.

This era of disintegration and conflict is paradoxically China's 'classical' period, when some of the most renowned developments in philosophy, literature, science

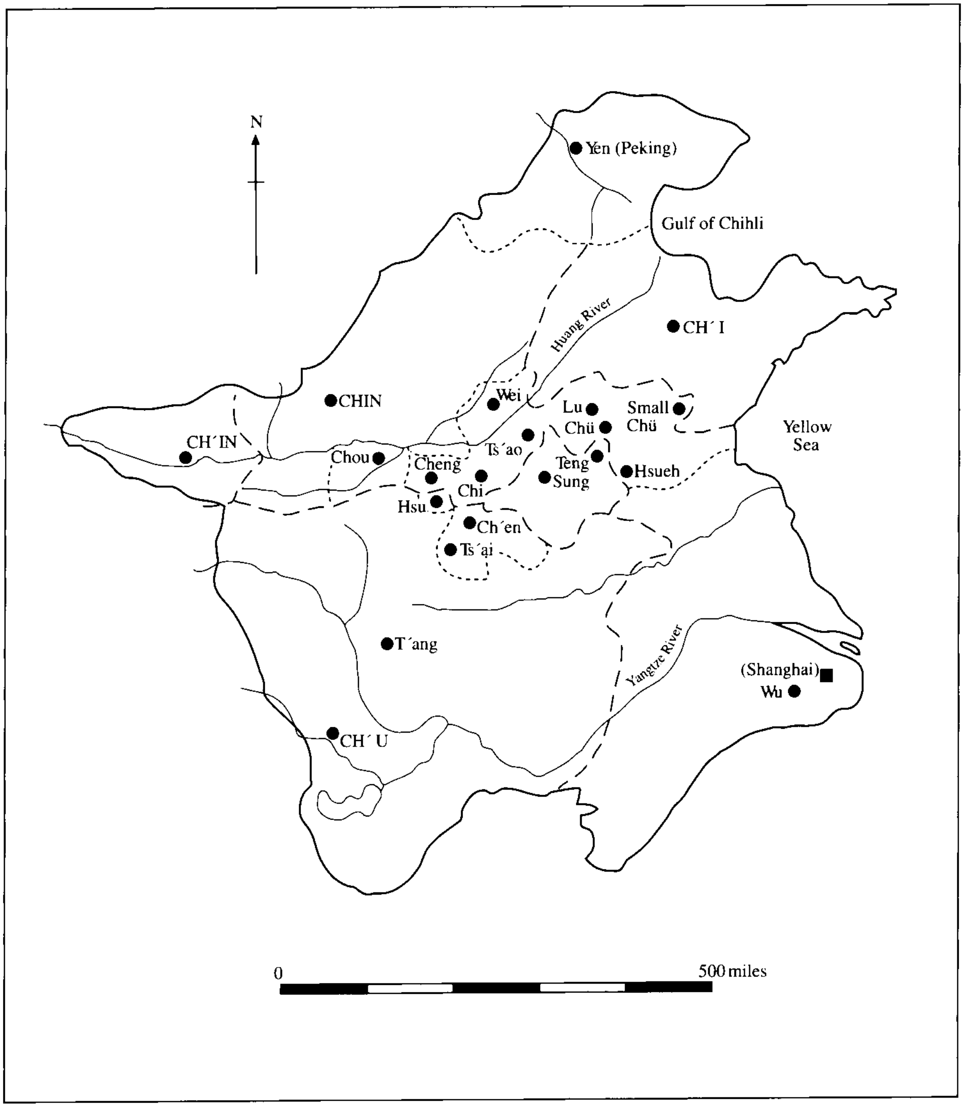

Figure 25.3 Political boundaries of China about 560 BC; heavier lines indicate spheres of influence. Adapted from Hsu 1965:xii. Source: J.Tainter. Redrawn by D.Miles-Williams.

and technology were produced. In philosophy the ‘Hundred Schools’ contended. The most lasting contributions came from Confucius (*c*. 551–479 BC), who promulgated a rational administrative system, and Mo Tzu (*c*. 480–390 BC), who articulated the view that rulers were stewards for the people, and that natural catastrophes revealed loss of the Mandate of Heaven. These writers were products of a post-collapse era, when unity, peace, order, and good government were wistfully recalled. The period also witnessed technical developments in craftsmanship and methods of production: the animal-drawn plough made its appearance, more land was brought under irrigation, market places multiplied, money came into wider use, iron technology spread, and the crossbow was introduced.

In the period from 770 to 221 BC there were only seventeen years that were entirely free of hostility. Warfare underwent a competitive spiral—in the seventh and sixth centuries BC battles rarely involved more than 10,000 men, but by the third century BC that figure had increased tenfold. Tactics changed accordingly: aristocrats armed with bows and riding in chariots gave way to massed infantry conscripts armed with spears and swords, and supported by horse archers. Chronic problems of supply and command affected the political structure, and helped bring about autocratic states run by bureaucracies. With larger armies and competent civil services, wars became longer, less numerous, and more decisive.

As this process neared its culmination, states became fewer but larger. In 403 BC there were fourteen states, of which the most powerful were Ch'in, Ch'u, Ch'i, Yeh, Han, Chau, and Wei. In 293 BC the Ch'in crushed the armies of Han and Wei. In 280 they defeated the state of Chau. In 249 the Ch'in took the Eastern Chou, and the dynasty ceased to exist. Finally, between 246 and 221 BC, Prince Cheng of Ch'in destroyed the remaining states and created an empire of 50 million persons (Creel 1953, 1970; Hirth 1923; Hsu and Linduff 1988; Hucker 1975; Levenson and Schurman 1969; Needham 1965; Parker 1988; Xueqin 1985).

OLD KINGDOM EGYPT AND THE FIRST INTERMEDIATE PERIOD

Old Kingdom Egypt (2686–2181 BC) was a centralized state headed by a king with qualified supernatural authority. The government was run by a highly organized, literate bureaucracy. Initially the government had substantial income from crown lands and mobilized large labour forces. It virtually monopolized some essential materials and imported luxuries. The government undertook to increase productive capabilities, expand the frontiers, and maintain supernatural relations. Over time, however, the Old Kingdom experienced some of the problems encountered later by the Western Chou. The provinces showed strong feudal characteristics. The political authority of the king declined as the power of provincial rulers and the wealth of the administrative nobility rose. Royal finances were weakened as Crown lands were divided. Monuments were built at royal expense and tax-exempt funerary endowments established. Phiops II, the last ruler of the Sixth Dynasty, built a splendid tomb in the face of sharply declining royal power.

In 2181 BC the Sixth Dynasty ended and the Old Kingdom collapsed: national unity was disrupted, several independent and semi-independent statelets emerged, and there were many rulers and generally short reigns. The period is sometimes referred to as the Egyptian Dark Age. The collapse generated a pessimistic literature, which reveals a breakdown of order and disregard for law. There were conflicts between districts and foreign incursions into the Nile delta. Anarchy and revolutions led to looting, killing, and plundering of royal tombs. Royal women were clothed in rags and officials suffered insults. Foreign trade dropped. Peasants carried shields as they tilled their fields. There were recurrent famines and life expectancy declined.

With the Eleventh Dynasty, beginning in 2131 BC, the Middle Kingdom was established, and order and unity began to be restored, though it was not until about 1870 BC that local and regional independence were totally suppressed, and Egypt fully reunited (Bell 1971; O'Connor 1974; Smith 1971).

MESOPOTAMIA

There were two periods in Mesopotamian history when powerful regimes attempted to maximize agricultural production, which in Mesopotamia means extending the scope and intensity of irrigation. These were the Third Dynasty of Ur (*c.* 2100–2000 BC), and the late Sassanian (AD 236–637) and early Islamic (post-637) periods.

The Third Dynasty of Ur and its aftermath

The Third Dynasty of Ur expanded the irrigation system, encouraged growth of population and settlement, and established a vast bureaucracy to collect taxes and tribute. Excessive irrigation in this region leads to good short-term harvests and to temporary increases in prosperity, security, and stability. Yet this strategy contains the germ of its own demise: after a few seasons of overirrigating, saline groundwaters rise and erode or destroy agricultural productivity. The result seems regularly to be destabilization of the political system.

Local populations were probably more secure at this time, but the complex superstructure took a high toll in labour. It was a system that could not be sustained. A few centuries earlier, in the Early Dynastic period (*c.* 2900–2350 BC), average crop yields had been about 2,030 litres per hectare, but under the Third Dynasty of Ur they declined to 1,134 litres. At the same time seeding rates had climbed sharply: Ur III farmers needed an average of 55.1 litres per hectare, more than twice the previous rate. The Third Dynasty of Ur was clearly pursuing an economic strategy of diminishing returns.

Badly salinized lands go out of production almost indefinitely, which intensifies pressures on the remaining fields. The Third Dynasty of Ur persisted through five kings and then collapsed. The consequences were catastrophic. By 1700 BC yields had declined to about 718 litres per hectare. More than one-fourth of the fields in production yielded on average only 370 litres per hectare. Labour demands were inelastic, so for equivalent effort farmers took in harvests less than one-fourth the size of those 800 years earlier. Soon there was extensive abandonment of southern Babylonia. Within a millennium or so of the end of the Third Dynasty of Ur, there was a 40 per cent reduction in the number of settlements and a 77 per cent reduction in settled area (R.McC.Adams 1978, 1981).

The collapse of the Abbasid Caliphate

Beginning in the last few centuries BC and continuing into the Islamic period, there was an irregular but generally sustained increase in the scale and integration of the agricultural regime. By the Sassanian and early Islamic periods, city-building, population density, and other manifestations of complexity had reached their highest levels. Population increased fivefold in the last few centuries BC and the first few centuries AD. There was a 900 per cent increase in the number of urban sites. These trends continued through the Sassanian period, when population densities came to exceed significantly those of the Third Dynasty of Ur. At its height, the area of settlement was 61 per cent greater than in Ur III.

The fullest development of Sassanian urbanism and agriculture came in the early to mid-sixth century AD. Under Khosrau I (AD 531–79) the dynasty reached its height, but his policies were reminiscent of those of the later Roman empire. The needs of the state took precedence over the ability to pay. Taxes were no longer remitted for crop failure. Because the tax was fixed whatever the yield, peasants were forced to cultivate intensively. State income rose sharply under Khosrau II (590–628). Much of this production may have been needed for the perpetual wars with the Byzantines. Their final war ended in a Byzantine victory, but left both powers so weakened that they were easily defeated by the new Islamic forces. The Byzantines managed to keep about half their empire, but the Sassanian dynasty was completely destroyed. The year 637 begins the Islamic period in Mesopotamia.

Under the Abbasids (beginning AD 750), taxation became abusive: tax assessments increased in every category, and 50 per cent of a harvest was owed under the caliph Mahdi (775–85), with many supplemental payments. Sometimes taxes were demanded before a harvest, even before the next year's harvest. On this unstable base the Islamic rulers built a new imperial structure. Under the Abbasids there was unprecedented urban growth: Baghdad grew to five times the size of tenth-century Constantinople, and thirteen times the size of the Sassanian capital Ctesiphon. Yet the state did not always fulfil its irrigation responsibilities. As the irrigation system grew in size and complexity, maintenance that had once been within the capacity of local communities was no longer so. Local communities came to depend on the imperial superstructure, which in turn became increasingly unstable.

Peasants had no margins of reserve, and revolts were inevitable. Civil war and rebellion meant that the hierarchy could not manage the irrigation system. Mesopotamia experienced an unprecedented collapse. In the period from AD 788 to 915 revenues dropped from 479,550,000 to 217,500,000 dirhems. The Sawad region, at the centre of the empire, had supplied 50 per cent of the government's revenues, but this dropped within a few decades to 10 per cent, mostly between the years 845 and 915. In many strategic and formerly prosperous areas there were revenue losses of 90 per cent within a lifetime. The perimeter of state control drew inward, which diminished any chance to resolve the agricultural problems. By the early tenth century, irrigation weirs were listed only in the vicinity of Baghdad.

In portions of Mesopotamia the occupied area had shrunk by about 94 per cent by the eleventh century. Population dropped to the lowest level in five millennia. Urban life in 10,000 square kilometres of the Mesopotamian heartland was eliminated for centuries (R.McC.Adams 1978, 1981; Waines 1977; Yoffee 1988). Robert McC.Adams has eloquently described the aftermath of this collapse:

> Much of the central floodplain of the ancient Euphrates now lies beyond the frontiers of cultivation, a region of empty desolation. Tangled dunes, long disused canal levees, and the rubble-strewn mounds of former settlement contribute only low, featureless relief. Vegetation is sparse, and in many areas it is almost wholly absent. Rough, wind-eroded land surfaces and periodically flooded depressions form an irregular patchwork in all directions, discouraging any but the most committed traveler. To suggest the immediate impact of human life there is only a rare tent…Yet at one time here lay the core, the heartland, the oldest urban, literate civilization in the world.
>
> (R.McC.Adams 1981:xvii)

THE HITTITE EMPIRE AND ITS AFTERMATH

The Hittites are a poorly known people of Anatolia. Their political history begins about 1792 BC with the conquests of Anitta. The building of the Hittite empire was an uncertain affair, and over the succeeding centuries their fortunes rose and fell. Periods of conquest and expansion were cancelled by episodes of defence and disintegration. During these times Hittite armies were defeated, provinces were lost, and little-known tribes called the Kaska raided and burned Hittite cities. At the lowest point the Hittite capital, Khattusha, fell to the Kaska.

The Hittite position was restored by their great ruler Shuppiluliumash, who came to the throne *c.* 1380 BC. During this and successive reigns the empire was established firmly in Anatolia and Syria. The Hittites successfully challenged Egypt for domination of Syria, concluding a treaty with Ramesses in 1284 BC. In the early thirteenth century BC the Hittites and Egypt were the premier powers in the region.

The Hittite empire included most of Anatolia, Syria, and Cyprus. Yet with the exception of Egypt they encountered troubles in nearly all directions, including the Assyrians to the south-east, the Kaska to the east, and little-known peoples in western Asia Minor and Cyprus. Their written records decline towards the end of the thirteenth century BC, then finally cease.

With the collapse of the Hittite empire there were major but little understood catastrophes across the region. Excavated sites in Anatolia and Syria are consistently found to have burned about this time. In the central Anatolian plateau life was disrupted for a century or more after 1204 BC. There were no urban settlements. While the archaeological record of this time could no doubt reveal further details, at present it seems that the area was thinly populated or used by nomads. As in Mesopotamia, there was a major demographic decline corresponding to the political collapse (Akurgal 1962; Barnett 1975; Goetze 1975a, 1975b, 1975c; Gurney 1973a, 1973b; Hogarth 1926).

MYCENAEAN, DARK AGE AND GEOMETRIC GREECE

Mycenaean society can be distinguished archaeologically by about 1650 BC. It was characterized throughout central Greece by a high level of homogeneity in art, architecture, and political organization. The region was divided among a number of independent polities, each centred on a fortified palace/citadel complex, and headed by a single ruler. Mycenaean palaces served as political and economic centres, and much of the Linear B writing (an early form of Greek script) was devoted to accounting. Mycenaean administration was particularly complex. All classes of persons had strictly allotted roles. All raw materials and manufactured goods, people, and animals were meticulously scrutinized and recorded. Mycenaean art and architecture are widely admired. The palaces had frescoes and bathrooms. Artisans produced carved gemstones, metalwork, pottery, inlay, and items of ivory, glass, and faience. Roads and aqueducts were built, and Mycenaean wares were traded about the Mediterranean.

Around 1200 BC troubles began. Most of the palaces were destroyed. In the following century there were unstable conditions, repeated destructions of political centres, and population movement. Fortifications were built across the Isthmus of Corinth and elsewhere. At the citadels of Mycenae, Tiryns and Athens wells were cut at great labour through solid rock. Uniform Mycenaean pottery gave way to local styles. Metalwork became simpler. There is no further trace of the craft workers and artisans. Trade declined sharply. Writing disappeared from Greece for at least 450 years. The number of settlements declined precipitously (Fig. 25.4). While there seems to have been some movement of people to less troubled areas, there was still a 75–90 per cent population decline. Even areas that escaped devastation, such as

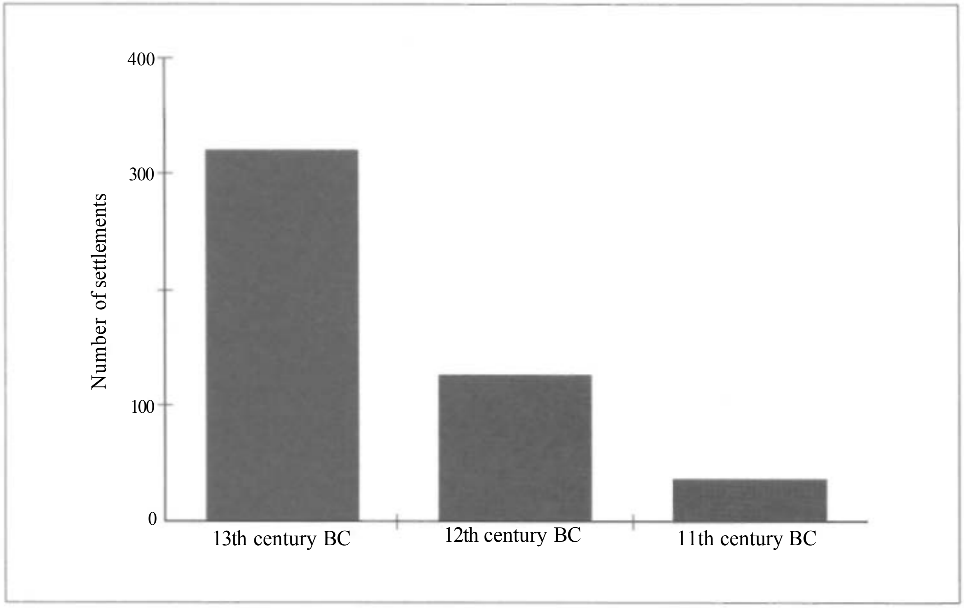

Figure 25.4 Declining numbers of Mycenaean settlements, thirteenth through eleventh centuries BC. Data from Snodgrass 1971:354. Source: J.Tainter. Redrawn by D.Miles-Williams.

Athens, ultimately experienced political collapse. In the twelfth century, when Mycenaean society still existed in an attenuated form, communities were small and independent. There were few stonemasons or craft workers, and insufficient personnel to fortify settlements. There seems to have been no building in stone. At Tiryns a cemetery overlay the Mycenaean settlement. Some archaeologists have the impression that there was little conflict. After the initial round of catastrophes there was a period of stability and rebuilding, but by 1050 BC what was left of Mycenaean society was everywhere gone.

The post-collapse period is difficult to characterize. The archaeological record recovered to date consists predominantly of burials (Fig. 25.5), from which have come a fair number of pottery vessels and some scraps of metal. Not surprisingly, archaeologists who study this period tend to concentrate on the development of tomb types and pottery styles. In the Protogeometric period of pottery style (*c.* 1050–900 BC), there appears still to have been a substantial settlement at Athens. This settlement is evidenced, however, by only a few pottery sherds from the Acropolis, and by pits, wells, and burials in the area of the later Agora.

At the time when one major synthesis was written in 1972, over the whole of Greece and the Aegean there were fewer than thirty sites of this period on which settlement evidence had been recognized (Desborough 1972:261). This evidence is mainly pottery. Only about a dozen sites have yielded actual features of settlement such as structural remains. Hardly a single temple can be shown archaeologically to have been built in the ninth century BC. The impression is of a population that was comparatively low, with only a few, mostly small, settlements. The peaceful conditions probably reflect the low population, lack of personnel for combat, or inability to conduct campaigns. Political organization changed from centralized monarchies served by literate bureaucracies to small units dominated by aristocrats and their families. The Mycenaean royal citadels were used as communal refuges. Burial data suggest that dark-age society was socially stratified, with an aristocratic class and great emphasis on adult ranking.

The Dark Age technically ends with the adoption of Phoenician-derived alphabets around 750 BC. Even in this there is evidence for continued isolation and local development. Early Greek alphabets have much in common, but also exhibit peculiarities, suggesting that each is an individual adaptation of Phoenician (Betancourt 1976; Chadwick 1976; Coldstream 1977; Desborough 1972, 1975;

Figure 25.5 Sub-Mycenaean cist graves at Athens. German Archaeological Institute at Athens, Neg. Nr. Ker. 2324: reproduced by kind permission of the German Archaeological Institute at Athens.

Finley 1981; Hooker 1976; Morris 1987; Mylonas 1966; Snodgrass 1971, 1980; Stubbings 1975a, 1975b; Taylour 1964).

Archaeologists of the Greek Dark Age must cultivate precious inferences from a flimsy record. Some scholars see an increase, shortly before 850 BC, of sea communications within the Aegean, and of exchanges with the Near East. The cities involved in these exchanges experienced an increase in material prosperity. Yet, not unusually for dark-age archaeology, 'the most substantial evidence of this progress comes from well over a dozen graves at Athens and Lefkandi' (Coldstream 1977:55).

THE CLASSIC MAYA COLLAPSE AND THE POSTCLASSIC PETEN

The Lowland Classic Maya have long been puzzling. They were one of the few early complex societies that did not develop in semi-arid conditions. The Maya are also, as Netting put it, 'a people whose greatest mystery is their abrupt departure from the stage of world history' (1977:299).

The Maya of the southern Lowlands underwent a rapid, dramatic, and justly famous collapse between about AD 790 and 890 (Fig. 25.1). It will be useful to refer to the Mayan chronology, which Willey (1982) gives as follows:

Middle Preclassic	1000–400 BC
Late Preclassic	400–50 BC
Protoclassic	50 BC–AD 250
Early Classic	AD 250–550
Hiatus	AD 550–600
Late Classic	AD 600–800
Terminal Classic	AD 800–1000
Postclassic	post-AD 1000

Not all authors make the distinction between Terminal Classic and Postclassic, and in this discussion the important contrast is between the Late Classic and the subsequent post-collapse occupations.

The evolution of Maya political organization may be traced to the Late Preclassic and Early Classic. The tropical rainforest of the southern Lowlands had been extensively cleared and planted by this time. Intensive agricultural systems and hydraulic engineering efforts were underway. Major fortifications have been dated to the Early Classic. Formal public architecture and social differentiation are in evidence by the Middle and Late Preclassic. In the Late Preclassic there was an administrative hierarchy of two or three levels. Public architecture became truly monumental, and the site of Tikal emerged as a major centre.

Throughout the Classic era these patterns intensified. There was continued growth in population, agricultural development, socio-political complexity, architectural elaboration, and conflict. Classic monuments and art styles reached their maximum extent in the sixth century. Major centres emerged which may have been regional capitals. The hierarchy of places developed at least four levels, and secondary centres were arranged around regional capitals in hexagonal lattices.

These trends culminated in the Late Classic. Between AD 652 and 751 there was remarkable homogeneity across the southern Lowlands in the style and iconography of monuments. A standardized lunar calendar, the most accurate of its time, was adopted throughout the region within a ten-year period. Major Mayan sites, once thought to have been vacant ceremonial centres, are now known to have been cities. Tikal held a population of perhaps 49,000, with defensive earthworks and moats up to 9.5 kilometres to a side. (Ancient Sumerian cities, by comparison, may have held about as many people.)

At its height the Lowlands population averaged about 200 persons per square kilometre, which made it one of the most densely populated areas for a non-industrial society. Late Classic populations were approaching an upper limit, for population peaked, in various localities, between the sixth and ninth centuries AD. Complexity, and its costly manifestations, did not stop growing when population did. An expanded building programme had to be supported by a static population, many of whom appear from their skeletal remains to have been in poor health. At Altar de Sacrificios the size and extent of formal architecture, number of stelae (dated stone monuments), and amounts of elaborate pottery reached a peak between AD 613 and 771. At the sites of Yaxchilan and Bonampak, the greatest quantities of sculptural art preceded the end of monumental construction by a brief interval. The greatest building period at Tikal was between 692 and 751. Across the southern Lowlands as a whole, 60 per cent of all dated monuments were built in a period of sixty-nine years, between 687 and 756.

Power decentralized during the collapse. New centres proliferated along the peripheries of the central southern Lowlands (the area known as the Peten). Even as construction ceased at major centres, many smaller sites erected monuments for the first time. Between 830 and 909, 65 per cent of monuments were built at minor centres. Of the centres that erected monuments at this time, more than 40 per cent did so for the first time. In many cases this was the only monument that such sites dedicated before they, too, collapsed.

As Figure 25.1 shows, the collapse was rapid: in 790, nineteen centres erected dated monuments; in 810, twelve did so; in 830 there were three. AD 889 is the date of the last certain stela with full calendrical inscriptions. There is no evidence for construction at Tikal after 830. With the collapse, many aspects of complexity were lost: administrative and residential structures, building and maintaining temples, stela carving, manufacture of luxury items, and Classic calendrical and writing systems. The élite class for which these things were created ceased to exist. The most startling aspect of the collapse is an enormous loss of population: estimates range from a decline of a million in a century, to a loss of 2.5 million over seventy-five years. Either scenario indicates a demographic disaster.

Unlike most cases discussed so far, careful excavation at Tikal has revealed much about the post-collapse occupation. It is called the Eznab occupation, and is dated *c.* 830 to 900. The Eznab occupation was by a materially impoverished population of 1,000 to 2,000, who tried to carry on a semblance of Classic ceremonialism. They lived in the great structures, and deposited their refuse in courtyards, down stairways, even within rooms. Deteriorated Classic structures were not rebuilt. Eznab constructions were small and rudimentary, and their pottery compares unfavourably with the perfection of Classic ceramics. The Eznab people buried their dead in the same places as Classic élites, but their graves are minimally equipped. Tombs and caches of the earlier era were looted. The Eznab occupants tried to imitate Classic ceremonialism, but clearly had lost the correct knowledge. As many as 40 per cent of Tikal stelae were reset at this time, but by Classic standards it was done improperly. The reset stelae consistently wound up in the wrong places, or even upside down. Similar patterns are seen in the behaviour of the post-collapse occupants of other major centres: Uaxactun, San José, Palenque, and Piedras Negras. Among the rural Maya of Barton Ramie, post-collapse construction was minimal even though there continued to be extensive occupation.

While the Classic Maya collapse in the southern Lowlands was 'the most devastating demographic and cultural disjuncture prehistoric Mesoamerica ever experienced' (Freidel 1985:293), it was not the end of Maya civilization. The northern Maya Lowlands were not affected by the southern collapse. The Puuc sites here show a Terminal Classic occupation in no way diminished from former times. In the central Peten itself there was much continuity of occupation, though there was a decline of some magnitude in the number of structures occupied from the Late Classic, and much reuse of earlier structures. Most notably, there were densely settled communities situated on naturally defensible landforms: islands and isthmuses. The Peten, though, was no longer the centre of the Mayan world: the evolution of complexity had shifted to the northern periphery (R.E.W.Adams 1973a, 1973b, 1977, 1981; Andrews and Sabloff 1986; Cowgill 1979; Culbert 1973, 1974, 1977, 1988; Erickson 1975; Freidel 1979, 1981, 1985; Hammond 1977, 1982; Haviland 1967, 1969, 1970; Marcus 1976, 1983c; Matheny 1978; Netting 1977; Rands 1973; D.S.Rice 1976, 1986; P.M.Rice 1986; Sanders 1962; Saul 1972, 1973; Tainter 1988:152–78; Thomas 1981; Webster 1976, 1977; Willey 1973, 1977a, 1977b, 1982; Willey and Shimkin 1973; Wiseman 1978).

TEOTIHUACÁN AND THE VALLEY OF MEXICO

Teotihuacán was the largest native city in the New World (and in AD 600 the sixth largest in the world), with a population of roughly 125,000. Its central feature, the

Street of the Dead, holds over 2 kilometres of monuments. There are more than seventy-five temples, including the pyramids of the Sun and the Moon. The former is the largest structure in pre-Columbian America, being 64 metres high, measuring 210 metres along each axis and holding an estimated 1 million cubic metres of material. At the south end of this street was an élite residential structure, the Ciudadela, with twin palaces. The city contained more than 2,000 residential compounds, and hundreds of craft workshops specializing in obsidian, pottery, jade, onyx, and shell. There were hundreds of painted murals. Networks of drains carried off rainwater.

Teotihuacán exerted compelling influence throughout Mesoamerica. Its leaders could mobilize labour at unprecedented levels. The population and resources of the Valley of Mexico and beyond were thoroughly reorganized. Exotic materials were imported from locations up to hundreds of kilometres distant. Tens of thousands of people were relocated to Teotihuacán and its vicinity. For 600 years or more, 85–90 per cent of the population of the eastern and northern Valley of Mexico lived in or near the city.

In Teotihuacán's later phase, military themes became prominent in art. The flow of some goods into the city was reduced. Around AD 700 Teotihuacán abruptly collapsed. The political and ceremonial centre of the city, the Street of the Dead and its monuments, was systematically burned, an act which in Mesoamerica signified defeat and subjugation. Within fifty years the population dropped to no more than a fourth of its peak level. This remnant population sealed off doorways, and partitioned large rooms into smaller ones. In its emptiness, post-collapse Teotihuacán must have resembled medieval Rome. Population declined also in the rural areas of the Basin of Mexico, from perhaps 250,000 to around 175,000.

A period of political fragmentation followed. Despite its relative decline, Teotihuacán remained a major city. Power diffused outward, though, and autonomous regional centres emerged. Often these were in defensible locations, such as hilltops, in what had been politically marginal zones. Central Mexico was divided into several competing political and economic systems. These were organized for warfare, which apparently was recurrent, and which influenced the development of social, political, and economic systems. As in Warring States China, polities grew through conquest; some of the new powers were Xochicalco, Teotenango, Cacaxtla, Cholula, and El Tajin. Local styles developed in ceramics, architecture, iconography, and other cultural elements (Diehl 1989; Diehl and Berlo 1989; Hirth 1989; Mastache and Cobean 1989; Millon 1981; Sanders *et al.* 1979).

One of the competing centres, Xochicalco, was built on a hilltop, with defensive architecture. Among its public buildings is a structure known as the Pyramid of the Plumed Serpent. It contains carved panels that illustrate the inter-polity competition and conquest that characterized the region after Teotihuacán's collapse. Some of this sculpture portrays repeated elements which may be pictographic (Fig. 25.6). Each group of elements shows a seated figure whose mouth is open, signifying

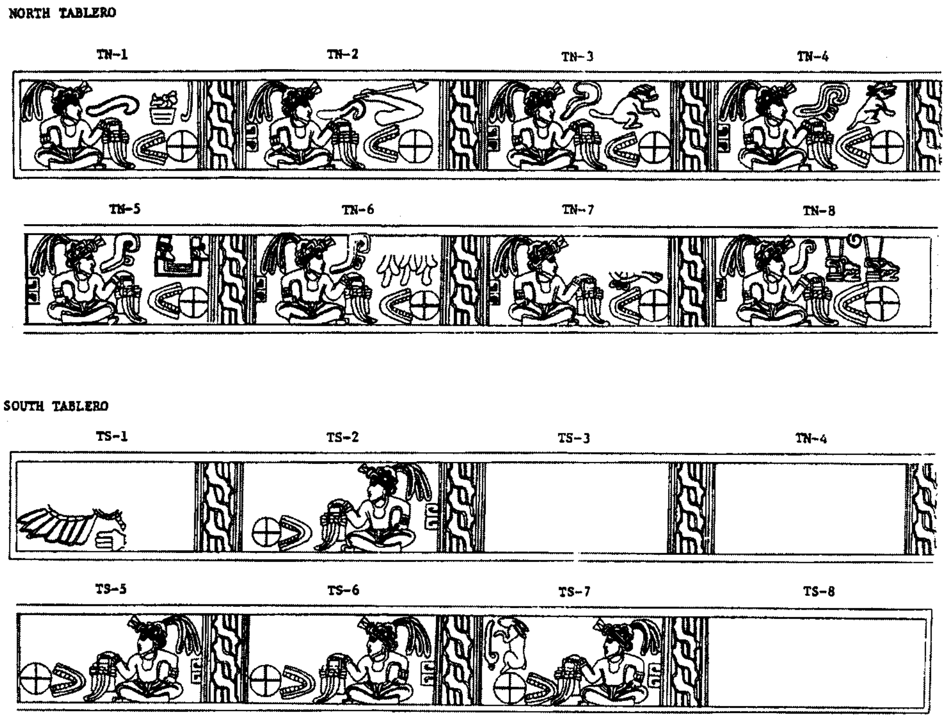

Figure 25.6 Stone carvings from the Pyramid of the Plumed Serpent, Xochicalco, possibly listing subject places. Reproduced from Hirth 1989:74, with permission. Source: Dumbarton Oaks 1989.

speech. In front of each seated figure is an open jaw, devouring a four-part circle. Above each circle is a non-repeating iconographic element. Research suggests that the last were toponyms, depicting specific places. If so, then each panel portrays the themes of warrior, conquest, and tribute, and the whole scheme may list the places once subject to Xochicalco (Hirth 1989:73–74).

MONTE ALBÁN AND THE VALLEY OF OAXACA

Monte Albán, in the Oaxaca Valley south of the Basin of Mexico, was a political centre roughly coeval with Teotihuacán. The city and its walls were built on a mountain-top, a large section of which was levelled to build a community and an arena of public architecture. The city contained pyramids, temples, ballcourts, stelae, and frescoes. There was craft production in obsidian, shell, and other commodities. Monte Albán was the political centre of Oaxaca, and experienced its major growth between AD 600 and 700.

Its collapse came at roughly the same time as that of Teotihuacán. This coincidence has led some archaeologists to suggest that the hierarchy at Monte Albán was supported by the Oaxacans as a response to the threat from the imperial power to the north. When this threat ended, so also did the need for Monte Albán to be a political centre (Blanton 1978:103). The collapse came after a period of rapid regional population growth, but with it the population of the city itself dropped from about 30,000 persons to 4,000–8,000; its role as a major administrative centre was over by AD 700.

After the collapse of Monte Albán, new centres emerged which apparently controlled sectors of the valley. Some of these had been occupied before, but as secondary or tertiary centres; now they, and Monte Albán itself, emerged as petty, autonomous states. At some point in the Monte Albán IV period (*c.* 600–950) there was a major settlement reorganization. During Monte Albán III (*c.* 400–600) occupation was well distributed throughout the Valley of Oaxaca, though sparse in the south-east quadrant (Fig. 25.7a), but in Monte Albán IV there was significant reduction in the north-west part of the valley, with concentration of the remaining population around fortified hilltops in the south-east (Fig. 25.7b).

Monte Albán no longer held a near-monopoly on writing. At its height Monte Albán had used writing to convey militaristic themes. These themes were carved on large stones which were placed in public buildings, and meant to be seen from a distance. Now the Zapotec hieroglyphic writing system spread to the new valley-floor centres, and it was employed in a different manner. A new type of stone monument was created that Marcus calls the 'genealogical register' (1983a:191). These are small and were meant to be read close in. They were placed in tombs or élite residences, and deal with such matters as ancestry, birth, ritual events, and marriages of Zapotec lords and nobility. In a political environment of decentralized competition, these monuments legitimized claims to rulership and recorded marriage alliances with heads of other polities.

The succeeding period, Monte Albán V (*c.* 950–1530), and coeval periods elsewhere, were a time of 'Balkanization' (Marcus and Flannery 1983:217). There were many small, hostile states. Codices (native documents) and ethnohistoric records describe frequent military conflicts, interrupted by tenuous truces brought about through royal marriages or military alliances. Yet this was also a period of regional cultural similarities. Ceramic complexes were widely distributed. Terms for state offices were widespread, and in some cases the same term was used in different languages. Officers of competing armies shared a common technology. It was a time of convergent evolution, as the Aztecs, Mixtecs, Cuitecs, and Zapotecs, in continual contact and conflict, emulated each other at an accelerated rate (Blanton 1978, 1983; Blanton and Kowalewski 1981; Kowalewski 1983; Marcus 1983a, 1983b, 1989; Marcus and Flannery 1983; Paddock 1983).

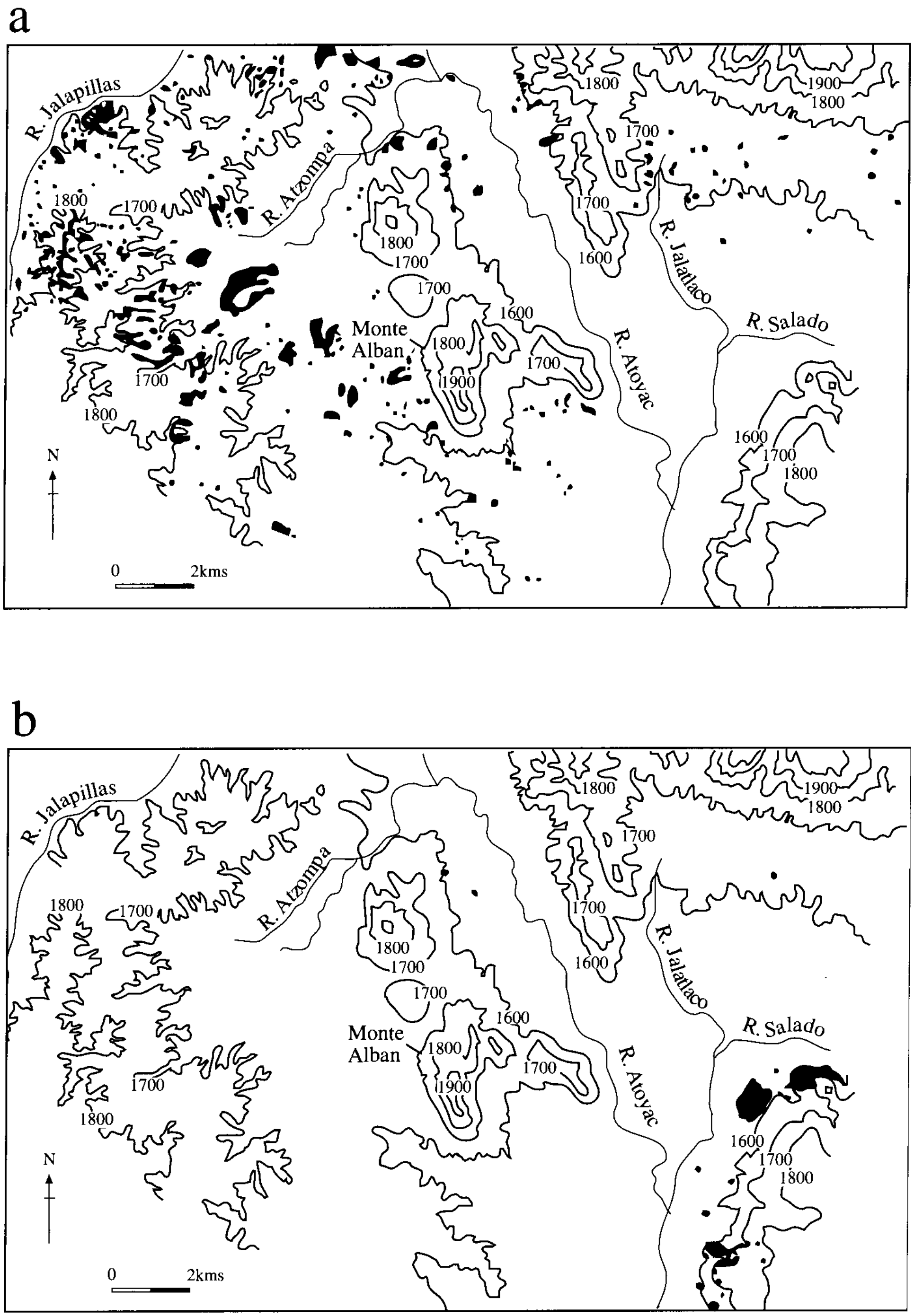

Figure 25.7 Settlements in the Valley of Oaxaca during (a) the Monte Albán IIIb period (*c.* AD 400–600) and (b) the Monte Albán IV Period (*c.* AD 600–900). Figures redrawn from Kowalewski, 'Monte Albán IIIb-IV settlement patterns in the Valley of Oaxaca', in K.V. Flannery and J.Marcus (eds), *The Cloud People: Divergent Evolution of the Zapotec and Mixtec Civilizations* (NY: Academic Press, 1983). Adapted from Kowalewski 1983:188–89 by D.Miles-Williams.

HUARI, TIWANAKU, AND THE POST-COLLAPSE ANDES

The Huari and Tiwanaku polities are discussed together, since they seem to have been closely related and to have followed similar patterns of development and collapse.

Between 200 BC and AD 700, Peruvian societies developed extensive irrigation systems and agricultural terracing, in conjunction with a growing population. Cities were built which were the capitals of regional states. They shared a heritage of technology and common ideology, but were divided by local art styles, separate governments, and competition for land and food. Out of this competitive background two empires emerged: Huari in the north and Tiwanaku in the south. Huari is the better known.

The Huari empire dominated almost the entire central Andes and much of the adjacent coastal lowlands. The empire imposed economic, social, and cultural changes on the areas it dominated. Major urban centres were established in each valley. Buildings in the Huari architectural style seem to have been administrative structures, storehouses, or barracks. Goods and information were exchanged across the central Andes on an unprecedented scale. Huari-derived ceramic styles (themselves influenced by Tiwanaku wares) appeared in many regions. As these wares spread, local styles became less important.

The extent of a contemporary Tiwanaku empire is less clear. Recent work has shown that much of the high-altitude Lake Titicaca Basin (3,800 metres above sea level), where the city of Tiwanaku is located, was transformed under central management into an artificial agricultural landscape. There were massive public reclamation and construction projects, which, required large, coordinated labour forces. The basin contains at least 190 square kilometres of raised agricultural fields. Tiwanaku itself may have held between 20,000 and 40,000 persons, and below it there were smaller cities and tertiary settlements.

Both states collapsed *c.* AD 1000–1100. In the Lake Titicaca Basin the Tiwanaku collapse brought political decentralization and simplification. The fall of Huari had widespread consequences. All cities of the southern highlands were abandoned and their populations returned to the countryside. The north Peruvian coast was apparently depopulated. Regional stylistic traditions emerged again, as did local and regional political organizations. As with the collapses of Rome, the Western Chou, Teotihuacán, and Monte Albán, the fall of Huari brought an era of smaller, contending states (Graffam 1992; Kolata 1986, 1991; Lanning 1967; Lumbreras 1974; Willey 1971).

SYNTHESIS: POST-COLLAPSE SOCIETIES

Of the cases examined, only post-Roman Europe offers a reasonably coherent picture of a post-collapse period, yet specialists in this area find their data frustrating and inadequate. The other cases yield a little information on some topics, less on most. Yet with this survey, and previous work by Renfrew (1979:482–85) and Tainter (1988:18–20), it is possible to begin to synthesize a composite picture of the process and aftermath of collapse.

Population

Whether as cause, consequence, or both, depopulation frequently accompanies collapse. Not only do urban populations decline, so also do the support populations of the countryside. Many settlements are concurrently abandoned. The levels of population and settlement may revert to those of centuries or even millennia before.

Population decline is clear in the collapses of Rome, the Third Dynasty of Ur, the Abbasid Caliphate, the Hittite empire, Mycenaean Greece, the southern Lowland Maya, Teotihuacán, and portions of the Huari empire. If life expectancy declined in the Egyptian First Intermediate Period, then population should have dropped as well. Exceptions include the Valley of Oaxaca, where Blanton sees regional population increase at the time of Monte Albán's collapse (1983:186), and the Lake Titicaca Basin, where a substantial population continued after Tiwanaku (Graffam 1992:887).

In several cases population seems to have stopped growing, or even declined, some time prior to collapse. Two well-known examples are the Roman empire and the southern Lowland Maya. Apparently the late rulers of the Western Chou had reason to fear that the population they administered had shrunk. Two different and somewhat contradictory forces may be at work here. Levelling or decline of population prior to a collapse seems due at least partly to the stresses on rural populations of supporting a complex hierarchy. In the case of the Roman empire the population could not recover from plagues and wars because high taxes precluded supporting large families. Taxation levels under the Abbasid Caliphate were higher still. The May an peasantry are known to have been highly stressed. Yet the population crashes that accompanied many collapses (Ur III, the Abbasids, the Hittites, the Mycenaeans, the Maya, and Teotihuacán) indicate also that hierarchical, centralized management was required to support large populations. Thus while complexity is needed to support dense populations, it is so costly that in non-industrial economies it can do so for only limited periods.

Perceptions of collapse

As societies become vulnerable to collapse there are no doubt great differences of opinion of what is wrong, or whether anything is wrong at all. In late Rome, pagans blamed Christians for the troubles, and conversely. Yet there are notable convergences in how peoples of different times and places have perceived impending collapse. China at the end of the Western Chou produced a remarkable literature on the many disturbances unfolding simultaneously (Hsu and Linduff 1988:280–87). One poem related the natural catastrophes of the times.

> At the conjunction (of the sun and the moon) in the tenth month
> On the first day of the moon which was Hsin-Mao
> The Sun was eclipsed,
> A thing of very evil omen,
> Then the moon became small,
> And now the sun became small.
> Henceforth the lower people,
> Will be in a very deplorable case.
> [...]
> Grandly flashes the lightning of the thunder;
> There is a want of rest, a want of good.
> The streams all bubble up and overflow.
> The crags on the hill-tops fall down.
> High banks become valleys;
> Deep valleys become hills.
> Alas for the men of this time!
> Why does (the King) not stop these things?
>
> (Hsu and Linduff 1988:281)

Compare this to the tone of the following tract by Cyprian, written during Rome's crisis of the third century AD:

> [The] age is now senile...the World itself...testifies to its own decline by giving manifold concrete evidences of the process of decay. There is a diminution in the winter rains that give nourishment to the seeds in the earth, and in the summer heats that ripen the harvests. The springs have less freshness and the autumns less fecundity. The mountains, disembowelled and worn out, yield a lower output of marble; the mines, exhausted, furnish a smaller stock of the precious metals: the veins are impoverished, and they shrink daily. There is a decrease and deficiency of farmers in the field, of sailors on the sea, of soldiers in the barracks, of honesty in the marketplace, of justice in court, of concord in friendship, of skill in technique, of strictness in morals...Anything that is near its end, and is verging towards its decline and fall is bound to dwindle...This is the sentence that has been passed upon the World...this loss of strength and loss of stature must end, at last, in annihilation.
>
> (quoted in Toynbee 1962, IV:8)

The collapse of the Old Kingdom is mirrored similarly in a pessimistic Egyptian literature (Smith 1971:200).

Disruption of the social order

Immediately following a collapse there may be a time when the social order is disrupted, or even a period of lawlessness. The Egyptian First Intermediate Period provides a good example, though the widespread destruction at the end of the Mycenaean period suggests similar troubles. The government of Visigothic Spain was unable to suppress brigandage (Carr 1992:151–52). It is difficult to see how the population crash of the Maya collapse could have occurred without civil disorder. In China, after the collapse of the Western Chou, there were usurpations by subordinate officials, and even alliances between the rulers of some states and the ministers of others. A Chinese poet of the time wrote that 'the people desire disorder'(Creel 1970:431).

Hierarchy and political order

Simplification of the political hierarchy is almost by definition an attribute of collapse. Sometimes the highest-ranking position, associated with overarching territorial control, disappears entirely or is changed in its meaning. Where it is retained, as with the Eastern Chou or the Egyptian First Intermediate Period, it may signify only a powerless figurehead.

Below the position of highest rank the status hierarchy will, depending on the extent of the collapse, undergo further simplification. In Europe the late Roman hierarchy and bureaucracy rapidly disappeared as local administration became the basis of society. In Gaul of the sixth century the term 'Senator' underwent a change of meaning, from designating a political class to an economic one. The Mycenaean bureaucracy disappeared entirely. At the opposite extreme, following the Western Chou collapse, political hierarchies may have become more differentiated, as states grew larger and tried to resolve the logistical bottlenecks of large-scale warfare.

The Mycenaean and Roman collapses, although occurring among very different societies, provide parallel examples of political simplification. In each case the supreme title dropped from use, and what had been secondary or tertiary positions were promoted by default. Among the Mycenaeans the paramount had been accorded the title *wanax,* with a subordinate labelled *basileos* (*pa*$_2$*-si-re-u* in Linear B). In post-Mycenaean times the *wanax* no longer existed, and *basileos* became the supreme title (Morris 1987:172; Snodgrass 1971:387).

In the Roman empire the supreme title *Augustus* was accorded only to the ruler of the Roman state. In the immediate post-collapse period only the eastern Roman Emperor held this title; the élites of the west were designated *rex* (king), *dux* (duke), or *comes* (count). *Rex* was a title the late Romans had awarded to tribal chieftains. *Dux* and *comes* were Roman administrative titles, which in the Middle Ages were transformed to designate semi-autonomous rulers of small- to moderate-sized territories.

Societal simplification

Not only is the hierarchy simplified in post-collapse societies, in many cases the society as a whole recognizes fewer distinctions among people. The driving force is economic and political change. As the political hierarchy simplifies or disappears, there is less demand for craft workers or artisans. As local self-sufficiency increases, there is less need for economic specialists and centralized production. As states become smaller, there is more potential for conflicts, making trade dangerous, and with more boundaries there are more barriers to trade. The result is that specialization decreases, except as it is necessary at the local level and can be sustained at that level.

While societal simplification may seem intuitively clear, it is not well documented. Few ancient historians were concerned with social processes among those of low to moderate rank, and until recently few archaeologists were either. Still there are supporting instances, and more will no doubt be documented. Mycenaean archaeologists, for example, have concluded that craft workers and artisans disappeared with the Mycenaean collapse. Certainly their work seems no longer to have been produced. In Merovingian Gaul there were still cloth, pottery, and jewellery industries, but these were much reduced from Roman times, and served only the aristocracy and the church. Trade was dominated by persons from the eastern Mediterranean. The period produced only one poet and one major historian (Pfister 1913:155–57). Visigothic Spain, on the other hand, differentiated more sharply among slaves, clients, tenants, and freedmen (Carr 1992:146).

Built environment

With reversion to local self-sufficiency, the main institutions to continue are those supportable by local resources. There is an end to monumental construction, and to publicly supported art, at the earlier scale. Characteristically in urban centres there is little new construction, and that which is attempted may be much less substantial, or may concentrate on adapting existing buildings: great rooms are subdivided, flimsy façades are built, and public space is converted to private. People may reside in upper-storey rooms as lower ones disintegrate, and when a building starts to collapse, the occupants move to another. At best the former monuments are just allowed to deteriorate, at worst they are mined as easy sources of building materials. This post-collapse use of architecture is well illustrated at Rome, in Mayan sites, and at Teotihuacán. In both town and country of post-Roman Britain, rooms in élite houses were converted to grain-drying kilns (Davis 1982:21–23) and many sites were abandoned altogether (Higham 1992:115).

Were the Dark Ages really dark?

It is easy to apply the term 'dark age' to post-collapse societies, but the term is ambiguous and should be used with care. It refers to the declines in literacy, writing, and communication that often result from collapse. Yet until recent times literacy and travel were the preserves of select groups of élites, merchants, and military officers. Even in the ancient classical world, most people were illiterate, and the major foci of interaction were always neighbourhood and community. Some history texts give an impression of medieval peasants as poor, tired, huddled masses, yearning to read. Actually, peasants typically did not read Thucydides or Tacitus, or other such literature, either before or after the fall of Rome. In Europe and elsewhere, a Dark Age means the transition from a situation where only a minority can read and write, to one where a smaller minority can do so. Dark Ages, for most people, were only slightly less luminous than preceding periods.

There is also the matter of the Mesoamerican Highlands. Here, after the collapses of Teotihuacán and Monte Albán, writing actually spread (Marcus 1989: 205–6). Collapse fostered the spread of writing as new centres and élites broadcast their political messages. The lesson is that writing may have different functions in different cultural contexts. The purpose of writing must be known to understand its development after collapse.

Return on investment in complexity

Societies that collapse are often considered to have 'failed', but such a view is both unfortunate and misplaced. Under a situation of diminishing returns to complexity, collapse is not a failure but may be the most appropriate response (Tainter 1988: 197–98). If a society collapses from economic weakness induced by diminishing returns to complexity, then collapse yields both a reduction in the costs of complexity and an increase in the return on social investment. There is both less cost to supporting social institutions and a higher return per unit of cost. The result is a more efficient society in which, if the hierarchy produces fewer goods and services, those that it does produce represent a better investment. This is a paradox of collapse: a process that we regard as the worst fate that can befall a society may actually bring economic and administrative gains. What may be a catastrophe to élites and administrators need not be to most people.

Post-Roman Europe illustrates this point. The smaller kingdoms that succeeded Roman rule in the west were, as noted, more successful at resisting invasions (for example, of Huns and Arabs) than had been the late empire. They did so at lower administrative and military costs. Peasants enjoyed lower taxes and better productivity in the post-Roman period. The prosperity of North Africa actually rose under the Vandals, but declined under Justinian's reconquest (AD 533), when imperial taxes were reimposed (Hodges and Whitehouse 1983:28).

Yet little of history is uncomplicated. In the cases of the Mycenaeans and the Maya, the dramatic loss of population can hardly mean that collapse was a net benefit to most people. Carr concludes that Spanish peasants were marginally better off under Roman than Visigothic rule, in part because of population decline (1992). Even still, those who survived these collapses will have found themselves less burdened by bureaucracies and state obligations, and able to realize a greater return to their endeavours.

Territorial and political fragmentation

The breakdown of political centralization means that petty states emerge in the previously unified territory. One of these may be the former capital itself. Typically these contend for domination, and the result is a long period of conflict. This was the outcome in China of the Spring and Autumn and Warring States periods, in post-Roman Europe, in the Mesoamerican Highlands, and in the Andes after the fall of Huari and Tiwanaku. Under conditions of conflict, settlements are often relocated to defensible locations, as in Highland Mesoamerica, the Peten Lakes, the *Ager Faliscus* north of Rome, and some settlements of post-Mycenaean Greece and Crete. The latter may be exceptional, since Greece at this time seems to have been peaceful, due perhaps to low population and lack of military personnel and organization.

Evolution of complexity after collapse

Where complex societies are surrounded by less-complex neighbours, the evolution of complexity after collapse often shifts to what had been politically peripheral areas, and new peoples rise to prominence. Two famous examples are the development of complexity among the peoples of the Arabian peninsula, and somewhat later of northern Europe, after the decline of Roman power. Another case is the growth of the Puuc cities of northern Yucatan after the collapse of the southern Lowland Maya (Andrews and Sabloff 1986). In Highland Mesoamerica, following the collapse of Teotihuacán, new powers emerged in what had been politically marginal zones: Xochicalco, Teotenango, Cacaxtla, Cholula, and El Tajin (Diehl and Berlo 1989; Mastache and Cobean 1989). After the Western Chou, power shifted to the peripheries, and ultimately to the Ch'in of the far west.

Lower complexity and other post-collapse characteristics persist for various times, as the following examples illustrate:

Chou China: from the collapse of the Western Chou (771 BC) to the reunification by the Ch'in (221 BC): 550 years.

Egypt: from the collapse of the Old Kingdom (2181 BC) to reunification (1870 BC): 311 years.

Hittites: from the collapse of the Hittite empire (late thirteenth century BC) to the emergence of the Phrygians (ninth century BC): *c.* 300 years.

Mycenaeans: from the final disappearance of Mycenaean society *(c.* 1050 BC) to the end of the Greek Dark Age: 400 years.

Rome: in Italy, from the wars of the sixth century AD to the full emergence of the Italian Renaissance in the fourteenth century: *c.* 800 years (longer periods elapsed in other parts of western Europe).

Huari: from the collapse of the Huari empire (conservatively *c.* AD 1100) to the expansion of the Inca: *c.* 300 years.

Maya: after the collapse of the southern Lowland Maya (*c.* AD 800), native populations never did re-establish a similar level of complexity in the Peten.

Regional differentiation

With decline of centralization and of trade, local idiosyncrasies often take the place of regional uniformity. This is evident in the realm of material culture, where widespread pottery styles are replaced by local wares. Thus following the Mycenaean, Huari, and Tiwanaku collapses, regional ceramic uniformity gave way to styles developed in, and peculiar to, individual localities. Linguistic diversification is another consequence of collapse and regional differentiation: the most famous case is the growth of the Romance languages from Latin, but something similar seems to have happened with the Maya collapse (Fig. 25.8). In the Postclassic period new languages formed in the Mayan area at an unprecedented rate (Dahlin *et al.* 1987), a pattern which is even more impressive when one recalls the depopulation of the collapse. Each new Postclassic language was spoken by comparatively few people.

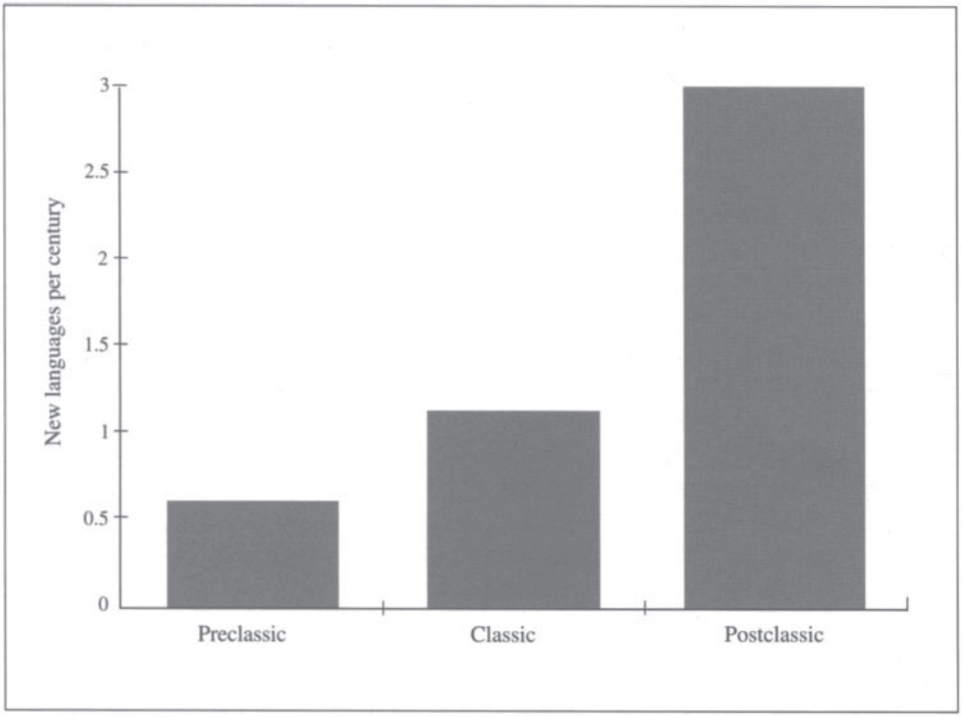

Figure 25.8 Increasing linguistic divergence in the Maya Postclassic following the Classic Maya collapse. (Data from Dahlin *et al.* 1987:369.) Source: J.Tainter. Redrawn by D.Miles-Williams.

Post-collapse mythology

Often the fall of early states and empires comes later to represent a paradise lost, a golden age of good government, wise rule, harmony, and peace, when all was right with the world. This is evident in the writings of Gibbon (1776–88) on the Roman empire of the second century AD, of the 'Hundred Schools' on the Western Chou (Creel 1970; Fairbank *et al.* 1973; Needham 1965), and of Nehru (1959) on the Mauryan empire of India (*c.* 300–100 BC). The following characterization of several early Chou kings was inscribed on a bronze vessel during the middle Western Chou period (between 927 and 908 BC), and exemplifies similar idealization:

> In antiquity, King Wen reigned. God bestowed upon him virtues which allowed him to possess a multitude of states between Heaven and Earth. The powerful King Wu campaigned in four directions, took over the Yin (Shang) people, and quelled troubles with (nomadic) Ti and the I peoples (on the east coast). The wise, sage King Ch'eng was assisted by strong helpers and consolidated the Chou. The virtuous King K'ang was

> the one who divided the territory (by enfeoffing feudal lords). The broad-minded King Chao campaigned southward in the region of Ch'u-Ching. The brilliant King Mu developed a model to educate the current Son of Heaven in the ways of the old Chou kings Wen and Wu. A Son of Heaven who enjoyed long life and good health, who served the deities well, who glorified the previous kings and royal ancestors, who brought good harvest and made people of all places come to pay their respects was the model.
>
> (Hsu and Linduff 1988:115)

Myths of a former paradise are simultaneously an attempt to comprehend current conditions, and a philosophy of how a civil society should be led. The stories of lost golden ages explain much of the persistent interest in collapse.

In the latter half of the eighth century BC the Greeks became increasingly aware of a vanished 'heroic' age (what we call the Mycenaean period). Sagas like the Iliad and the Odyssey were developed, hero-cults emerged, votive offerings were left at Mycenaean tombs, and some attempted to emulate 'heroic' funerals. Heroic-age themes appeared in art, especially pottery (Coldstream 1977:341–56), much as Renaissance art was to be influenced by classical themes. Yet as Snodgrass points out, 'one of the greatest attractions of a Heroic Age is the impracticality of any return to it' (1980:18).

POST-COLLAPSE ARCHAEOLOGY

The extent to which post-collapse archaeology relies on burials is striking. Human interments are commonly the primary data for historical periods lasting up to several centuries. This is the case in post-Mycenaean Greece, Merovingian Gaul, Anglo-Saxon England, Lombard Italy, the post-Roman Balkans, and even China of the Eastern Chou period. Much of what we know of these post-collapse societies comes from a very small number of graves. This situation is emphasized when compared against, for example, Roman archaeology, which relies very little on mortuary remains. It is clear, moreover, that the disproportionate emphasis on mortuary data comes only partially from a propensity to excavate graves (though in China there is great emphasis on élite tombs): it reflects to a large degree what has been available to excavate.

Archaeologists who study these periods are not averse to excavating settlements, but they are able to locate surprisingly few. Writing of the early Slavic occupation of the Balkans (*c.* AD 600–900), Evans has succinctly stated the empirical problem:

> If there is one certainty in the archaeology of the period it is that the individuals that were buried in the cemeteries must have lived somewhere. There must have been settlements, presumably close to the burial grounds, as demonstrated at Z̄drijac, where the cemetery lies close to a town that is known to have been occupied through at least part of the cemetery's usage. Yet in spite of the likelihood of individuals living in the vicinity of the cemeteries before their burials, there are very few indications of the settlements, and no properly excavated settlement in the Dalmatian area. This absence is one of the severest lacunae in the archaeological record for the period.
>
> (Evans 1989:108)

This statement could apply equally well to many parts of post-Roman Europe, and to other post-collapse societies.

While this is deplorable from the perspective of representative data, it does reflect the nature of post-collapse societies. Simpler societies produce a more ephemeral archaeological record. They erect fewer substantial buildings and make less elaborate artefacts. Their archaeological record is weakly structured (that is, not characterized by salient features or strong statistical patterns), and in some cases is difficult to detect at all. In Italy no monumental buildings were constructed anew in over 500 years, between the sixth-century churches at Ravenna and the eleventh-century cathedral at Pisa. Late Roman buildings and fortifications were used whenever possible, and new construction was often in timber (see, for example, Higham 1992:104). For post-Mycenaean Greece the number of excavated buildings is statistically negligible. British archaeologists are very familiar with the problem of finding Anglo-Saxon occupational remains.

Yet recent work has demonstrated that much more can be done. Research on late Roman/early medieval Italy (Hodges 1993, 1995; Hodges and Wickham 1995; Potter 1979), the Peten of Guatemala (D.S.Rice 1986; P.M.Rice 1986), the Mesoamerican Highlands (Diehl 1989), the Guadalquivir Valley of Spain (Ponsich, cited in Carr 1992), and the West Heslerton Anglo-Saxon settlement (Powlesland 1987) is showing that detailed information on post-collapse societies can be developed. Two complementary approaches should be adopted widely in post-collapse archaeology. The first is systematic regional surveys employing the best chronological controls. Such surveys must cover large areas and be thorough, so that virtually all locatable remains are found. The second is careful excavation of post-collapse occupation levels, which may be disturbed upper levels, as at Wroxeter (P.Barker 1979). These approaches will require more intensive research than has been customary in many areas, but are necessary unless post-collapse societies are to remain dark. Complex societies leave archaeological remains that are impossible to avoid, whereas the study of disintegrated societies requires fine-grained research at nearly a microscopic level.

Post-collapse societies are a logical and regular product of social evolution. As a recurrent social form they are fully amenable to comparative analysis, generalization, and explanation. Post-collapse societies can no longer be treated as a tedious interlude between more interesting periods. They represent, in fact, a return to the normal human organization of low complexity, and as such reflect more accurately the human experience than do the rare, complex societies to which so many scholars are drawn. While it may be that social evolution tends in general towards greater complexity, periodic simplification is to be expected as well, and is worth our best efforts to understand.

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The outline of late Roman and early medieval history can be found in *The Cambridge Medieval History,* and see also Jones (1964); the potential of medieval archaeology is well illustrated by Hodges and Whitehouse (1983) and Randsborg (1991). Early Chinese history is covered by Creel (1970), and Chou archaeology by Hsu and Linduff (1988) and Xueqin (1985). For the archaeology and history of Mesopotamia see R.McC.Adams (1981) and Yoffee (1988). Post-Mycenaean archaeology is synthesized by Snodgrass (1971, 1980), Desborough (1972) and Coldstream (1977), whilst Morris (1987) interprets the development of the Greek city-state. For the Maya, Culbert (1973) is a fundamental source, whilst recent research on the Postclassic is reported in A.F.Chase and P.M.Rice (eds) *The Lowland Maya Postclassic* (Austin: University of Texas Press, 1985) and J.A.Sabloff and E.W.Andrews V (eds) *Late Lowland Maya Civilization* (Albuquerque: University of New Mexico Press, 1986). Sanders *et al.* (1979) synthesize extensive regional surveys into a comprehensive model of long-term cultural evolution in Highland Mesoamerica, K.V. Flannery and J.Marcus (eds) *The Cloud People* (New York: Academic Press, 1983) describe the prehistory of the southern highlands, and both areas are covered in R.A.Diehl and J.A. Berlo (eds) *Mesoamerica After the Fall of Teotihuacán* (Washington, DC: Dumbarton Oaks, 1989) which concerns the post-collapse period AD 700–900.

26

EUROPE IN THE MIDDLE AGES

Neil Christie

DATES AND DEFINITIONS

The term 'Middle Ages' is a cumbersome one, bracketing the thousand-year expanse between the end of classical Antiquity and the Renaissance. It embraces the 'Dark Ages', the rise of feudalism, the Crusades, the Black Death and the introduction of gunpowder. It sees castles and monasteries rise and fall, trade and manufacture re-blossom, and closes with the meeting of the Old and New Worlds. However, despite extensive survivals of military and ecclesiastical architecture and culture, medieval Europe is generally viewed as a grubby successor to classical Rome both socially and physically, marked by a slow recovery of lost culture, restored (at least in the eyes and minds of Renaissance scholars) only from the late fifteenth century.

Yet it is nowhere easy to define when the Middle Ages commence. It is too sweeping a term to insert immediately after Rome's fall, since Rome's influence lingered long into the 'Dark Ages', mutated but still evident. In the eastern Mediterranean and the Near East, Constantinople (Istanbul) was Rome's direct heir and survived with many reversals full into the thirteenth century and the pillaging of the Fourth Crusade and then beyond that until 1453; and whilst the Arab expansion of the seventh and eighth centuries had certainly forced a military mutation upon Constantinople, her political and religious importance saw no curtailment and thus no traumatic break with which we can define a transition from antique to medieval (Holmes 1988). As in the whole development of human society, change is, or at least was, slow and rarely perceptible to contemporaries, and transitions are largely modern inventions (Braudel 1992). Even in instances of martial conquest, the political name may have changed but the basic social fabric persisted and only slowly mutated into new forms.

Thus for the medieval world, divisions such as 'early', 'low', 'high' or 'late' are our own crude historical conveniences, broadly partitioning up the wide time period of *c.* AD 600–1500, but with an astonishingly wide variation in the way the terms are applied throughout Europe. To some the terms 'Late Antiquity', 'Dark Ages', 'early Byzantine' and 'early Middle Ages' are all one and the same, an archaeological and historical blur, but all demarcating a breakdown in the transmission of the written word. The 'Middle Ages' are in fact an invention of the Renaissance, its contemporaries rejecting the immediate past and seeking instead to resurrect the learning of the more refined classical world. Yet while there is a blur at the start of this 'medieval' period, its end is equally indistinct: in terms of urban living, for instance, the standards and range of amenities of a typical early imperial Roman town were not matched in most of Europe until the nineteenth century; and the ordinary peasant farmer will not have identified any major material change with the passing of the late Middle Ages. Indeed, the Renaissance itself meant no cessation to the wars between kingdoms and empires, nor to religious turmoils: rather it marks a phase when art, architecture, and words take over centre stage and form a new focus for modern historical debate.

ARCHAEOLOGY AND HISTORY

For Europe, discussion of these medieval centuries is still largely dominated by politics, people, dates and places—all elaborations of the vast array of documentary sources that emerge after *c.* AD 1000. A redistribution of literacy in the wake of a rebirth of political, social, religious and economic vitality resulted in the progressively escalating need for more extensive means and levels of recording, in the form of land charters and grants, sales documents, wills, theological treatises, trade pacts and so on, to be set alongside re-disseminated and even forged ancient texts. This wealth of detail—almost exclusive to the Old World, but more than matched in the decadently stable Chinese realm—has since Renaissance times in Europe been variously processed and repackaged, synthesized and expanded, and is reflected in the evolving nature of the modern historian (Cantor 1991). The ceaseless investigation of these medieval texts, constantly enhanced through the discovery of lost or overlooked archive material, until recently allowed little time or space for what were considered subsidiary academic cousins: *art and architectural history,* so long tied to the study of religious or élite secular structures; *economic history,* applied primarily to modern and early modern periods; *historical geography,* tied tightly to documentary premisses; and *archaeology,* viewed chiefly as a means by which castles and other high-brow establishments could be further analysed in order to provide occasional illustrative back-up to the rich pageant of social historical evolution.

As disciplines have evolved, so scholars have been made aware of the opportunities and needs for cross-fertilization beyond the scope of mere academic support (see, for example, the approach by Rackham 1986). In the case of archaeology, the advancement of theoretical frameworks and in particular the growing union with anthropology, allows for a more exacting range of questions to be asked of its own field and of modes of investigation and interpretation. Such reassessments have enabled archaeology to 'intrude' more capably and more scientifically into the sphere of medieval history. The range of questions archaeology is employed against can rarely be coherently met by historical documents: literacy may have spread but it still remained in the domain of the élite and rooted in the intellectual concepts of property, society and wealth (Champion 1990). Archaeology of course begins at the grass-roots, the foundations and physical manifestations of all medieval societies: tools, houses, dress, diets, rubbish and burials. Analyses of these help identify and interpret social hierarchies and gender contexts, settlement evolution, economic change, environmental relationships and technological skills. Documents may now and then allow a vivid picture to emerge of the *actions* of everyday life, as witnessed in the detailed confessions of the inhabitants of the hamlet of Montaillou near the Pyrenees in the mid-thirteenth century (Le Roy Ladurie 1980; compare also Origo 1986), but the *mechanics* and *make-up* of this medieval lifestyle are improperly understood without the integration of information derived from excavation.

Yet archaeology's intrusions into the Middle Ages are still rather tentative: in Europe and beyond, university lectureships in medieval and post-medieval/industrial archaeology are rare at best, few Masters courses exist in medieval studies, and there is limited back-up in terms of academic journals. In Mediterranean countries like Spain, medieval studies remain very much the preserve of the historian, although the development of systematic urban excavation and the adoption of multi-period field surveys is everywhere forcing changes, pushing history and archaeology together. The discipline of medieval archaeology is thus expanding rapidly, as was demonstrated in the huge attendance of the Medieval Europe conferences held in York, England, and in Brugge, Belgium, in 1992 and 1997 respectively. Potential study in so many quarters is, however, still at a very preliminary stage: for instance, more is known of Roman than medieval material culture and ceramic type-series still require to be formulated for much of the medieval world; land and sea transport remains obscure; and precious little is known of the physical characteristics of Deserted Medieval Villages (DMVs), a common phenomenon in Britain but one not properly recognized elsewhere in Europe. Documents survive to frame archaeological investigations but insufficient excavation means that scholars remain ill-informed of village and house morphologies, structural histories, local and extra-local industrial and commercial industries, and economies.

Medieval archaeology may be looking beyond the castles to the villages and from manors to field systems, but progress remains slow: even at the DMV of Wharram Percy in the Yorkshire Wolds in north England, where research has been going on since 1948 (with excavation proper from 1952), only about 7 per cent of the overall site has been systematically sampled (Beresford and Hurst 1990:131). The Wharram Research Project itself fully illustrates the changing face of medieval archaeology in Britain, with the goals of the project constantly being expanded as new techniques of sampling and analysis evolve. Similarly, one can note the changeover in title of the Deserted Medieval Village Research Group—a body formed in the time of the first Wharram Percy investigations—in 1971 to the Medieval Village Research Group and its subsequent merger in 1986 with the Moated Sites Research Group (founded in 1972) to form the Medieval Settlement Research Group, whose constitution seeks to promote wide-ranging 'interdisciplinary involvement in the collection, analysis and dissemination of data relating to the history, geography and archaeology of medieval rural settlement'.

The theoretical aims of medieval archaeology, as with the discipline of archaeology as a whole, have been under close scrutiny (Austin 1990; Moreland 1991), with critical self-reassessment of the discipline's utilization and range of data and its relationship with textual tools. Post-processualist approaches seek clearer perceptions into past material expressions—whether archaeological, artefactual, documentary or architectural—to allow for more defined images of past landscapes, settings and mentalities: 'meaning in these [historical] periods was conveyed through the complex interaction of these alternative forms of discourse, and to concentrate on one—whether it be the written or the "artefactual" —to the exclusion of the others is to diminish our understanding of the complexity and richness of the past and its inhabitants' (Moreland 1991:25). To meet these new demands, excavations and surveys draw on ever wider specialist and scientific input to provide more comprehensive databanks. The overturning of previous conceptions of the early medieval rural and urban landscape, the beginnings of closer analysis of medieval, post-medieval and early modern settlement forms and of socio-economic mechanics, and the raising of gender debates, all reflect the expanding aims of the new breed of medieval archaeologists. The revised discipline is still somewhat in its infancy, however, and is still not met with universal approval or pursuit. In Germany, for instance, a strongly positivist approach remains to the fore in medieval archaeology, with these scholars seeking primarily to combine more systematically with other related sources, whilst constantly working within a historical framework. Fehring (1991:235) argues that medieval archaeology 'is to be understood today as an historical science. Its concern, like that of all historical disciplines, is to investigate "past reality", history'. The results, to some degree, are the same, with a new eagerness evident to reveal the medieval world and all its material workings. Ideas, as in any healthy discipline, however, are constantly in flux, and accordingly much more change is to be expected from medieval archaeology in the next decades.

THE EVOLUTION OF MEDIEVAL SOCIETY AND THE STRUCTURES OF THE FEUDAL ELITE

The term 'feudal' has long been synonymous with 'medieval', designating the strict localization of power in the hands of lords and castellans, overseeing the lives and labours of dependent peasants. Too often viewed merely as an invented relationship of the period post-AD 1000, revised documentary analyses and historical archaeology have revealed the roots of feudalism in the immediate post-Roman period, as central powers degenerated and potentates seized the reins of local power, based on town or fortress, and with the local populations readily turning to foci of strength in times of insecurity. However, the formalization of feudalism is indeed a 'medieval' invention of the period *c.* AD 1000, created by the signing of bonds of dependence and made evident to us by the emergence of textual data (Bartlett 1993; Reynolds 1994). Ties of loyalty between king and lord/noble consolidated through grants of lands and of jurisdictional rights were extended downwards between lord and vassal. Vassals held lordly lands as fiefs—not always through a uniform manner of adoption but with a variety of origins and levels of obligations—and were required in consequence to render military service to the lord, to pay taxes, to attend court and to place themselves under the lord's legal protection.

The extension of such feudal authority went hand-in-hand with the building of castles, with the right to fortify once the prerogative of the king but in time watered down to become a seigneurial privilege. Castles provided protection, authority and status in the landscape and acted as physical reminders to dependent vassals and serfs. The castles tended to emerge less in times of war or threat, but rather came to proliferate in the stable eleventh century, a period when economic structures were again expanding, population levels rising and rural exploitation increasing. Consolidation of power in the form of castles and acts of patronage all required revenue and this came through tighter control of land and human resources, through the creation of a legal servitude of peasants, often fostered by means of the formal foundation of new villages (Bois 1992; Whitton 1988:118–30). Monasteries too were forced to participate in this feudalization of the landscape, yet maintained a clearer conscience through offering a less rigid mode of lordship to farmers and communities settled on their lands—indeed the survival of many monastic archives detailing landed possessions and grants of land has provided invaluable databanks for analysing the evolution of the countryside through archaeological field survey (Wickham 1987).

These structural changes are the elements that are best visible in the archaeological record of medieval Europe: the rise of castles and villages, the clearance of new lands, urban growth, and church and monastic patronage. The image throughout is one of general economic buoyancy, but one that is not easily tied into the documented pattern of social remodelling. Rather, a high level of continuity in the urban and rural landscape can be identified, suggesting in many cases that 'feudal' structures such as castles and villages have a much longer and more involved origin than that suggested by the textual sources. In Italy, for example, the process of castle formation (termed *incastellamento* in Italian) and of settlement nucleation (termed *accentramento*) can be traced in some instances back into the ninth and tenth centuries, if not earlier (papers in Noyé 1988:411–535; Wickham 1987). Here, of course, definitions inevitably become problematic: how far do these earlier fortified and upland sites relate to direct state control, how far to feudal-style nobility and how far to locally initiated refuge? Should castles be defined solely as the developed stone-built edifices of the period post-1000? What structural elements are in fact required to define a castle?

The problem is geographical too: in continental Europe, excavations have begun to clarify the roots of the castle-building tradition, extending it far back to the period of the break-up of Roman rule, the fragmentation of society and economy, the related decay of open rural and urban settlement patterns, and the subsequent emergence of semi-independent rural lordships which were in part attempts to maintain a semblance of the past order (Fehring 1991:89–108). In Britain, by contrast, the castle is seen as a fully fledged Norman introduction, strategically installed within and over Saxon fortress towns or *burhs* (themselves an attempt at centralized defence) or as new foci in the countryside. Here, then, a changeover is apparent, offering a ready guide to the consequences of the extension of feudal society. Elsewhere, as in eastern Europe, castles develop within Slavic, Bohemian, Magyar and other young kingdoms as central places for the wielding of royal power and as trading nodes. Here, castle growth appears as an elaboration of former hill-forts, but with the creation of palaces, churches and stone walls as a western or even a Byzantine borrowing, a response to the transmission of ideas from commercial exchange and from military conflict (Gerevich 1990).

Inevitably, however, the castle remains emblematic of the medieval European landscape, a symbol of state and élite power. Stone built and imposing, castles have long been viewed as the domain of architectural historians, providing a powerful physical image of a militarized society, and at the same time allowing, through structural analysis, detailed reconstructions of defensive evolution. Yet, as such, they have long remained distinct as items of study from the towns and communities they dominated: more tangible and thereby more valued. As discussed below, however, they are part of a bigger, more complex, human landscape which only now is being adequately scrutinized and appreciated.

In Britain, a spate of castle excavations, such as at Castle Acre, Hen Domen and Portchester, has done much to extend our understanding of the range of castle types and to analyse the internal everyday workings of these sites through discussion of internal buildings and of the associated material artefacts (Kenyon 1990; McNeill 1991). The principal contribution of these modern archaeological investigations has been the recognition of timber precursors to defences, towers and halls, often part of a long sequence of timber construction. Indeed, many motte-and-bailey and ring-work sites never developed into stone castles and so excavation alone will provide information regarding form and chronology. Overall, studies have shown that for Europe as a whole no single, simple, sequence of castle building can be reconstructed: differing political, military, territorial, economic and geological contexts mean that data gained from one excavated site need not correlate tidily with another (Kenyon 1990:3–38).

There are of course general conformities in plan, as in the arrangement of mottes, keeps, barbicans and baileys, but the transition from timber to stone, the provision of outer defences, and the location of domestic structures follow no neat pattern. The recent excavations at Hen Domen in Powys, Wales, have, for example, discerned a complex arrangement and evolution of the domestic buildings within the bailey, comprising halls, kitchens, houses, barns, cisterns and chapel, all constructed in timber and undergoing frequent rebuildings into the thirteenth century (Higham and Barker 1992; Fig. 26.1). The relative clutter of buildings is surprising, but may be reflective of a high military profile to the site and thus denotes the quartering of soldiery within the castle confines. Elsewhere such fighting men were an impermanent feature—retainers would otherwise have only been called upon by the lord when required—and would have lived outside the main walls. But whilst the densely packed interior of Hen Domen need not be typical, air photography of castle earthworks, standing remains, and limited excavation do point at least to a significant scatter of domestic buildings inside the castle baileys, designed to serve the lord's seat and table: as such, this greatly modifies the usual artistic reconstructions of castles, which tend to leave the bailey all but empty (on domestic structures see Kenyon 1990:97–180).

Clearly, also, defence was not always the overriding factor in the layout of these castles, even if mottes, gates and moats indicate that security was an essential ingredient. Status played as important a role, as denoted in the mere control of labour, and the use of imposing architecture set on a height overlooking the dependent urban or rural population. It was further manifested from the mid-twelfth century in the translation from timber to stone, an act requiring much time and effort but resulting in the greater permanency of the site. Status needs should also be identified in the desire to 'upgrade' residences to castle-style standards: hence at Castle Acre in Norfolk, excavations have shown how the first stone buildings on the site, dating from the eleventh century, comprised a two-storey mansion with ditch and bank surround; later on, in the 1140s, the ditch and bank were modified

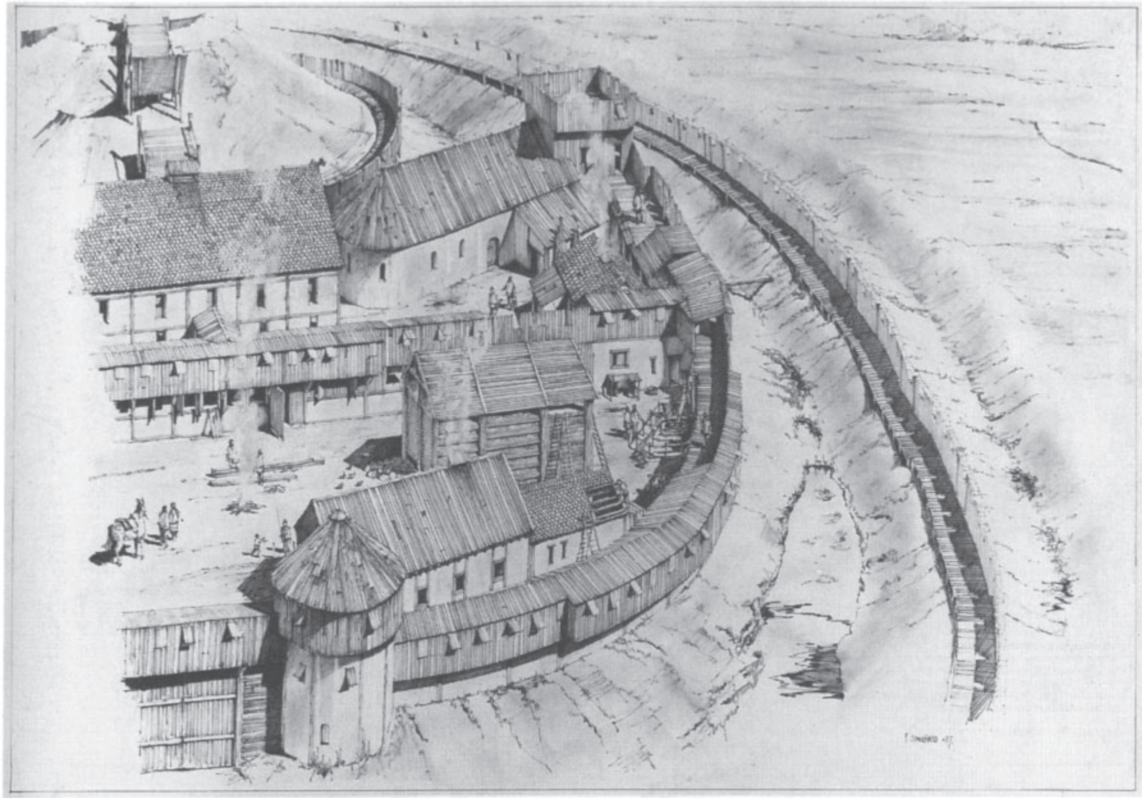

Figure 26.1 Hen Domen, Powys: reconstruction drawing of the timber housing and defences of *c.* AD 1150 excavated in the castle bailey; note the presumed single-storey height of the buildings and the presence of rooms butting up to the inner face of the circuit. Source: Higham and Barker 1992.

to create a motte and the house was remodelled in two stages as a smaller but taller keep through a doubling of the wall thickness in the northern half of the old manor. Although this remodelling can be set to a time of political and military unrest, building work may have covered many years and this probably left the site open to attack in that time—if an attack was even expected. As a result it may not denote a militarizing of the site, merely a cosmetic upgrade. In fact, after 1200 the keep appears to have fallen out of use and the lower ward or bailey instead came into prominence.

Of similar interest is the sequence at Lydford in Devon, where the square tower was long viewed as a rare example of a stone keep set on a motte. However, excavations showed a first phase free-standing tower of late twelfth-century date set some distance away from the original eleventh-century Norman ring-work, which was subsequently part-demolished; a 5-metre high motte was then created around the tower base before new walls were constructed to create the extant keep structure (Kenyon 1990:43–44, 49–51; Saunders 1980). Despite its layout, documents record this not as a castle but as a prison. In effect, 'the creation of a motte and miniature bailey was perhaps a deliberate anachronistic conceit intended to give visual confirmation of the title Lydford Castle while at the same time manifesting the power and authority of the Earl of Cornwall' (Saunders 1980:162). Lesser nobility were also keen to exhibit status through structures, and a common feature in the landscape are manors and low motte-and-bailey-type sites, where the defences appear nominal at best (Aberg 1978; Cherry 1986).

For Britain, artificial hills and, later on, rings of stone defences provided the key elements to castle formats. In continental Europe greater topographical diversity meant a more prominent utilization of natural hills, heights and promontories as the seats of fortifications, dominating rivers, roads, passes or harbours. Formats are accordingly more varied, dependent on natural contours; often, medieval castles are found to overlie much earlier installations, whether late bronze age or iron age hill-forts or early medieval refuges, and regularly reuse elements of their defensive cordons. In Italy, many of the sites documented as castles from the tenth and eleventh centuries have been shown through excavation to possess timber antecedents, an uncertain mixture of refuge and fortress, difficult to date precisely because of the poverty and paucity of early medieval material culture. A good example of this occurs at Montarrenti (Fig. 26.2) not far from Siena in central Italy, where excavations between 1985 and 1988 uncovered most of the interior space of a medieval castle-cum-village and in so doing revealed traces of a wooden palisade and of post-built houses which stratigraphically predated the tenth century. Radio-carbon dates of grain deposits relating to the first stone phase at the site pointed to a restructuring in *c*. AD 950–1000, while a single radio-carbon date for the initial phase with timber buildings was calculated to the late eighth century (Francovich and Hodges 1989). Montarrenti is in fact not documented before 1156 and yet the

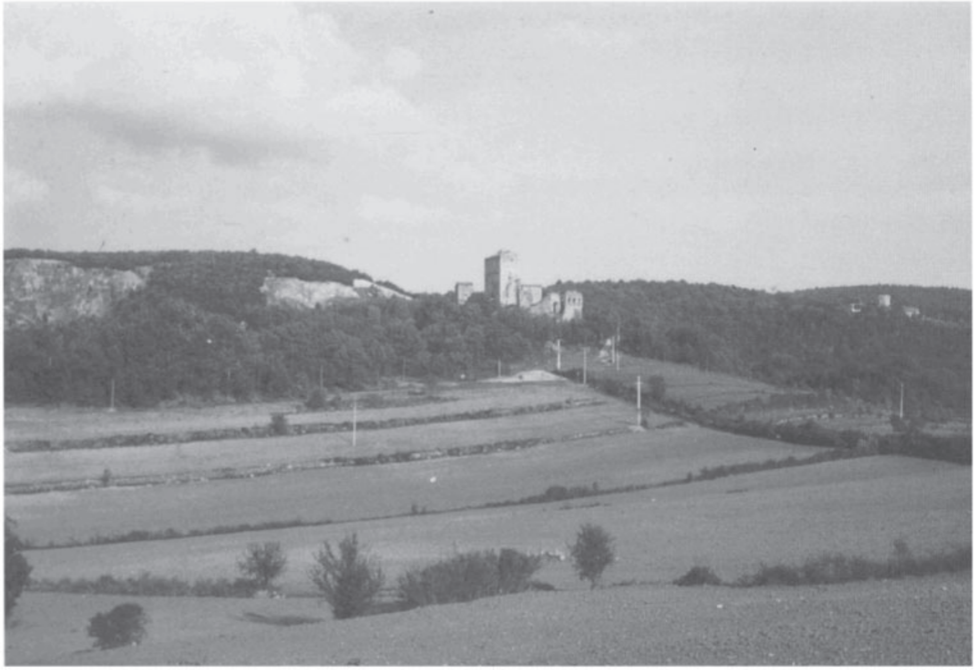

Figure 26.2 Montarrenti, central Italy: a typical case of medieval upland movement and defence dating from the tenth or eleventh century, where excavation has revealed that wooden dwellings and defences preceded the visible stone buildings. Photograph: G.Barker.

excavations have shown a vibrant community well established by 1100 and with a peak of prosperity coming in the thirteenth century. Prominent structural elements were the tower houses on the summit of the hill denoting the lordly zone, though these can have been only petty nobility; below these a tidy village fanned out along the contours of the hilltop, with various stone-built houses set into the bedrock slopes. Finds from these structures, which appear to have housed both humans and animals, with animal byres forming the lower storeys, suggest an economically healthy community, receiving some of the seigneurial prosperity.

PEOPLE AND THE LANDSCAPE: THE ARCHAEOLOGY OF MEDIEVAL VILLAGES

The example of Montarrenti serves to show how a recent goal of medieval archaeology has been to break free of the architectural scrutiny of the élite, and instead to analyse the relationship between castle and community, by seeking in the character of the excavated structures something of the minds of the medieval inhabitants. While the castles may show changes in their fabric to reflect power and wealth, the houses and material culture of the associated villagers provide far more tangible data regarding how the rest of society functioned. Indeed, it is often the case that the villages persist long after the decline of the castle structures, with many of these medieval sites only undergoing a decline and a shift in location from hill to plain in the present century, generally because of the simple desire of the inhabitants to be closer to the amenities of modern life. Thus examination of hilltop sites in the Mediterranean is starting to yield essential information regarding medieval human mechanics: notably the resilience of the medieval and post-medieval rural population in terms of economy, architecture and basic lifestyle (again, in general, see Braudel 1992).

Villages need not congregate on hilltops. Natural topography dictates the location and human choice moulds the character of the actual settlements. The plains of Mongolia, Hungary and Britain are dominated by open villages established, for the most part, in the course of the early Middle Ages. Many persist as villages today of course, or have expanded into towns and thus largely shroud their rural origins. In other regions, the medieval centuries marked a notable growth of population and of rural settlement, checked viciously by economic decay, plague and climatic change from the thirteenth and fourteenth centuries. Remnants of this rural recession occur as earthworks, buried features in the landscape, marking abandoned farm and village structures. Identification of these earthworks is not new, but detailed archaeological research is a modern phenomenon, still offering only patchy coverage. Such study is reasonably advanced in Britain, however, where over 3,000 earthwork sites of presumed medieval date have been recognized through field survey, mapwork and air photography. Here it has been clearly demonstrated how landscape archaeology can offer new dimensions to old themes by looking beneath the humps and bumps of these lost or shrunken villages and manors. Integrated studies allow for the examination not just of the buildings but also of field boundaries, ridge and furrow, fishponds and mills, presenting thereby an image of the settlement in its fullest context (Aston 1985).

Most prominent in this regard has of course been the long-running project at Wharram Percy in Yorkshire: here, around the village the surrounding system of earthwork boundaries and fields has been scrutinized, revealing elements dating back to Saxon, Roman and even prehistoric times, indicating thereby an unexpected sequence of almost continuous land-use (Beresford and Hurst 1990). The project has discerned a planned late Saxon village comprising two regular rows of timber-built houses set in enclosures, gravitating around manors and church and fronting onto a central thoroughfare (Fig. 26.3). Documents record two early lords as the major landowners, the Percys and the Chamberlains; but after 1250 the Percys alone presided over the village. Excavations have analysed the building history of the Percys' manor house and have also revealed that of the ejected Chamberlains,

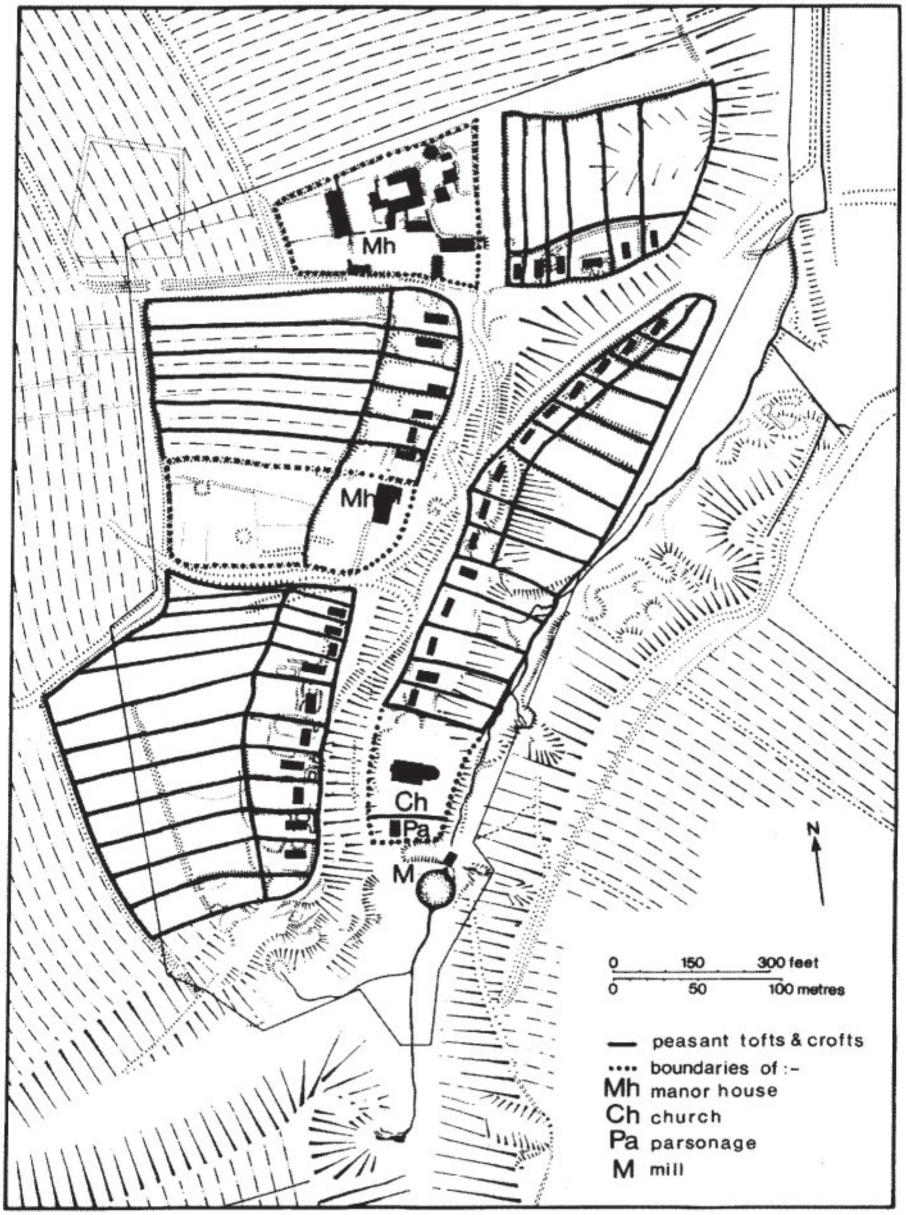

Figure 26.3 Plan of the deserted village of Wharram Percy in Yorkshire, with reconstructed toft (farmyard and dwelling) and croft (paddock) and manor property arrangements. Illustration by Peter Dunn. © Wharram Research Project. Source: Beresford and Hurst 1990.

demolished in the mid-thirteenth century with the ground subsequently given over to peasant houses, thus blotting out the traces of the rival manor. The architectural pretensions of each family as identified by archaeology in both manors and church had otherwise gone unrecorded by the written sources.

Meanwhile, excavation of peasant 'tofts' (farmyards and dwellings) and 'crofts' (paddocks) has illuminated the changing character of rural domestic architecture and offers a useful comparison with urban housing. In towns, so far, a distinction between social classes is hard to identify in terms of building types before the fifteenth century, after which date building in brick or stone begins to become fairly commonplace. At Wharram, the transition from timber to stone and timber falls largely in the thirteenth century, although the changeover was presumably very much dependent on individuals' finances. Even in regions where stone was in ready supply, timber seems to have long remained in vogue, thus highlighting the resilience of traditional vernacular architecture (Clarke 1984:35–40; Granville 1997, ch. 5). (For continental forms, see Chapelot and Fossier 1985; Fehring 1991:148– 71; on 'house' and 'farm' interpretation, see Austin and Thomas 1990:53–64.)

In the countryside three basic house types can be identified: at the bottom end of the market lay the labourer's cot or cottage, a small single- or double-roomed building; higher up the scale, and typical of many villages like Wharram Percy, comes the more prosperous peasant's long-house combining both human and animal space; the wealthiest peasant's accommodation comprised a farm with detached byre and barns, structures which in some instances overlie earlier long-houses, suggestive of improved financial status to earlier middle-range peasants. In the case of the long-houses, the animal presence, whilst undoubtedly offering warmth and a ready supply of milk (and flies!), appears to have also necessitated a notable state of cleanliness, in stark contrast with urban-dwelling (see below pp. 1055–56). Manure and rubbish was stored outside and then scattered onto the fields, with only a few small items left inside the house confines for future archaeological benefit.

Studies at Wharram also highlighted the shifting nature of the rural settlement, with almost regular shifting of position of houses within their enclosures: dating such movement is not easy, but a thirty-year lifespan is suggested for the timber buildings, with subsequent rebuilding seen as the better alternative to major on-the-spot repairs; only with the adoption of stone footings and stone superstructures does the mobility come to a halt here. Thus well-preserved earthwork plans at many villages may denote only the final seat of the houses; earlier arrangements may differ quite markedly in terms of the house alignments, although enclosures seem overall more fixed.

Yet it is still fairly true to say that our understanding of the morphology and of the actual units of medieval rural life still remains vague at best—villages, manors, farmsteads are such a common feature of the landscape that while field archaeology has done much to identify and locate these sites and structures, excavation has still barely scratched the surface. Furthermore, the work at Wharram Percy has shown that no straightforward format to house forms and evolution can be expected, but that considerable variability exists and that each village and each phase within a village must be scrutinized carefully (Aston *et al.* 1989; Taylor 1992).

Various surveys of the scale and range of that of Wharram Percy have been undertaken to fill out this rather sparse image. Such regional surveys in Britain include that conducted around Royston Grange in the Derbyshire Peak District, sampling sites and features relating to all periods, and with an emphasis on analysing the living landscape and assessing the level of continuity and/or discontinuity, notably in terms of field boundaries and rural house forms (Hodges 1991). Evolving field survey analysis has greatly contributed to the debate regarding medieval field systems, as for instance in reconstructing manuring patterns around villages on the basis of artefact scatters. Field walls, ridge and furrow, and trackways were all integral elements of the medieval countryside: all of these provide clues regarding land management, animal husbandry and property demarcation, as well as agricultural practices (Astill and Grant 1992). Just as towns are improperly understood without setting them into a broader economic context, so village and farm life cannot be divorced from their local contexts. This concept of panoramic scrutiny is slowly infiltrating Mediterranean surveys too: a like explosion of data can be promised from these (Mannoni *et al.* 1988; Noyé 1988).

The end of Wharram Percy as a village came in the late fifteenth century, a result of a change in ownership, with the village's new patrons pursuing the fashionable switch from the old arable farming practices to sheep rearing and pasturage—all to the obvious cost of the peasants. This trend had lasting effects elsewhere across many parts of the landscape. Various of the 3,000 Deserted Medieval Villages identified in Britain are linked with this new trend, and many others with the devastating effects of the Black Death, the plague that ravaged Europe in the mid-fourteenth century and periodically thereafter (Hawkins 1990; Platt 1996; Ziegler 1969). However, despite the documentation that allows for local and regional sequences to be built up in terms of village decay, no uniform sequence can be claimed. Enforced removal of villagers to make way for sheep could occur from the twelfth century onwards and yet is only easiest recognized from the fifteenth century; economic expansion in the twelfth century saw many marginal lands settled by farms and villages, but thirteenth-century economic recession, in part caused by the Little Ice Age climatic deterioration, ended this expansion and began a rural decline accelerated drastically by the Black Death. Yet many affected villages clearly survived to endure still today, shrunken but alive, often with a church or chapel standing isolated amongst earthworks—symbolic of the resilience of both the farmer and the Church (Aston 1985:53–81).

MEDIEVAL TOWNS: STRUCTURES AND RELATIONSHIPS

Serfs, peasants, pilgrims and lords did not of course live in total isolation. There was still, as in the classical world, an important relationship between the countryside and the towns: the castle builders generally kept roots in the towns; towns acted as key markets and exchange points for manufactured goods; pilgrims came from towns to the monasteries; the clergy of the monasteries liaised with the urban clergy; and the countryside still fed the towns. Rural archaeology cannot in effect be divorced from urban archaeology: the results from one have essential bearing on the other. Yet systematic urban archaeology remains a fairly novel discipline. Town excavations until the 1960s tended to be virtual treasure hunts, ploughing down to find solid Roman levels with suitably impressive buildings, mosaics and material culture. Medieval contexts were truly an overburden important only for the level of destruction they had wrought on the antique phases. Obviously there has been much redirecting of archaeological thought to the degree that most urban studies now are designed to record equally modern, industrial, medieval and earlier layers

Figure 26.4 Bonner's Lane, Leicester: excavation within the urban context, demonstrating the damage caused by Victorian cellaring and medieval and later pitting and cutting. The post holes here belong to a fifth- or sixth-century Saxon building. Photograph: N.Finn, University of Leicester Archaeological Services.

to provide complete images of urban transformation. (Fig. 26.4). Consequently a mass of data is becoming available for study, constantly requiring the integration of archive research—in medieval and later urban studies the close working relationship of a variety of disciplines is essential (Barley 1977; Carver 1987; Platt 1976; Schofield and Vince 1994).

Urban excavations now seek far more to understand the structures and lives of the ordinary town-dwellers, to identify elements of survival from Roman to medieval, and from medieval to modern times (Carver 1993; Christie and Loseby 1996; Ottaway 1992). The level of such work is increasing all the time but results are still in their infancy and the non-documentary urban world remains rather shadowy. For Britain and Ireland, the Viking impact on urban growth has of course been revealed by the large-scale excavations at both York and Dublin, highlighting the role of commercial regeneration in stimulating the birth/rebirth of these centres (Edwards 1990:179–88; Hodges and Hobley 1988). For York, excavations in the Coppergate between 1976 and 1981 yielded remarkable vestiges of the Anglo-Scandinavian period settlement (AD 850–1066), preserved chiefly due to damp ground conditions and limited later intrusions into these deposits. Here a series of tenements was identified running back some 25 metres from the street frontage, with wicker fences as property boundaries. The actual buildings of the early tenth-century town were constructed of upright posts and timbers with wattle between; later in the century these were replaced by houses of post and plank construction. Internally the buildings featured central clay hearths lined with tile set into a beaten earth floor. These were the houses of craftsmen engaged in various activities, notably metalworking, the debris and tools from which were scattered about, with products including dress fittings, weapons and knives. Even if these should properly be called mere cottage industries, these craftsmen were technically highly skilled, producing fine blades, some pattern-welded, designed for long use. Besides metalwork, wooden cups and bowls were being made, bone and antler carving was practised, plus textile working, all perhaps indicative of family industries geared to supplying an expanding urban market. The place-names of York give further clues as to the commercial din of the Anglo-Scandinavian centre, with the '-gate' names deriving from the Old Norse word *gata* meaning street: hence Coppergate, signifying the Street of Wood-turners (not coppersmiths), Jubbergate (Market Street), Skeldergate (Street of the Shieldmakers) and Fishergate (Hall 1984; Ottaway 1992:146–55).

Despite these varied practical and technical skills, housekeeping did not seem to have figured highly on the lists of domestic priorities for the inhabitants of Anglo-Scandinavian York. The Coppergate excavations found abundant evidence for piles of waste food, bones and other refuse cluttering up backyards, which the house-owners clearly allowed to decompose close to cess pits and wells; human faeces, suitably infested with parasitic worms, were even found on yard surfaces and on some house floors. Interestingly, only a few of these fine medieval sights and smells are on offer to visitors to the Jorvik Centre established over the Coppergate site which recreates this bustling part of the tenth-century township. Noticeably, after 975, the Anglo-Scandinavian Coppergate tenements seem to have been cleared of metalworkers, either in a move to counteract the fire risk or perhaps because of noise pollution, although the level of squalor was not alleviated, and so was presumably seen as acceptable.

Later medieval towns may not have differed much in terms of smell and activity, but there are signs from the thirteenth and fourteenth centuries of greater urban hygiene, seen through the provision of town-tips, the cleaning of roads, and the use of earth-closets; at the same time many industrial activities such as potting and metalworking were sited outside of the towns, although actual trade remained rooted to specific urban quarters. Personal standards obviously varied too and town-dwellers undoubtedly must have often kept a clean house. Indeed, it is the case that the archaeologist is often faced with the debris of households relating to their abandonment phase, when their sites would have swiftly been choked up with the neighbourhood's rubbish—thus it should not always be assumed that medieval townsfolk lived side-by-side with the leftovers of their meals (Carver 1987:96– 100; Platt 1976:69–72; Schofield and Vince 1994:99–123; on household goods and dress, see Crowfoot *et al.* 1992; Egan 1996; on housing forms see Grenville 1997, chapter 6).

Where food waste is suitably stratified, it provides valuable data on diet, as well as on the supply of meat, butchery methods, and animal husbandry (Clark 1989; Grant 1992). As is to be expected, studies indicate that the rich were able to dine on choice cuts supplemented by wild animals, while the poorer townsfolk stuck to sheep and pig. Whilst bones are a common find in both urban and rural contexts, archaeobotanical remains are generally quite restricted and prevent a clear assessment as yet of the range and quantity of non-meat products on offer. Here documentary and artistic sources must be combined with the archaeological evidence of bread ovens, ceramics, amphorae, ridge and furrow, granaries, and so on, to create a more balanced image of medieval diet (Clark *et al.* 1989; Broberg and Svensson 1987; Schofield and Vince 1994:189–203). Thus while the range of meat types is a good enough indicator of the ties between town and country and the healthy provisioning of urban markets, archaeology has much untapped potential for the investigation of medieval food and diet (see Chapter 14).

It is possible to argue that Scandinavian trading input of the level recognized at York stimulated rapid urban growth elsewhere in eastern England, and was matched by commercial expansion in late Saxon towns like London and Winchester. Identification of this economic vitality helps explain the early prosperity of Norman rule in England and the swift diffusion of Norman architectural forms. Indeed, in Britain, as across much of Europe, the eleventh century marks a remarkable regeneration of town life, back towards the population levels reached under Rome. The image may be surprising, perhaps, given the relative political disunity within the various kingdoms, empires or caliphates of Europe, North Africa and the East. Urban communes in Italy, for example, appear to have been in near constant conflict under the direction of various noble families, yet these struggles seem to have little impaired the towns' ability for architectural embellishment and innovation. The rise of feudalism may have placed local territorial power in the hands of lords, but although these expressed some of their power in castle building or in moated manors, most of the nobility remained largely town-dwellers, contesting primacy through feud, patronage and even tower-building (Waley 1988). Much like the old Roman aristocracy, the medieval élite possessed country retreats yet always felt the need to exhibit their wealth in an urban context.

New towns in previously non-urbanized northern and eastern Europe appear from excavations to have generally evolved as *Burgstädte,* around fortified royal or noble seats which acted as magnets to traders and craftsmen and the like, many of foreign extraction. Hand-in-hand with this was the Christianization of these kingdoms, with new clergy drawn to the courts and using their influence to reinforce their missionary activities (Brachmann and Herrmann 1991). Here again, the vital role of trade has been highlighted as the prime prompter of urbanization, although generally under the direction of the élite (Hasselmo 1992 for Sweden; Yeoman 1994:53–71 for Scottish towns or burghs; and see Chapter 16). In many cases the documentary sources suggest that actual, that is written, urban status was only achieved or granted from the twelfth to fourteenth centuries, and yet archaeology has demonstrated fully functioning market settlements with roads and churches in constant evolution from the eleventh century.

In the case of Prague, for example, the foundation of the royal castle belongs to the ninth century as the central place of the emergent Bohemian state. It rapidly attracted a myriad of small dependent village settlements filled with clergy, foreign merchants, craftsmen and farmers and these expanded slowly as suburban style agglomerations or *vici*. Only in the 1230s was much of this sprawl collectively walled and granted the status of town with legal rights, creating the Stare Mesto ('Greater Town'); soon after, a new planned township, the Mala Strana ('Lesser Town') was created on the opposite side of the river through clearing away old housing and roads. Finally, the fourteenth century saw unabated expansion of extramural suburbs, in time leading to the creation of a third urban zone, the New Town, also walled, lying to the south of the Old Town (Hüml 1989). Closely comparable is the rise of royal castles and trading centres at Obuda, Buda and Pest on either side of the Danube in Hungary to form medieval Budapest, and of other western Magyar towns like Szekesfehervar and Esztergom (Gerevich 1990).

The development of the Burgstädte therefore resembles the transition from pre-Roman *oppida* to Roman *civitates,* with a cumulative formalization of the largely commercial suburban quarters. To a large degree the growth of these medieval towns was paralleled by the decline in royal power from the thirteenth century on, though their central place role was generally maintained. The problem is merely one of definition: many *vici* were clearly urban equivalents well before the thirteenth century but the royalty withheld formal granting of an urban charter to these. Without the documentation archaeologists would have little hesitation in viewing the presence of markets, churches, public buildings and roads as indicative of urban status. In many of these regions, the fourteenth and fifteenth centuries are characterized by the extension of the urban form: the creation of royal towns and Burgstädte had generally dictated wider agricultural exploitation and the prosperity of many of the villages thus encouraged brought about the creation of late medieval market centres. Such quasi-urban units are well attested in regions like east-central Hungary and Scandinavia (Broberg 1992; Kubinyi 1990), though as yet they have received little archaeological attention.

Urban populations suffered most from the effects of the Black Death of the late 1340s: the rather primitive character of urban living, revealed at York and adequately described in documentary sources contemporary with the plague (by such as the Italian Boccaccio in his *Decameron*), allowed the pestilience to take a decisive hold and to carry off vast numbers of the population. Mass graves outside of a few towns, as at the Royal Mint site in London, give suitable visual confirmation of the written images, although the full impact of the plague is not easy to trace otherwise archaeologically within the towns (Hawkins 1990; Platt 1996). There is a clear tail-off in building activity in and after this period, and even beforehand too, suggesting that the plague seriously aggravated an already ailing medieval world. Unlike settlement in the countryside, however, the urban fabric was by then so well established that the devastations of the Black Death could in no way cancel out town life. Urban populations had long suffered from plague, food shortages and fire—and all would continue to do so, even after the late Middle Ages.

PIETY AND POWER IN MEDIEVAL RELIGION

The rise of the feudal élite created notable changes also in the religious sphere. In the post-Roman or Dark Age world, religion had become central to the organization and control of both state and society, as witnessed in the secular authority exercised by the Pope in Rome and in the extensive landed wealth of abbeys such as Farfa, San Vincenzo and Monte Cassino in central Italy (Hodges 1993; 1995: 138–75). After AD 1000, however, seigneurial powers prompted a redistribution of territorial control, though this did not force the Church into a secondary role, since Christianity formed an essential ingredient of daily life and its structures remained the principal focus of patronage. The strength of the Church is nowhere better illustrated than in the rapid spread of monasticism, prompted first by the revitalization of

Benedictine monasticism at Cluny in the early tenth century and then by the subsequent emergence of various assorted daughter and breakaway rules such as the Cistercians and Augustinians, all of which contributed to the blossoming of Romanesque architecture (Chadwick and Evans 1987:52–74; Lawrence 1984). Building activity is attested across most of Europe, creating new village and town churches or creating sizeable rebuilds of older edifices. Scale is everywhere impressive, contrasting powerfully with the lacklustre and tiny early medieval churches. Belltowers, portals, murals and sculpture are common survivors of these medieval centuries.

The most striking feature of medieval religion—bar the multinational crusades against eastern infidels and the inquisitional uprooting of heresies—is indeed the growth of monasticism. Monastic fervour is duly attested in the extension across Europe of grandiose and lesser structures, each stamping a powerful mark on both the urban and rural landscape. Church power was now scattered amongst a whole number of monastic units to which the local nobility all contributed. The castle-building élite frequently sought to register their piety through founding monastic seats and donating rich offspring. For France alone, it has been estimated that between AD 1098 and 1600 up to 400 Cistercian houses were founded; for England more than a thousand monasteries of all sizes and denominations are known before the dissolution of 1536–40. The towering naves and broad chapter houses certainly reflect the popularity of the medieval monastic ideal and its architectural and financial vitality. Inbred greed and state jealousies, however, combined with internal reform movements, eventually brought monastic power to a close, to be replaced by mendicants and friars, free from architectural expressions. Various abbeys of course still survive in mutated form, but only their dimensions fully reveal the strength of the medieval monastic world (Coppack 1990; Greene 1992).

Elements at least of the church and cloisters of many of these monasteries remain visible today to give a ready image of the central portion of the monastic plan; these buildings have long been the focus of architectural and archaeological interest (Fig. 26.5). Extant remains allow for some determination of the general structural sequence, whether in terms of basic plan or of architectural competence, but excavation helps to reveal more closely the chronological and physical evolution of these sites and has recently begun to extend investigations to cover the whole area of the monastic precinct and beyond, to study elements such as mills, tileries and granges, structures which at best are merely listed in inventories. Details of water management, storage facilities and industrial production are now forthcoming for monasteries like Norton Priory in Cheshire or Rievaulx Abbey in North Yorkshire (Fig. 26.6), highlighting the highly self-sufficient character of these establishments (Coppack 1990:100–28; Greene 1992:109–58). These were not all inward-looking, however, for they did produce an industrial surplus and duly assisted in the secular economy. Landscape archaeology meanwhile shows the varied impact monasteries had with time on the

Figure 26.5 Air photograph of West Dereham Abbey, Norfolk: this provides a clear indication of the extent of both the claustral complex and the monastic precinct. Traces are evident of various of the outer structures and in particular the gate and roadway leading to the church. Photograph: D.Edwards reproduced with permission of the Norfolk Museums Service Air Photographic Unit.

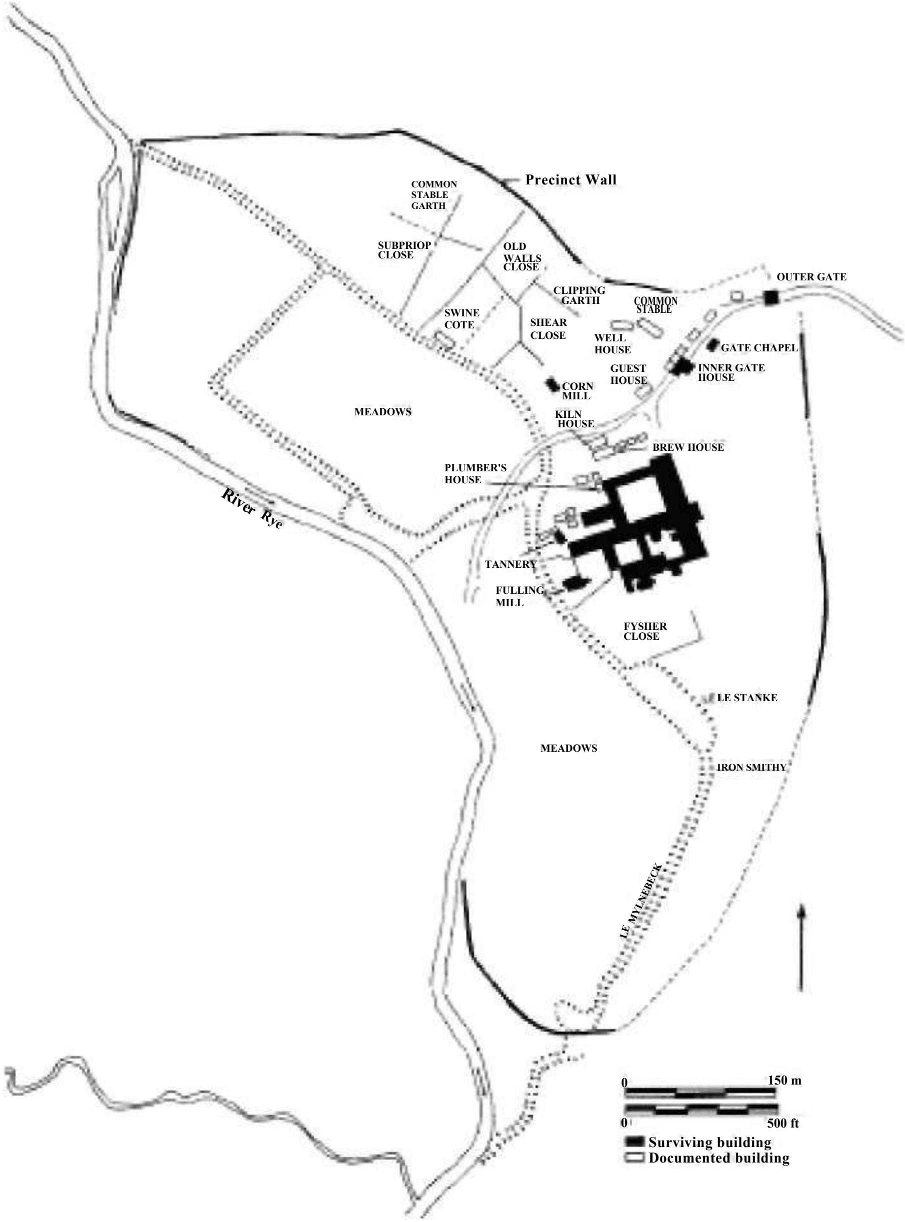

Figure 26.6 **Plan of Rievaulx Abbey, identifying structures beyond the claustral confines, as interpreted from sixteenth-century documentation, earthwork analysis and air photographs. © English Heritage. Source: Coppack 1990.**

countryside: whole village communities could be ejected to make way for monastic granges and sheep farms; yet elsewhere monastic growth created a need for wider rural exploitation to feed the monks and lay brothers and so meant the formation of new villages. Monasteries were also foci for fairs and markets and these in some cases became established settlements, in effect urbanizing the monastery, as in the case of Shrewsbury (Greene 1992:173–77).

Other unsuspected features may emerge from the excavation of these and other religious sites: for example in France and Italy many monasteries have been shown to overlie Roman villas, suggestive of continuity of activity, an early Christian precursor, or at least a survival of the villa ruins and their availability for reuse or quarrying (Hodges 1995:131–37; Percival 1981:183–99). In the case of parish churches in Britain or early Slavic churches in eastern Europe, excavation alone may reveal primary timber-built cult edifices, with their successive phases of enlargement, rebuilding in stone and embellishment. Church archaeology is indeed becoming an important component of settlement research; churches are in many ways a mirror to their dependent settlements and, as stone-built structures, are often our sole extant architectural guide to the medieval years. By and large, therefore, settlement vitality is reflected in the fabric of the church, in its decoration and in the tombs that surround or lie within it (Morris 1989; Rodwell 1989). A number of cemeteries have accordingly also seen excavation: even if medieval burials lack the array of informative grave-goods typical of so many 'Dark Age' cultures such as the Franks and Vikings, and are often conspicuous for their plainness, none the less the growing skills of archaeological science and palaeopathological study are beginning to provide fascinating new data regarding medieval monastic as well as urban and rural populations through analysis of diet and disease. The detailed skeletal analysis undertaken for the medieval cemeteries in York at St Helen-on-the-Walls, Fishergate, and in particular Jewbury (Fig. 26.7) are examples of this valuable new direction of research (Dawes and Magilton 1980; Lilley *et al.* 1994; Stroud and Kemp 1993). This, combined with the renewed use of tombstones and grave-markers from the later Middle Ages, furthermore allows for preliminary comparison of the diets of different social groupings. Now at last it may be possible to see how well monks, merchants and ordinary consumers looked after their stomachs.

TECHNOLOGY, TRADE AND TRANSPORT IN THE MIDDLE AGES

Monasteries were, in the Middle Ages, important production centres and, as noted above (p. 1059), accordingly attracted fairs for distribution or exchange of their manufactures with the secular world. Manufactures require technology, and money for this largely came from lordly patronage, though it would be dangerous to

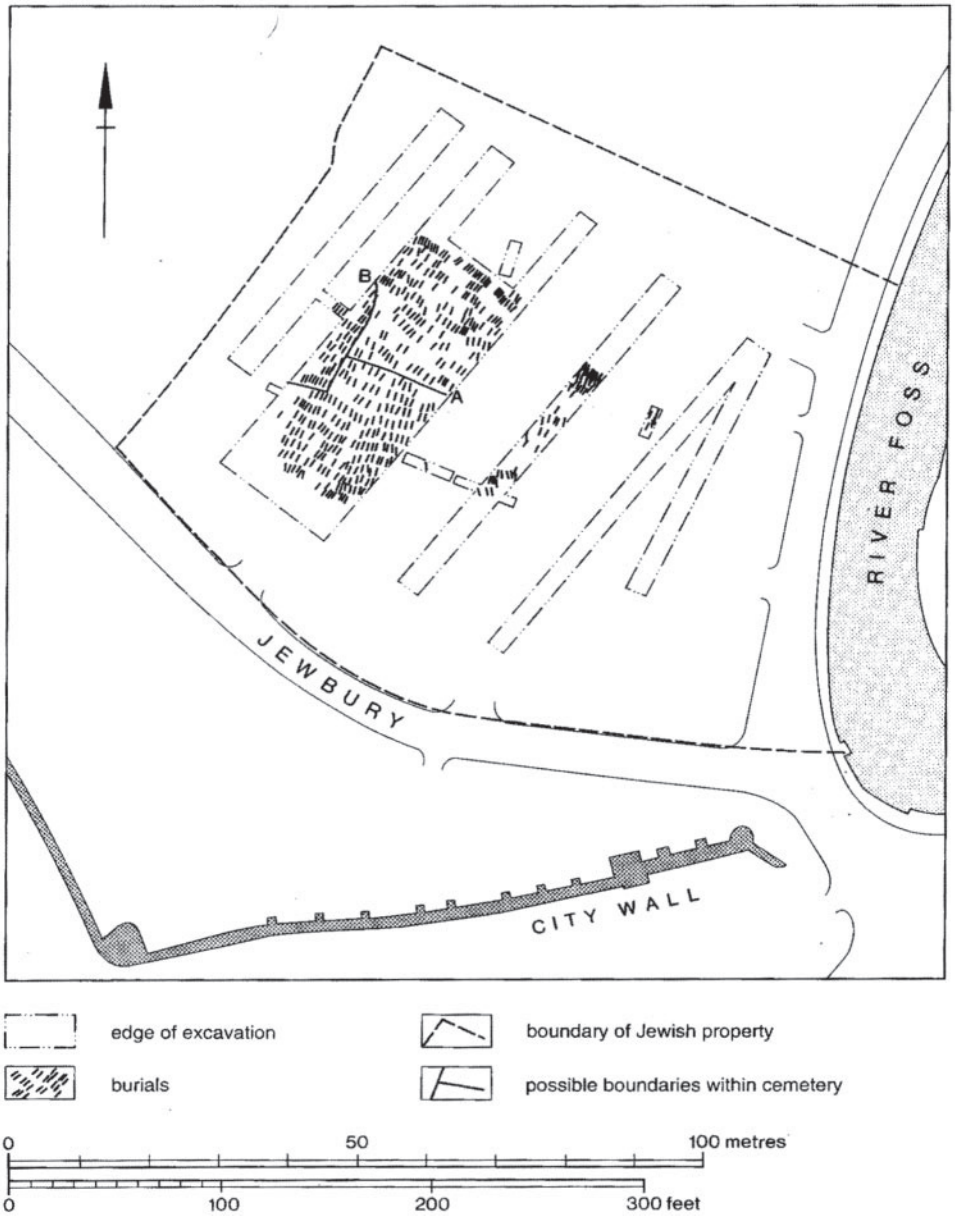

Figure 26.7 Location and layout of the later twelfth- and thirteenth-century Jewish cemetery at Jewbury, York; the plan shows the documented boundaries of Jewish property and possible boundaries (marked A and B) within the graveyard itself. © The York Archaeological Trust for Excavation and Research Ltd. Source: Lilley *et al.* 1994.

overstress this relationship. Indeed, many elements of medieval technology—windmills, dams, metalworking, glazing—have too often been viewed as inventions which produced dramatic social changes across Europe (White 1962). Partly this belief stems simply from the greater availability of written documents after AD 1100 recording fully for the first time new social structures, whether gentry with manors and mills or knights with spurs, and partly this belief is due to a lack of adequate archaeological scrutiny. Many aspects of medieval technology can now instead be shown to have clear antique roots, generally Roman, and these by and large appear to have persisted, if at a reduced level of availability, through the 'Dark Ages'. Social evolution may have been the spur for revival or rather expansion of this technology: wider trading activity created trading emporia, each requiring greater economic supply mechanisms; that is, more land needed to be ploughed. Elements of the 'new' technology may appear to have been the preserve of the élite (for instance, with mills far better attested alongside manor sites than elsewhere), but this seems more to represent an artificial bias in the sources, both historical and archaeological. As excavations expand to explore more rural sites, technology gains a more even distribution across the human landscape.

It is the case that monastic archives relating to the lands of abbeys such as Farfa and San Vincenzo in central Italy or secular documents such as the Domesday Book of 1086 readily attest the widespread use of water mills and windmills in the early and full medieval landscape of Europe. In the case of Domesday, over 6,000 mills are noted in England, but this must certainly imply that mill construction was an ancient survival rather than, as has too often been assumed, a Norman introduction (Crossley 1981; Holt 1988). These devices gave a degree of productive stability to the farms and villages, and expansion of these settlements in turn signals the effectiveness of farming created by such mills. The massed ranks of windmills in the Don Quixote country of central Spain are picturesque symbols of former rolling fields of grain, with produce largely destined for the blossoming urban centres (Fig. 26.8). Their fate has varied: in some parts of Spain many have been revamped as tourist attractions, whereas in others only earthen platforms survive; the situation is the same in Greece, in particular on its islands. Careful manipulation of water resources is shown also in the presence of fishponds in the rural and monastic landscape, demonstrating a desire for variety in diet, or at least an availability of fish for religious festivals. Again here a survival of or readaptation from antique models is argued, if little investigated (Aston 1988; Grant 1992; Greene 1992:124–28).

In terms of pottery and metalworking, production had resumed the industrial levels and complexities of the Roman era by the thirteenth century, with the proliferation of kilns and furnaces readily testifying to the wide demand for these material goods in both urban and rural contexts (Crossley 1981; McCarthy and Brooks 1988). The emphasis appears to have been, as under Rome, on 'on-site'

Figure 26.8 The Don Quixote windmills at Campo de Criptana, central Spain; now white-washed and semi-functional for tourist appeal, the location, height, and narrow windows of these windmills may betray a former defensive role. Photograph: N.Christie.

production in the immediate environs of clay and ore sources. Smaller-scale premises persisted within the towns, but here there was now clear appreciation of the fire risks; less hazardous operations like fulling, dying and cloth-making, meanwhile, remained fully accommodated within the urban and suburban environment. Archaeology allows for full recognition of the structural processes of these varied crafts, otherwise only cursorily described in contemporary documents (Schofield and Vince 1994:98–127). Hence for potteries, the distribution of the puddling pits, drying sheds and dump sites has come under study, whilst working kilns have been reproduced to help assess the technology involved. For the thirteenth-century village of Lyveden in Northamptonshire, excavations of a group of potting tenements revealed that the potters were not full-time in their profession but rather had periodic bouts of agricultural work, baking, or smithying; in one phase one kiln was used by two potters, each identified by their respective waster dumps. All stages of pottery production occurred within the same tenement, although none of these activities were static, since the site of the kiln and the storage points shifted fairly frequently even within one workshop (McCarthy and Brooks 1988:74–76).

Potters seem to have kept pace with fashion also, as in the adoption of glaze in the firing process, for both decoration and functional sealing. Close study of the waster heaps from fifteenth- to seventeenth-century kiln sites in Halifax, however, have revealed something of the human cost of this pace of change: whereas early discarded glazed material was of good quality with consistent forms, a progressive deterioration could be witnessed, to the degree that misfirings and poor vessel forms became frequent. It is argued that the use of raw lead in the glazing process effectively curtailed a potter's working life to around fifteen years maximum (Moorhouse 1986:29). Notable also is the fact that experimental firings have shown that failed pots would have been a common feature of medieval pottery production and that inadequate preparation of the clay for firing might have resulted in exploding pots. With lead poisoning and terracotta bombs abounding, it is understandable why potters tended to break off for an agricultural season and for potteries to be shifted outside of towns.

A blossoming of local and regional manufacturing denotes a blossoming of production and trade on a much wider setting. The Middle Ages mark an expanding of horizons, recreating a semblance, though not a unified semblance, of the Roman imperial trading economy. The rise of the powerful Pisan and Venetian trading empires is one principal event signalling the regeneration of Mediterranean and east-west trade in the eleventh and twelfth centuries, as reflected in new ship technology, developing trade manufactures, the transmission of ideas, and of course the wanderlust of the Crusaders, who made their special contribution to stimulation of art and architecture by their despoliation and dispersal of various treasures of Constantinople (Holmes 1988:223–34; Lewis and Runyan 1990:64–78). The Italian trading despots were based on amazingly small city units, with little or no agricultural back-up, most apparent in the hemmed-in port of Amalfi and the watery wastes around Venice. It was chiefly this lack which led ultimately to their decline, as greater land-based units took also to the sea and challenged Italian dominance: Spanish, Portuguese, French and Dutch boats and manpower opened the seas up again to all and sundry and of course led in time to such an intensity of trading rivalry that required the discovery of new worlds and new markets (Braudel 1992:214–24, 430–58).

The rapid development in recent decades of underwater archaeology has provided numerous opportunities to extend our knowledge of the form and workings of these vessels, whether traders or men-of-war. These include the eleventh-century Serçe Limani ship, located off the south-western coast of Turkey, and nicknamed the 'Glass wreck' because of its cargo of over three tons of waste glass plus eighty complete, saleable products. Finds from this ostensibly Arab wreck highlight the vital role of the merchant in the Mediterranean economy in this politically turbulent era: whilst the glass was of Islamic manufacture and the anchor had an Arabic inscription, there were also Byzantine coins and lamps, plus amphorae and net weights inscribed with Greek graffiti and Christian symbols. The ship perhaps was carrying Greek-speaking passengers and was certainly carrying goods drawn from Byzantine-held ports. The crew meanwhile were equipped with swords, lances and javelins, showing that cross-cultural trade needed to be defended (Throckmorton 1987:88–96). The mobility of such cargoes is notable: the Torre Civica, adjoining the cathedral at Pavia in central-north Italy, before its collapse in 1989, was decorated with twenty-nine glazed bowls or *bacini* datable to the first half of the eleventh century, all Islamic manufactures, and mainly deriving from Fatimid Egypt and Tunisia. Many Italian centres like Pisa, Noli (Fig. 26.9) and Pomposa brightened their brick-built religious architecture with these brightly coloured vessels, unworried by their non-Christian origin (Blake and Aguzzi 1990); and in Sicily, Norman fusion with Arabs and pre-existing Greek cultures fashioned stunning examples of art and architecture.

The early medieval centuries have been shown to have marked the transition to frame-first boat construction from the slower, if longer-lasting, shell-first boat types of classical Antiquity. A virtual industrialization of ship-building developed, with concomitant advances in ship design, such as in the adoption of stern rudders and

Figure 26.9 The Romanesque (eleventh-century) church of San Paragorio, Noli, on the Italian riviera, overlying a part-excavated Byzantine (sixth century) and early medieval complex; the top of the apse displays a number of imported Islamic *bacini*. The eleventh century marked a major rebuilding and expansion of many church and monastic sites across Italy and Europe. Photograph: N.Christie.

triple-masted rigs by the fourteenth and fifteenth centuries. For some time boats remained relatively small in size: on the Atlantic shores the cog emerged as an established boat type, with high forward and aft ends and a flat base, enabling it still to be drawn up on land; here the width generally exceeded the length, giving the cog a sturdy, box-like image (Fig. 26.10). From the cog developed ever-larger vessels, most notably the carrack, which rapidly gained supremacy in the Mediterranean, providing heavy duty trading vessels of capacities up to 1,000 tons, carrying salt, grain and timber; Christopher Columbus's flagship in 1492, the *Santa Maria,* was a small carrack. A western rival was the caravel, a multiple-masted ship of likely Islamic design, successfully employed by the Portuguese in the fifteenth century in the Atlantic and as far afield as western Africa; Columbus also employed two such caravels in his journey west. The vitality of this far-flung trade is duly reflected in the creation of warfleets, militarized versions of the cogs and carracks, replacing the traditional galleys of the old Italian republics: excavated remains plus contemporary depictions on seals and in paintings reveal deep-draught boats, with crenellated towers or castleworks erected over both stern and stem and with fighting

Figure 26.10 A seal from Winchelsea, England. © The National Maritime Museum, Greenwich, London.

tops at the masthead (Hutchinson 1995; Lewis and Runyan 1985; Throckmorton 1987:134– 47). By the mid-sixteenth century huge vessels such as the *Mary Rose* acted as flagships to these powerful fleets: the *Mary Rose* herself was equipped with an assortment of guns ranged from gunports in her hull, some set fatally close to the waterline. Despite the ever-increasing numbers of guns, archers remained useful elements on board these vessels, as shown by the *Mary Rose's* stock of 250 longbows and 4,000 arrows. The new artilleries played vital roles in the capture of Muslim Granada in 1492 and even earlier in the Ottoman capture of Constantinople in 1453, but served more to create a political and maritime technological stalemate between West and East in the Mediterranean. The stalemate did more than anything to stimulate the drive outward in search of the New Worlds.

The introduction and development of gunpowder and artillery on the land had equally far-reaching consequences. To counteract the employment of these new vehicles of war, the castle architects in the fourteenth and fifteenth centuries responded by angling circuit and tower walls, by building in brick, and by providing broad platformed bastions for mounting artillery upon. However, the relative lack of manoeuvrability of these defensive measures meant that the days of the 'military' castle were numbered—indeed, castles were well in decline as fortifications from the fourteenth century, reflecting the fact that warfare tended to be pursued more in open battle than in the siege and defence of strongholds (Thompson 1987:32–42, 112–16). None the less, urban fortifications persisted and evolved in continental Europe, with the elaborate 4-kilometre long, early sixteenth-century defences at Lucca in Italy amongst the most stunning survivals of new-wave heavily bastioned and moated anti-artillery compounds. Such 'Italian style' defences, as instigated by Machiavelli in 1526, dictated urban fortifications into the late seventeenth century (Parker 1995:106–17). This trend did not totally negate the need for independent military fortifications: many harbours or ports could be well defended by the provision of powerfully munitioned blocktowers or the like—the twin harbours at Cartagena on the south-eastern coast of Spain are defended by five such fortlets. But more significantly this transition marked another end: a decline in the patronage of and role of rural castles and a concomitant shrinkage in the associated villages. Many upland villages persisted, dwindling only slowly as settlers budded off to found new villages or select open farmsteads. The decline was slow but constant, creating a dismembering and defeudalization of the old medieval landscape (Fig. 26.11).

CONCLUSION

The Middle Ages in Europe terminated with neither a traumatic collapse nor a conquest of states, nor even with an economic explosion: trade, technology and settlement had been on an upward curve since *c.* AD 1000 and these maintained themselves beyond the thirteenth- and fourteenth-century crises to stand reinforced

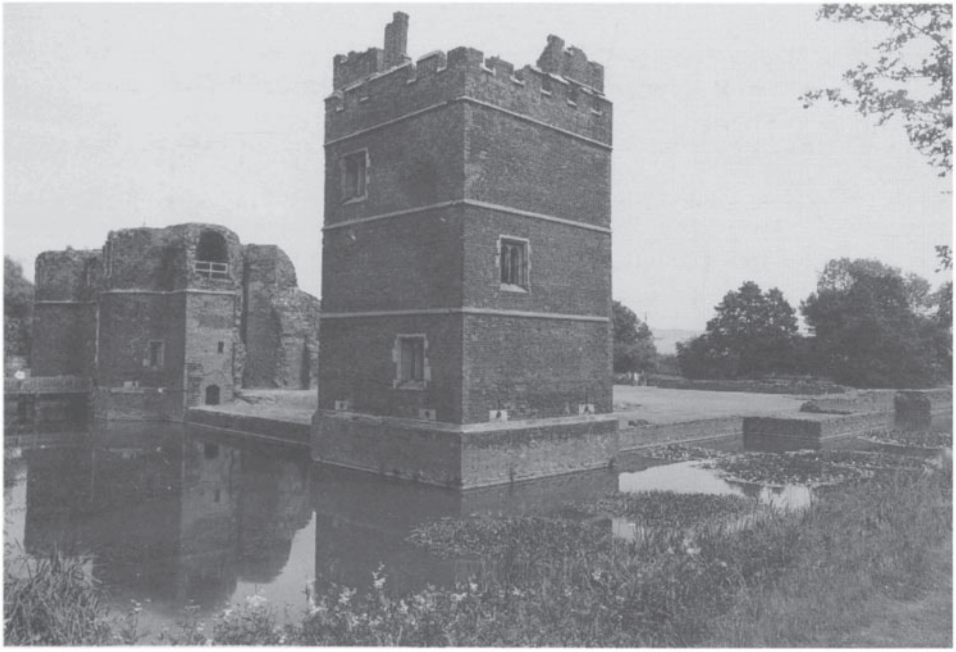

Figure 26.11 Kirby Muxloe castle/fortified manor in north-west Leicestershire: dating to *c.* 1480, this unfinished residence, built for Lord Hastings, marks the transition from defensive stronghold to aristocratic retreat and status marker, with moat and battlements denoting the persistence of threats—represented also in Lord Hastings' own beheading! Photograph: N.Christie.

by the end of the fifteenth century. The powerful stimulus of trade in the early medieval period had laid the foundations for this regeneration, but much time was needed to recall the far-flung net and quality of Rome. None the less, vitality is everywhere reflected in medieval society, religion and economy in all their material manifestations, whether castles, churches, or rubbish pits. Yet it is true to say that these manifestations of the medieval past are only now being properly subjected to archaeological scrutiny, and thereby have only just begun to embellish and elaborate upon the documentary image that has for so long held sway. Human and animal debris are generating many words, words largely omitted from the records of the medieval élite. The forthcoming dialogue between archaeology and history will be vital in reinterpreting the structures and fabric of the medieval world.

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27

ARCHAEOLOGY AND ISLAM

Alastair Northedge

INTRODUCTION

The Middle East in medieval times is normally connected with Islam, which appeared from the time of the first revelation of the Qur'an to the Prophet Muhammad about AD 610 at Mecca in Arabia (Fig. 27.1). In addition to his qualities as a prophet, Muhammad was also a political leader, and created a community of believers, which by the time of his death in 632 stretched in a network of tribal alliances across the Arabian Peninsula. The subsequent early rulers of the Islamic state were called *khalifa* (in Arabic) or caliph (in English), successor or deputy, but more often Prince of Believers *(Amir al-Mu'minin)*. Under the first four caliphs, the energies of the united tribesmen were diverted into raiding Syria and Iraq, respectively under the control of the Byzantium and the Sassanian Iranian dynasty (226– 637 in Iran and Iraq). The unexpected success by hitherto despised tribesmen in defeating two of the major world powers of the time caused the collapse of the Sassanian empire, and the permanent amputation of the rich Near Eastern and North African provinces of the Byzantine empire. Lack of serious resistance permitted the Muslim armies in the west to reach Spain by 711, and Samarqand and the Indus valley by about the same time. Nevertheless, the natural limits of military expansion brought a halt, with the defeat of a raid at Poitiers in central France in 732, and a battle against the Chinese at Talas (present-day Dzhambul in Kazakhstan) in 751.

The state was initially Arab; the Umayyad family of Meccan origin settled in Syria and provided the first dynasty of caliphs (AD 661–750), governing a vast population of unbelievers. Under the succeeding Abbasid caliphs in Iraq (750–1258), the frontiers of the Islamic world stabilized, and increasing numbers converted to

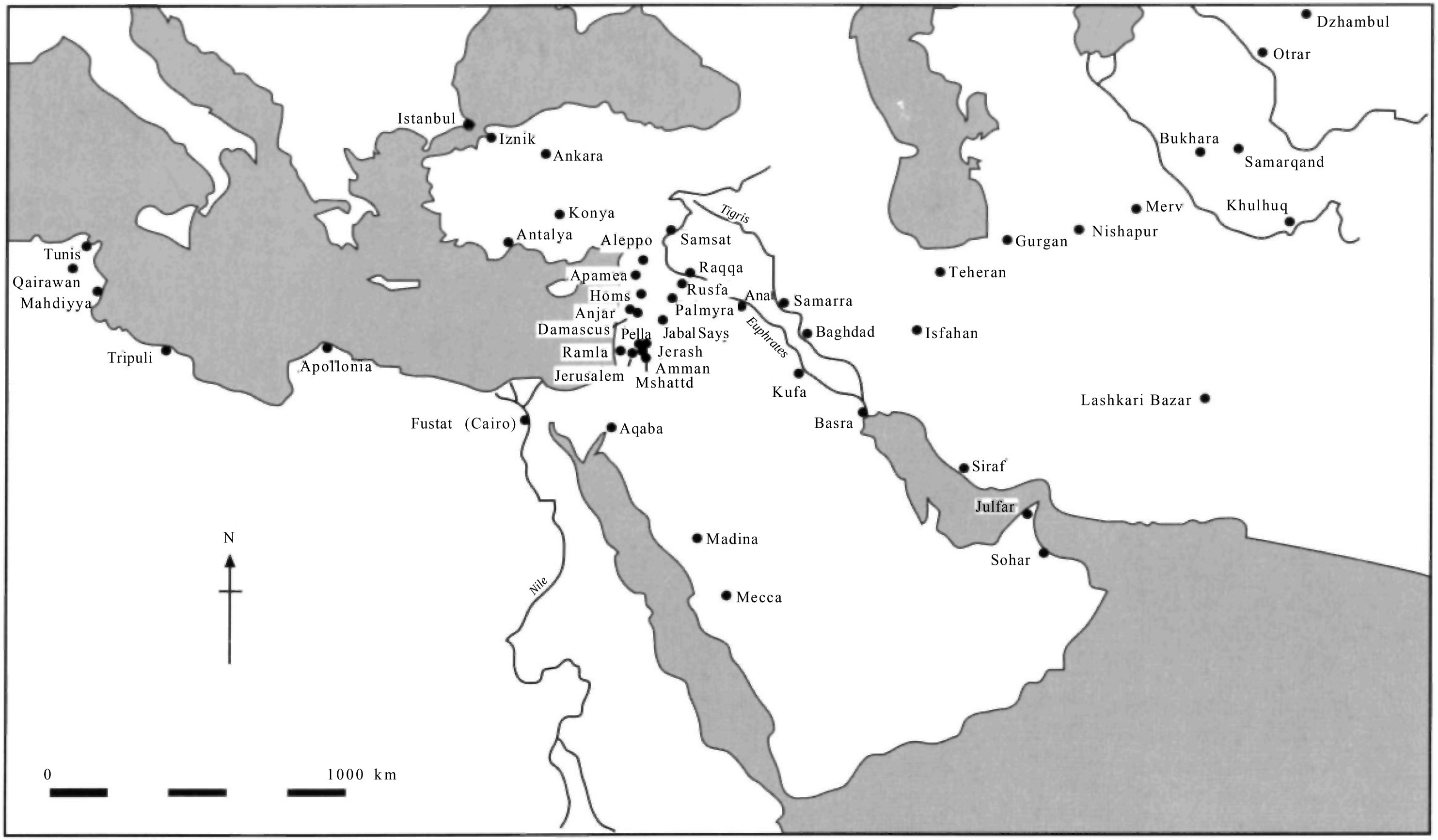

Figure 27.1 Map of Middle East and adjacent region, showing the principal sites mentioned in the chapter. Source: A.Northedge. Redrawn by D.Miles-Williams.

Islam (Bulliet 1979). These two caliphal dynasties, and their imitators, the Umayyads in Spain (AD 756–1010) and the Fatimids in North Africa and Egypt (AD 907–1171), bear some resemblance to the empires of Late Antiquity. However, although the Muslim world has always retained a sense of unified identity since then, the vast areas under Islamic control led inevitably to political fragmentation, notably as a result of the decline of the Abbasid caliphate in the middle of the tenth century.

Out of the decay of empire and the decentralization of power was born the brilliant civilization of medieval Islam—the Saljuqs and their successors in Iran and Anatolia (eleventh-thirteenth centuries), the Ayyubids and Mamluks in Syria and Egypt (AD 1171–1260, 1260–1517), and further dynasties in North Africa, Yemen, Afghanistan and India. Although Arabic became the lingua franca of the Semitic Near East, partly because of its primordial role in the Qur'an, the Arab ethnic component of the population ceased to play an important role in politics, and was replaced by Iranians, and later Turks, who were introduced from the central Asian steppes as slave soldiers, and then arrived in tribal groups. Turks peopled the governments of the Muslim world from the Saljuqs until the early twentieth century. One effect was a new expansion of the frontiers of Islam. Turkish nomads flooded into Byzantine Anatolia after the battle of Manzikert in 1071, and it was a small group of Turkish *ghazis* or frontier fighters facing Byzantium, who created the Ottoman empire in the fourteenth century by invading the Balkans, reaching the gates of Vienna in 1529 and 1683, and finally seizing Constantinople in 1453. The Ghaznavid Turks invaded India in the eleventh century, and their successors up to the Moguls (1526–1858) islamized north-west India and Bengal to the extent that those areas now form the basis of Pakistan and Bangladesh.

The striking economic and cultural success of a society without centralized power—and thus permanent political conflict—received a setback from the Black Death in the fourteenth century but more from the peculiar geographical exposure of the Middle East to great conquerors: the meteoric passage of Alexander the Great through the region was repeated by the Mongols under Genghis Khan (1219–21) and the Il-Khans (1258–1335), by Timur (1370–1405), and finally by Nadir Shah (1736–47). Islam ceased to spread by conquest, but by contacts with neighbouring peoples, such as the Golden Horde in the now Russian Steppe, or the Uighurs in Sinkiang. Particularly trade played an important role—it was by that that Islam spread to Java, Sumatra and Borneo in the sixteenth century (Colless 1969), along the East African coast (Chittick and Rotberg 1975; Horton 1986), and by trans-Saharan trade to West Africa.

Although the Middle East experienced no renaissance of European type (for classical philosophy and scientific knowledge had never been lost, only rejected as unnecessary in the face of divine revelation), the re-emergence of centralized states occurred at about the same time as in Europe. The administration of the Ottoman empire was reformed during the later fifteenth and sixteenth centuries, Safavid Iran was forced to follow, and Mogul India kept pace. It was only from the end of the seventeenth century onwards that the Islamic world ceased to rival the West, although it is now experiencing a revival.

THE ROLE OF ARCHAEOLOGICAL EVIDENCE

The study of the history of the pre-modern Islamic world has until recently been largely conducted through the medium of texts. The principal skill of orientalists lay in the decipherment and interpretation of Arabic, Persian and Turkish texts. Until the end of the 1960s even the analytical tools used by western historians were little known. Study of the archaeological remains of the Islamic world dates back to the end of the nineteenth century: it was an inevitable concomitant of the discoveries of early archaeologists in the Holy Land and elsewhere in the Middle East. However, they often lacked the dating tools to distinguish Islamic from earlier remains, a problem which still exists for the period before the introduction of polychrome glazed pottery in the ninth century. For example, a controversy continued for nearly a century, from its initial discovery in the 1840s, over the identification of the Umayyad desert castle of Mshatta in Jordan (Creswell 1969:622–41). Worse, although some good work was done in the earlier part of this century, notably by the German archaeologist Ernst Herzfeld, by the French historian Jean Sauvaget and his archaeological compatriot Daniel Schlumberger, and by the English architectural historian K.A.C.Creswell, from the 1960s onwards the study of Islamic material remains has tended to be dominated by a group of art historians who even today are unskilled in the interpretation of the primary material which is the daily bread and butter of archaeologists, and who often pose only a narrow range of questions on the artistic development of Islam. The discovery of the possibilities of archaeology for giving a new viewpoint on the history of the Islamic world is a very recent development, starting not more than twenty years ago, and the organization of the basic tools of analysis, notably the pottery typologies, is still underway. At the time of writing, a useful dialogue is beginning to take place between Islamic historians, that is, textual specialists, who have not been aware of the different kind of questions that archaeology is capable of answering, and Islamic archaeologists, who have not had time to look beyond the primary material with which they have been dealing and who often only have limited access to the textual sources, which are voluminous but mostly not translated.

The theoretical arguments for the advantages and disadvantages of archaeological material compared with texts for explaining the past have been well-rehearsed: archaeology does not suffer from the prejudices and ideological biases of chronicle authors, although the material is often more difficult to interpret than a text. It is well-adapted to explaining long-term economic and social evolution, but not so good at illuminating particular events, although many archaeologists would like that to be the case. At present the usefulness of archaeological evidence for explaining the evolution of Islamic society declines from early Islamic times onwards, as the quantity of surviving texts increases. Under the caliphs, archaeological evidence is vital for explaining the development of society and economy in the face of obscure and partial textual accounts; under the Ottomans it does not at present have much to add, by comparison with the quantities of data still to be deciphered from the central government archives in Istanbul, and the local archives of the *Sharī'a* law courts, both of which go back at least four centuries.

THE HUMAN AND PHYSICAL ENVIRONMENT

The Middle East has always been a multi-cultural area. Within the eastern Roman empire, the Jews were the only major religious community to survive the three centuries of intense and rather intolerant Christianity between the Edict of Constantine and the Muslim conquests. At the same time, however, Christianity was also dominant, though not unrivalled, in areas outside the imperial frontier—in Ethiopia, some parts of Arabia, Iraq (but not Iran), Armenia, and Georgia. Islam was in practice much more easy-going, in spite of its current image of fanaticism. The first Muslims aimed to live from taxes on the other communities—the three religious groups which were declared protected communities ('People of the Book'): the Christians, the Jews and the Zoroastrians (the last by concession of equivalence). Logically, this implied permitting their continued existence, and indeed discouraging conversion. Although discouragement was only briefly applied, and financial exploitation only lasted two centuries, the recognition could not be revoked. Christian and Jewish communities, if they were willing to accept a second-class status, and were able to outlast periodic bouts of bigotry from their Muslim neighbours, were generally tolerated. The recently published excavation of the great basilica of the Holy Cross at Rusafa in Syria illustrates the continuation of the pilgrimage to this desert site until the time of the Mongol invasions *c.* 1260 (Ulbert 1986).

The Middle East is a particular type of environment, lying as it does in the desert belt of the northern hemisphere. While most of the mountain chains and the Mediterranean coast receive rainfall adequate for cultivation, the remainder of the region is dependent on water originating from outside the area (for example the Nile), or from the well-watered mountains. The irrigation methods used before modern mechanical devices were variable, ranging from simple flooding, and canals fed by animal- or human-driven lifting machines, to diversion of floods in the wadis (Yemen), long surface canals derived from the Tigris and the Euphrates (Iraq), and underground channels (*qanat, foggara* and other terms) derived from raised water-tables in the mountains of Iran and elsewhere (see Chapter 14). This means that the environment in which humans live in the Middle East is more their own artificial creation than elsewhere, and it is relatively fragile: the best example is the south of Iraq, where a natural desert was turned into the home of one of the world's great civilizations in ancient Mesopotamia by irrigation from its two rivers (Adams 1965), but whose agriculture has today largely been ruined by a variety of natural and man-made disasters, including salinization and river-bed movement, the exact role of each of which stills remains controversial. But it is also true that the limited areas which could be turned into cultivable land by irrigation, together with the mountain and coastal areas where non-irrigated agriculture is possible, are intermixed in a patchwork with areas of desert.

The desert remained until modern times the domain of nomadic animal breeding, mainly camels, horses, sheep and goats. The settled states feared and disliked the desert and the bedouin (and their Iranian, Turkish and Berber equivalents), but always had to deal with the desert dwellers, and could often be toppled by them. While we may consider too simplistic the cyclic theory of history propounded in the fourteenth century by Ibn Khaldun, whereby a young and vigorous nomadic group conquers the settled land from a decadent dynasty, in its turn to become wealthy and decadent and replaced by yet another group, a surprisingly large number of Middle Eastern empires had tribal origins, both under Islam and long before. Islam itself came out of this milieu: although its leadership was of urban origin in Mecca, and its armies were manned by Yemenis, Omanis, Hijazis, and Syrian Arabs, all of whom were mainly cultivators, 'desert and sown' in Arabia are so closely intermixed that members of the same clan may be nomadic herders or sedentary peasants. The unifying factor is the tribal organization, which subsequently came to have a much more important role under Islam than before.

When Islam spread beyond its home region of the Middle East, it encountered new environments. The Muslim Arabs regarded the southern shore of the Mediterranean, with its dry Mediterranean vegetation and hinterland of desert, as not very different from the Middle East: Spain resembled Syria to the Muslims. However, Islam spread further than those environments which even remotely resembled the Middle East. In the steppes of Central Asia, the dense inhabited plains of northern India, the jungles of Indonesia and the desiccated lands of sub-Saharan Africa, it became a global civilization, where religion and its cultural baggage became the sole unifying factor.

THE ARCHAEOLOGY OF CONQUEST

The tribal origins of the Islamic state are clear: the Umayyad caliphate (661–750), conquering all before it from Spain to the Chinese frontier, was essentially supported by the Arab tribesmen. In its metropolitan province of Syria—in the larger sense of the modern countries of the Levant—it has been compared with the barbarian kingdoms of the west: a tribal aristocracy dominating a Roman provincial population, the principal difference being the existence of an ideology—Islam (Crone 1980). The written sources on Umayyad Syria are particularly poor, the early Arab chroniclers being mainly from Iraq and the east, and the Byzantine sources are fragmentary. Archaeology therefore plays a particularly large role in explaining the characteristics of this short period of rapid change, but the resemblance of the material—both the traces of building activity and evidence for pottery and other production—to their late Roman/Byzantine equivalents makes it difficult for archaeologists to reach a consensus. The Romanists see the continuation of the empire, and the Islamicists see a new beginning, in the same material. For example, the octagonal Dome of the Rock in Jerusalem (AD 691–92) is regarded by many Byzantinists as a perfect case of a palaeo-Christian *martyrium,* disregarding its differences in function and decoration from Christian architecture (Creswell 1969: 65–131; Fig. 27.2). These differences, relatively slight at first sight, are in fact important because they document a cultural revolution taking place slowly over two centuries. The archaeological remains of this period are also very rich. The Umayyad aristocracy loved decorated architecture, and the subsequent poverty of Syria during the ninth, tenth and eleventh centuries has left the remains on the surface.

Recent archaeological work in the Middle East has concentrated on those Roman cities which were abandoned under Islam. The location of the major cities changed very quickly after the conquest, partly because of the closure of the Mediterranean to international trade during the seventh century, but also because of the orientation of the Muslim world towards the Middle East rather than the Mediterranean. We know relatively little about Amman (Philadelphia) in Jordan (Northedge 1993), Damascus or Homs (Emesa) in Syria, or Tripoli in Libya, because those cities continue to be important today, whereas we have considerable knowledge of Jerash (Kraeling 1938; Zayadine 1986, 1989) or Pella in Jordan (McNicoll *et al.* 1982; Smith 1973, 1989; Walmsley 1988), Apamea in Syria (Balty 1981, 1984), or Apollonia in Cyrenaica, cities equally important in the late Roman period, because those cities disappeared from the map at an early stage, and with relatively little change after the conquest. The evidence of the excavations at Jerash and Pella, or Baisan on the West Bank (Tsafrir and Foerster 1994), has shown considerable continued small-scale construction and many finds under the Umayyads, but little monumental construction and no large mosques. This picture reflects the accounts in the historical sources of heavy taxation, and probably demonstrates that these

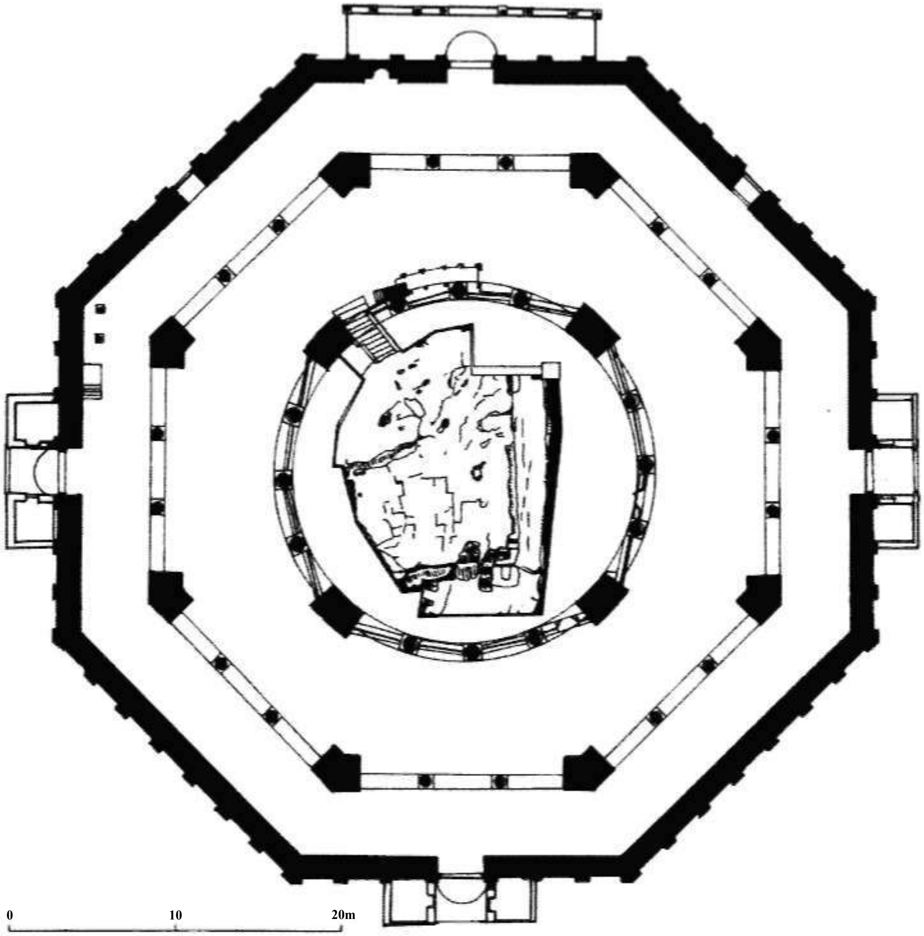

Figure 27.2 Dome of the Rock, Jerusalem (AD 691–92). Source: Petersen 1995.

cities remained largely non-Muslim until their abandonment. The preferred Muslim centres of settlement such as Amman and Damascus received large mosques at an early date (Fig. 27.3). Theoretical reconstructions, with some support from excavation, illustrate the narrowing of broad colonnaded streets into irregular market alleys, and have been taken as proof of deterioration from the Roman to a medieval mentality that was not interested in town planning (Hourani and Stern 1970; Kennedy 1985). One can, however, look at the question differently, and ask whether the organized town plans of the Hellenistic and Roman periods were not the exception, and the medieval city plans not simply a return to the pre-Hellenistic plans of the Iron Age.

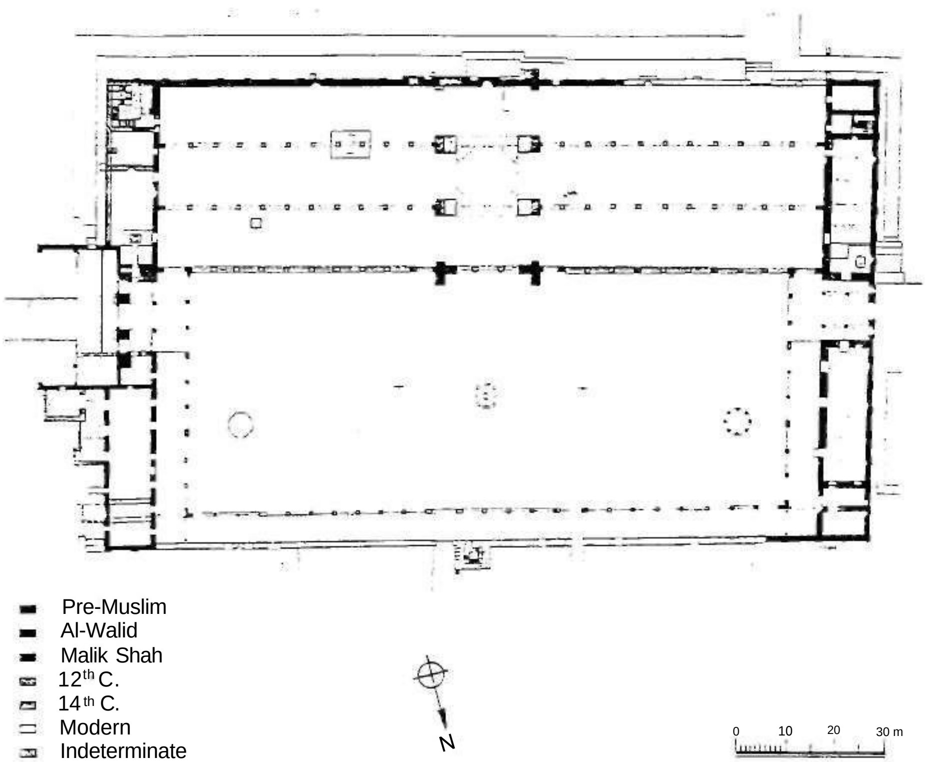

Figure 27.3 Plan of Umayyad mosque of Damascus (AD 706–14). Source: Creswell 1969.

The impact of the tribal aristocracy on Syria was very visible. The caliph ‘Abd al-Malik (685–705) introduced a programme of monumental religious architecture, beginning with the Dome of the Rock in Jerusalem (Fig. 27.2), which may have been intended as an Umayyad sanctuary based on Arabian sanctuaries such as at Mecca and elsewhere in the pre-Islamic period. At any rate it proved to be the sole building of its type, for Mecca came to be considered a unique symbol of God’s intervention on earth (Creswell 1969:65–131; Hawting 1986:59–61). His successors continued the construction of monumental mosques, such as al-Aqsa in Jerusalem and the Umayyad mosque of Damascus (Fig. 27.3). These mosques varied in size from single chambers with a *mihrab* (the niche indicating the direction of Mecca), found in towns with small Muslim populations, such as at ‘Ana in Iraq (Northedge *et al.* 1988:17–19) and Jerash in Jordan, and in the princely settlements, to courtyard mosques of about 2,000 square metres in towns of greater significance to the Umayyads, such as Amman in Jordan (Northedge 1993) or Rusafa in Syria (Sack 1996), and finally to the courtyard mosques of the great cities, 10–15,000 square metres in size, such as in Damascus and Harran in Syria, Madina in Arabia, and Kufa or Wasit in Iraq (Creswell 1969, 1989).

The presence of the tribal aristocracy was also marked by a series of new constructions on the desert edge and other traditional Arab settlement areas. Some come under the heading of the 'Umayyad Desert Castles'. In their most developed form, these were complexes of a quasi-feudal nature, composed of a square lightly fortified residence, an audience hall with bath, a small mosque, a series of houses of different sizes, together with storehouses and other buildings (Gaube 1979; Sauvaget 1967). The most perfectly preserved plan is Jabal Sais, located in the bowl of an extinct volcano in the Syrian desert 105 kilometres from Damascus (Sauvaget 1939), while the most grandiose was the residence of Caliph Hisham (AD 724–43) outside the walls of Rusafa in Syria (the plan of which is regrettably not yet published): four square castles and about thirty other buildings, with a garden pavilion recently excavated. The hierarchy of the plans suggests the attachment of a considerable number of followers to the lord in question—who was not necessarily the caliph, or even a member of the Umayyad clan, in spite of the superficial tendency today to attribute everything to the caliph—and this hierarchy reflects well the importance of clientage to a tribe *(walâ')* during the Umayyad period. The square castles themselves are subdivided into independent apartments called Syrian *bayts* (Arabic for room, apartment, or small house) by Creswell, suggesting a familial structure of the entourage. The same hierarchy of plan is visible in the fortified orthogonally planned urban settlements of the period, such as at 'Anjar in Lebanon, where the same elements as in the desert castle complexes are present, but in a form which resembles a planned Roman city (Northedge 1994; Fig. 27.4).

According to the historical sources, the Arab tribal armies in Syria were settled in existing cities, and the only new foundation was Ramla in present-day Israel, founded by the Caliph Sulaiman (*c.* 715); regrettably little is known about its archaeology, as Ramla is still a substantially sized town. Outside of Syria, the Muslims settled in new cities, effectively tribal garrison cities, which were generically called *amsâr* (singular: *misr*), though use of this term in the texts is rather vague, and it is often used to mean simply a major city. The first two *amsâr* were Kufa and Basra in Iraq (*c.* 637); the organization of their tribal allotments around the mosque and governor's palace is well known from textual descriptions, but owing to later occupation the particular characteristics remain little known from the archaeological point of view, although the governor's palace at Kufa *(Dâr al-Imâra)* has been excavated (Creswell 1969:46–64). Only at Fustat in Egypt, later replaced by Cairo, has a short section of the seventh-century plan been revealed in the recent French excavations at Istabl Antar—two narrow alleys with little booths and irregular houses (Gayraud 1991).

However, in general it is true to say that, outside the Fertile Crescent and Egypt, the archaeological traces of the transitional period are not very easy to see: the large investments made in architecture in Syria, and the new cities of Iraq and Egypt, at

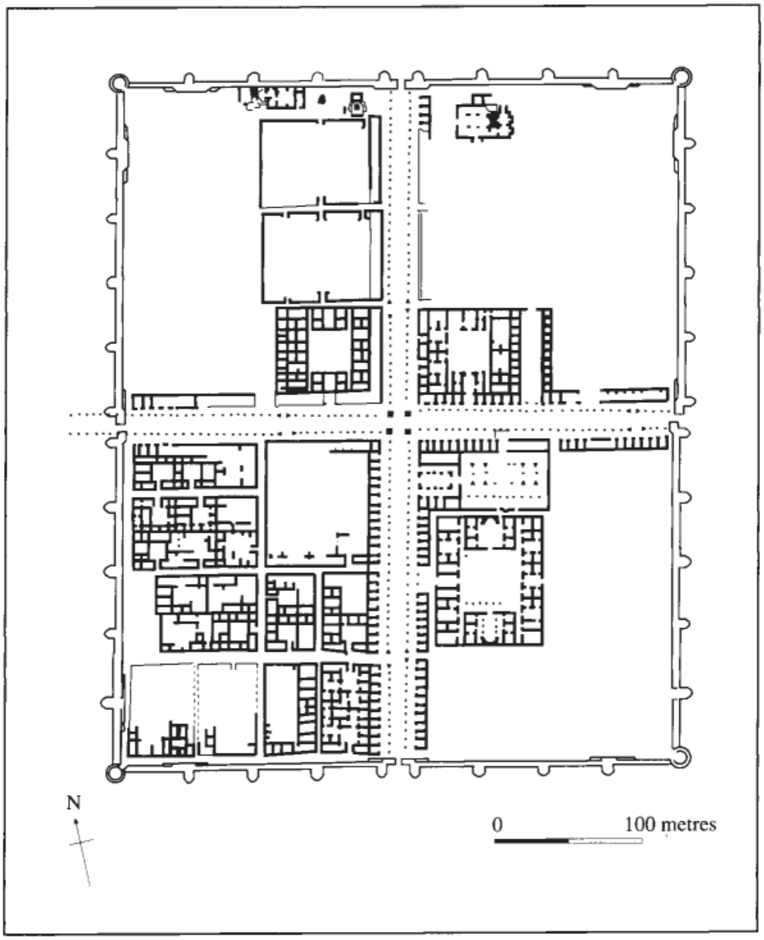

Figure 27.4 Plan of 'Anjar, Lebanon (AD 714–15). Source: Petersen 1995 (redrawn by D.Miles-Williams with additions).

least leave easily visible traces. The principal obstacle is the pottery typology, the main source of dating evidence in the Middle East for building remains which are not monumental architecture. The principal late Roman fine wares in the Mediterranean ceased to be manufactured at the end of the seventh century, but the first easily recognizable Islamic types with polychrome glaze date to two centuries later (Northedge 1997). As a result, many archaeologists have failed to detect eighth- and ninth-century remains, if they are not obviously new settlements such as Qairawan, the *misr* founded in Tunisia in the late seventh century and known for its ninth-century mosque. In the recent excavations at the sixth-century Byzantine fortress at Haïdra in Tunisia, the existence of transitional occupation was only recognized because settlement continued into the polychrome glaze period. The difficulty of identifying new changes until well into the ninth century suggests that, for many people, life changed slowly and that there was relatively little economic activity, but it is also very likely that new work may well alter this picture in the future.

THE CREATION OF THE NEW CULTURE

In 750 the Umayyad regime was overturned by the Abbasid revolution, a genuine revolution caused by the stresses of rapid societal change. The Umayyads were accused of being irreligious, the truth of which is evident in the luxurious decoration of their palaces, such as Khirbat al-Mafjar at Jericho, where excavations revealed large quantities of mosaics and stucco decoration, including sculptures, a richness of decoration far surpassing their late Roman equivalents (Hamilton 1959). Underlying this was the crumbling away of the tribal state, with the increasing conversion of non-Arabs to Islam—there were scarcely any anti-Islamic revolts—and the economic dominance of Iraq over Syria. The Abbasid caliphate, established in Iraq from 750 to 1258, was in fact, at least initially, a late version of an ancient Mesopotamian empire, and an urban civilization, building on the bases of Kufa and Basra. We have little trace of early Baghdad, founded by al-Mansur in 762, as it lies under the modern city, but it was much written about and described (Lassner 1970). Its reflection survives in the residence of Caliph Harun al-Rashid (786–809) at Raqqa in Syria, a walled city built in 772 with the mud-brick and *pisé* palaces of Rashid scattered outside the walls (Creswell 1940:39–48; Heusch and Meinecke 1985, 1989), and in the second temporary capital of the Abbasids at Samarra’ on the Tigris to the north of Baghdad (836–92).

At Samarra’ (Fig. 27.5) the Abbasids spread their brick and *pisé* palaces, and the military cantonments of their Iranian and Turkish army, out over 57 square kilometres of steppe only reoccupied in the last few years, around several former small towns, of which Samarra’ itself developed into a city (Creswell 1940: *passim; Encyclopaedia of Islam* 1960–: s.v.Samarra’; Rogers 1970). The massive amount of data about military installations, Abbasid housing and living conditions, and industrial structures, has only begun to be analysed, in spite of eighty years of excavations. The Abbasid army was quartered at the capital, not on the frontier, and the cantonments are composed of grids of streets of small courtyard houses, dominated by the palace of the general (Northedge 1994). Evidence of hunting in game reserves, and horse-racing on courses 10.5 kilometres long, is also well-preserved (Northedge 1990).

The wealth of the Abbasid state, depicted by the remains of Raqqa and Samarra’, was based on the land tax (Arabic: *kharaj*) —contrary to the conclusion of Hodges and Whitehouse (1983) —and the main contributor was Iraq. Under the late

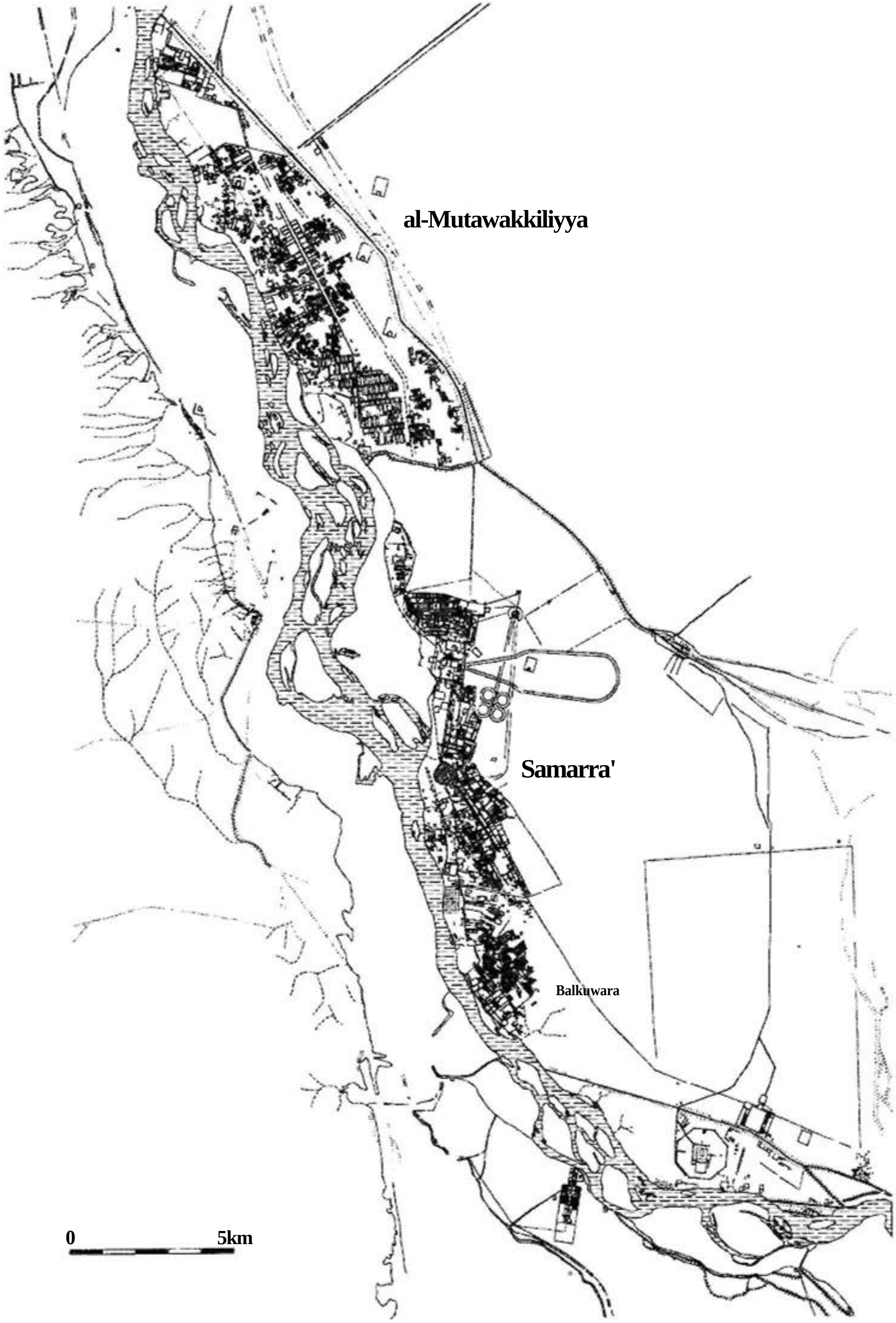

Figure 27.5 Plan of the Abbasid capital at Samarra', Iraq (AD 836–92); north is at the top.
Source: Samarra' Archaeological Survey.

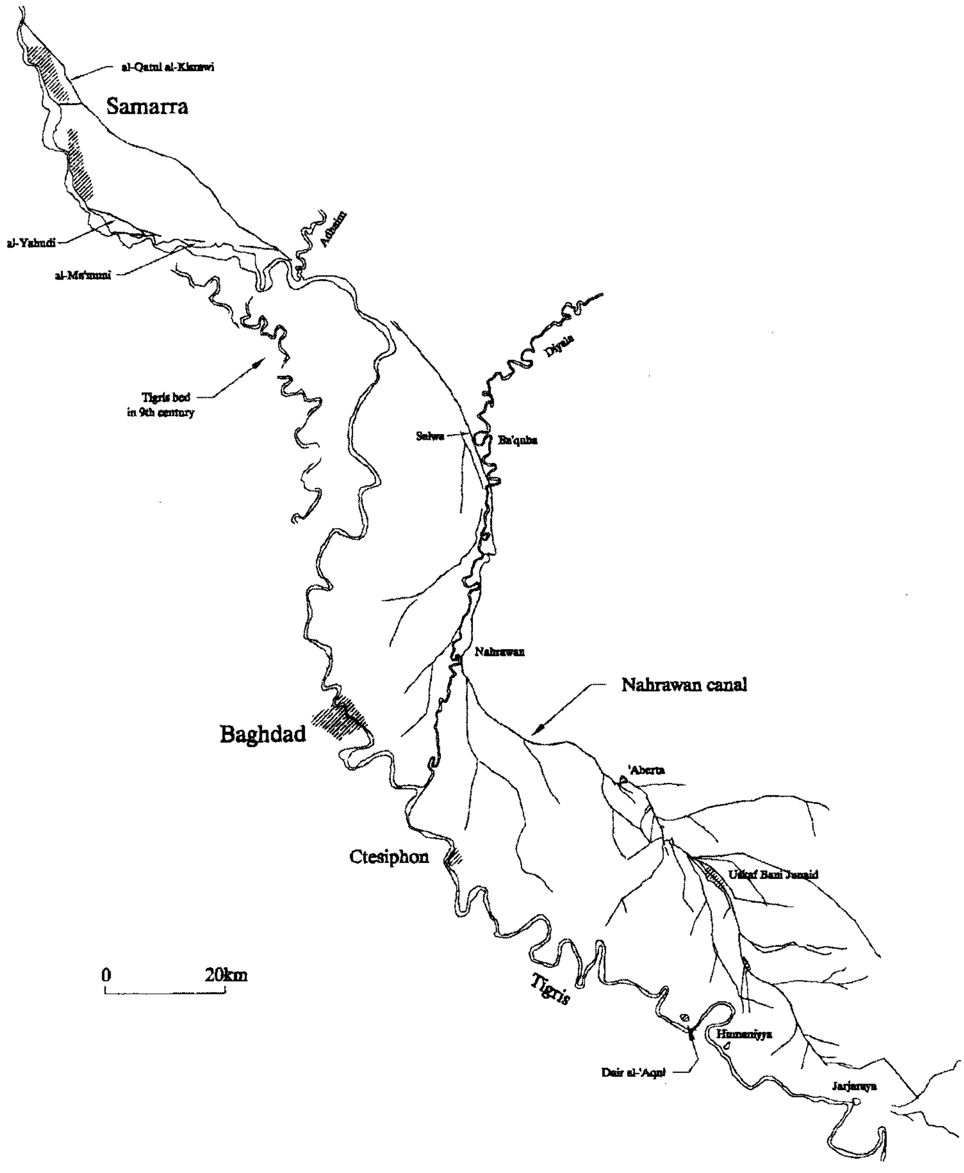

Figure 27.6 Map of Nahrawan canal system, Iraq; north is at the top. Source: Adams 1965, redrawn with permission of the Samarra' Archaeological Survey.

Sassanians in the sixth century the irrigation system was reorganized, and reached a high degree of efficiency. Robert Adams, in his classic archaeological surveys of southern Iraq, revealed dense areas of village settlement around branch canals (Adams 1965, 1981; Fig. 27.6). Regrettably, no adequate excavation has yet taken place of sample villages; the village site of Tell Abu Sarifa in southern Iraq has been excavated, but only for its archaeological sequence (Adams 1970). The character of life in the Jewish villages can be deduced from the Babylonian Talmud and other texts (Oppenheimer 1983). The surveys have shown that the system continued to develop until the early tenth century: Adams gave the ninth century for the date of large-scale contraction, but this date now has to be corrected to the tenth century, based on newer pottery dating, and corresponds to a point when the chronicles lament the dissolution of the Abbasid administration.

The collapse of the Iraqi economy, which did not recover until the twentieth century, is a central motif of Islamic history, for economic and political power passed from Iraq to Iran and Egypt. The reasons for the failure to rebuild the Iraqi system, destroyed in a relatively brief period of weakness, have proved a subject of controversy: was the land becoming uncultivable owing to salinization provoked by the flood of new irrigation water, as proposed by Adams, or was it that the fragmented medieval states which succeeded to political power were incapable of the effort to rebuild and administer a system of which the longest canal was 225 kilometres? At any rate, the most agriculturally successful regions in the Middle East subsequently were those that depended on short canals, easily repaired at a local level, such as in Iran and Egypt.

The most visibly successful economic phenomenon, from the late eighth century onwards, was trade and commercial investment. While the Arabs and ethnically related peoples had a long tradition of trade, being situated on the land bridge between the Indian Ocean and the Mediterranean, and the western end of the Silk Road, the initial impetus may have been given by the fact that the taxation system, which weighed heavily on peasants, scarcely touched merchants in the early days of Islam. Other factors also played a role: the importation of silkworm eggs to Byzantium in the sixth century—the revelation of a Chinese commercial secret—put an end to the Silk Road, and land transport from China. Arab seafarers penetrated further than their Sassanian predecessors, and established a colony at Canton from the middle of the eighth century (Sauvaget 1948). At this time new developments in Chinese ceramic technology, the invention of stoneware, porcelain and polychrome glazes, provided attractive products worth exporting which are easily visible in the archaeological record (Rougeulle 1991). The relative ease of long-distance transport for fragile objects across the Indian Ocean displaced the land route, and concentrated in the early period on the Gulf. The excavations at Siraf, an entrepôt situated in inhospitable terrain on the Iranian coast, directed by David Whitehouse between 1968 and 1974, have well illustrated the wealth of this trade, even in circumstances of political conflict (Whitehouse 1970, 1980). However, virtually every other port excavated on the Red Sea, the Gulf, and the Indian Ocean has revealed a similar story, for example Aqaba in Jordan (Whitcomb 1988), Sohar in Oman (Costa and Wilkinson 1987; Kervran 1984), and Julfar in the Emirates (Hansman 1985; Hardy-Guilbert 1991). With the decline of Iraq, the western terminus became the Red Sea, and activity continued to develop until the penetration of European shipping into the Indian Ocean at the beginning of the sixteenth century.

Chaudhuri (1985), working on the seventeenth-century records of the East India Company, showed that, although the initial investment in ship and cargo was high, and there was a certain danger of loss of the ship, the profit realized on safe return was enormous. In the ninth century at least, profits were invested in local development, partly visible in the archaeological record, such as extensive copper mining in Oman (Costa and Wilkinson 1987), and steatite vessel production in the Saudi desert, far from the Yemeni origins of the type. But in the end, decline in internal security probably ended these initiatives, although Weisgerber (1980) suggests that exhaustion of potential fuel for smelting terminated copper production. At the same time, cross-Saharan routes were developed for importation of gold from West Africa, and coin hoards of ninth-century dirhams in Scandinavia demonstrate Viking trade along the Volga with the Middle East (Hodges and Whitehouse 1983).

The model of the Abbasid caliphate and its world was fundamental to the future of Islamic civilization. Its administrative systems, its architecture, and even its pottery, were imitated both in the east and the west—for example by the successor caliphates of the Fatimids in Tunisia and later in Egypt (909–1171), and the Umayyads of Spain (758–1010). In both these cases, the monumental architectural pattern of the Abbasids was followed: fine mosques in the city—al-Azhar in Cairo and the mosque of Cordoba—and an administrative city outside—Mahdiyya (916) and Sabra-Mansuriyya (947) in Tunisia, al-Qahira outside Fustat in Egypt (969), and Madinat al-Zahra' outside Cordoba in Spain (936). In the west, the minor architectural details were derived more from the Roman tradition: mosques were adorned with square buttresses, wall mosaics of glass *tesserae* as at Cordoba, and horseshoe arches invented in Syria. In the east, in Iraq, Iran and central Asia, the Samarran tradition of architecture, with round buttresses, decorations in carved stucco and brick, continued until the twelfth century. Central Asian palaces, such as at Khulbuq in Tajikistan and Lashkari Bazar (Fig. 27.7) in Afghanistan (Schlumberger 1978; Sourdel-Thomine 1978), both eleventh century, are directly derived from Samarra'.

THE MEDIEVAL WORLD

The collapse of the Abbasid caliphate in the second quarter of the tenth century led to the 'medievalization' of the Middle East, although the dynasty itself survived until the Mongol capture of Baghdad in 1258. The centralized bureaucracy of the caliphate, however theoretical its effectiveness may have been across the vast

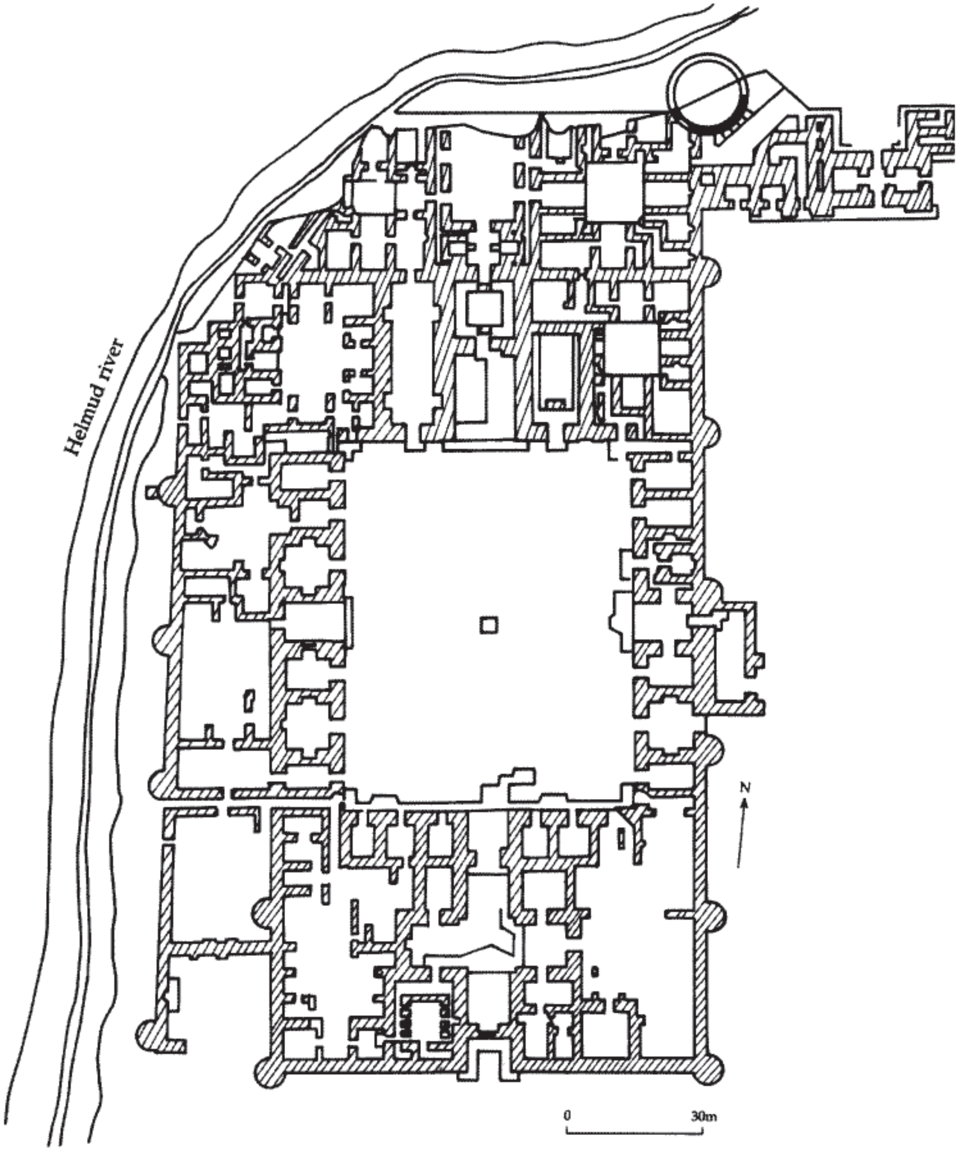

Figure 27.7 The South Palace, Lashkari Bazar, Afghanistan (AD 998–1030). Source: Petersen 1995.

distances from Tunisia to India, was replaced by an ever-changing mosaic of states founded largely by military or tribal leaders with only rudimentary administration.

In the course of the financial failure of the caliphate, an informal feudalism was introduced, the *iqta*ʿ. To pay the army, tax collection rights over a region were offered to military leaders in return for providing an agreed number of soldiers; although the rights were in principal limited, in practice they were not, for officials were excluded. Nevertheless, the *iqta*ʿ did not lead to the kind of formal relationships of lord, knight and peasant typical of European feudalism.

These relatively ephemeral dynasties lacked legitimacy, which was vested in the caliph, and the caliph did not control the mosque, which was in the hands of the *ʿulamaʾ* the religious scholars. The *ʿulamaʾ* were drawn largely from the ranks of the urban notables, often merchants. As a result, city and village became autonomous entities within the Muslim commonwealth, little—and usually only negatively—influenced by governments and their armies. It was for this reason that economic prosperity was possible in the absence of political stability. In particular, when an alliance was made between urban and rural institutions and the ruler, such as under the Saljuqs in Iran (1038–1157), a highly successful synthesis could take place, with great economic development, a period which was only terminated by the Mongol invasions (1219–58). It is unfortunate that, with the exception of Spain (for example: Bazzana *et al.* 1988), very little planned archaeological research has taken place on the evolution of urban and rural society in the medieval period.

Medieval urban settlement

A substantial number of excavations has brought to light urban data for the medieval period (eleventh-fourteenth centuries), but it is mostly fragmentary, for two reasons. In the case of the major medieval cities of Islam, the city is still occupied, and one can only reconstruct the medieval pattern under the overlay of later changes. For example, studies of this type have been made of Damascus (Sack 1989) and Aleppo (Sauvaget 1941). In the case of abandoned cities, only the two cases of Qsar es-Seghir in Morocco (Redman 1986; Figs 4.9, 16.7), and the port of Siraf in Iran mentioned earlier have been pursued with adequate persistence, resources and an overall vision; and not much of the latter excavation has been published in final form (Whitehouse 1970, 1980). The excavation of Aqaba in Jordan has also had considerable success in revealing an early medieval small port (Whitcomb 1988). Otherwise, greater or lesser areas of many cities have been cleared, only revealing parts of streets and houses without relationship to urban structure. In Iran, excavations have been published of Gurgan (Kiani 1983) and Nishapur (Wilkinson 1986); in Kazakhstan, Otrar (Baipakov 1992); in Syria, the citadel of Kama, Balis-Meskene and Mayadine; in Turkey, Samsat (Redford 1995); in Egypt, Fustat and the port of Qusair al-Qadim on the Red Sea (Whitcomb and Johnson 1978, 1982). Nevertheless, these excavations have normally brought to light rich finds, in particular large quantities of evidence for the evolution of ceramic production.

The essential problem is that urban structure was evidently different in medieval Islam from medieval Europe. The urban studies of surviving later Islamic cities, such as those of Damascus and Aleppo mentioned above, and studies based on textual evidence (such as Lapidus 1967), show this clearly. The stereotypical physical model of the Islamic city, with its narrow alleys leading to the bazaar and the mosque, which was an oasis of peace at the heart of a densely inhabited city without open spaces (von Grunebaum 1961), is hardly likely to have been true of all Islamic cities during the millennium and a half of the religion's existence, and across the vast distances from Spain to India. Only archaeology can really answer this question, but it has not yet done so.

One question is that of fortification (Creswell 1952; *Encyclopaedia of Islam* 1960–: s.v.Sur [City Fortification]). Earlier Islamic cities were either not fortified, such as Baghdad, Samarra' and Fustat (Cairo) in the eighth and ninth centuries, or they followed the traditions of late Roman urban fortification, with regularly

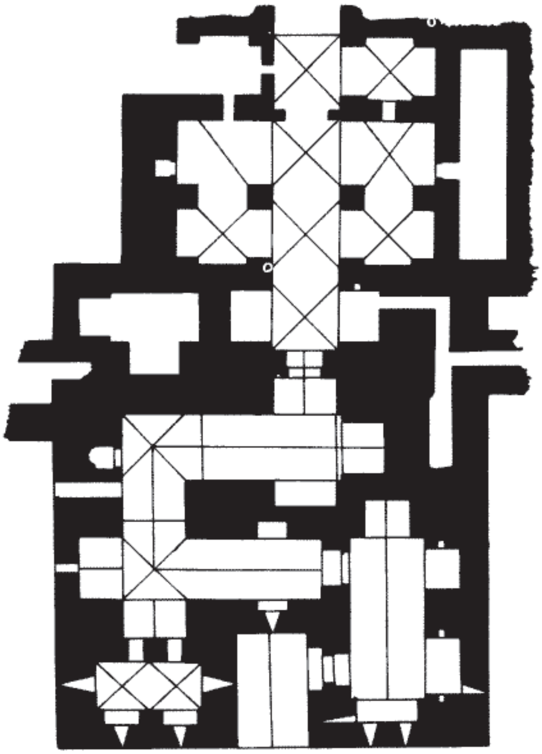

Figure 27.8 Plan of gateway to the Citadel of Aleppo, built by al-Zahir Ghazi in 1209–10. Source: Petersen 1995.

spaced projecting towers and no citadel. A citadel does not seem to have been built in Damascus until the eleventh century. It was the Crusades and their military technical developments that led to the construction of massive new citadels in Cairo, Damascus and Aleppo (Fig. 27.8) at the end of the twelfth and beginning of the thirteenth centuries. Politics also played a role: it was at this point that sultans came to live in urban citadels. In later Islamic cities, citadels of considerable dimensions were built to accommodate palatial residences of the rulers, as for example in 1321 at Tughluqabad outside Delhi in India (Shokoohy and Shokoohy 1994; Fig. 27.9), or the eighteenth-century Arg at Bukhara in Uzbekistan. Urban fortifications were also later dominated by massive bastions, such as the thirteenth-century round tower at the entrance to the harbour at Antalya in Turkey. However, Islamic fortifications, although they installed loopholes for cannons, did not develop a new defensive architecture to adapt to the possibilities of firearms, as occurred in Europe.

Considerable evidence of urban domestic architecture has now been recovered from excavation, to the extent that it would now be possible to write a history of the

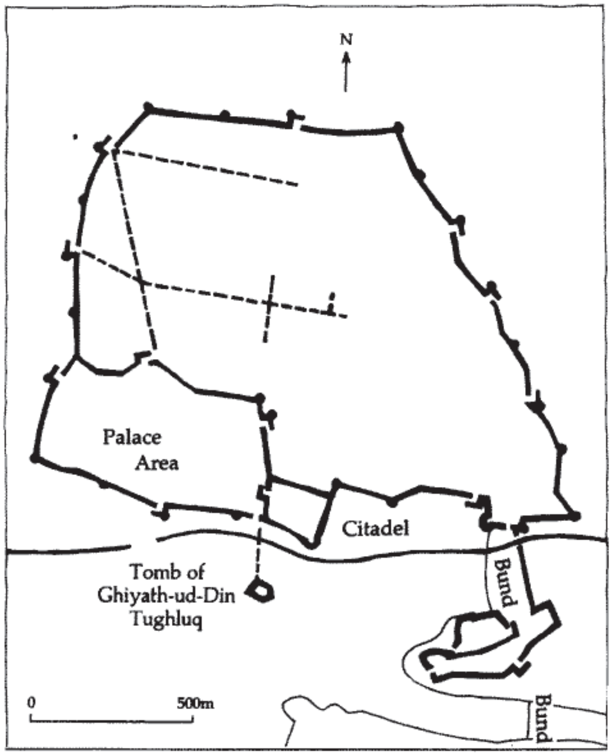

Figure 27.9 Plan of Tughluqabad, Delhi (1321). Source: Petersen 1995.

Muslim house from Roman times to the present day. There is a considerable literature on the architecture and functioning of the house in the Middle East, written mainly by architects (for example: Warren and Fethi 1982), but this is based principally on surviving houses not more than a century or two old. The interesting but static vision of this literature can now be filled out by excavation results to reveal a significant chronological evolution. All the early Islamic houses that have been found are based on the courtyard plan inherited from Antiquity—the eastern Roman empire and the Near Eastern tradition. Even in the eighth century there are some rare cases where it is possible to distinguish a house inhabited by Muslims rather than by Christians—for example a house at the Amman Citadel destroyed with its contents in the earthquake of 747 and excavated by Harding (1951), or the early houses of Fustat (Gayraud 1991). The desert castles of the Umayyad period are characterized by the subdivision of their accommodation into separate apartments, suggesting the complexities of the extended family, and this type of subdivision was carried over into larger town houses, for example at ‘Anjar in Lebanon (715) (Fig. 27.4), or Samarra’ in Iraq (836–92). The specialized room functions found in larger Roman houses disappeared, and were replaced by a simple structure of reception rooms, multiple side rooms, kitchens and store-rooms. It is evident that what are called reception rooms were in fact the living rooms of the house, at least for the men. The form of the reception room in the Middle East became increasingly that of the *iwan,* a hall open on one side to the courtyard, first used in Parthian Mesopotamia in the second century AD. The *iwan* is common in the eastern Islamic world, and in Syria and Egypt, but did not spread to the western Mediterranean. The limitations on space in cities did not permit the complicated plans to be found at Samarra’. The smaller houses of the ninth century have one, two or four *iwans* and a number of side-rooms on a courtyard, as at Siraf in Iran (ninth-tenth centuries), or the levels of the same period at Fustat in Egypt (Fig. 27.10). This type of plan is carried over into thirteenth-century Syria, for example at Mayadine, or the Ayyubid palace in the Citadel of Aleppo. From the eleventh-twelfth centuries onwards, but not before, the installation of stone or brick benches intended to be laid with carpets for sitting on has been commonly observed. Nevertheless, in the smaller houses, there is no trace of the separation of the sexes, such as in a harem— the strict segregation of women was limited to the upper classes.

The picture is much brighter for urban monumental architecture, mainly religious, where this has been preserved within the matrix of later cities. Mosques, *madrasas* (theological schools), and mausolea from the medieval period have been widely preserved (Hillenbrand 1994). On the other hand not many of the palaces and large houses of the political élite have survived, apart from the houses of the Mamluks in Cairo. The political élite being transitory, it was not necessary to preserve the houses of vanished princes. The mosques, *madrasas* and mausolea served an ongoing function in the urban society. While the mosque obviously served as the focal point of the city’s or quarter’s

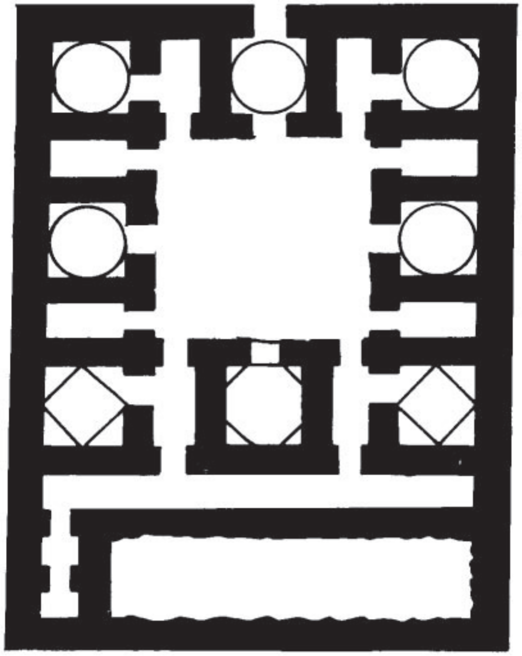

Figure 27.10 Medieval house plan of the pre-Mongol period, Merv, Turkmenistan (twelfth-thirteenth centuries). Source: Petersen 1995.

prayer, the salaries of the *imam* (prayer leader) and muezzin being paid from the state budget or a *waqf* (religious endowment), the institution of the *madrasa,* having appeared in early form probably in the tenth century, has continued to evolve until today, mainly for the training of the personnel who served in the religious institutions. Large numbers of mausolea have survived, either because they were situated outside of the city, and their ruins have been preserved, or because they were situated in the cities and continued to be maintained, being included in the endowment of *mosque-madrasa* complexes, or because they served as the focus of saint veneration. Although this religious architecture served a function within the society, much of it has the names of emirs and sultans on it, to the extent that one recent book has described Islamic art as essentially a royal art (Brend 1991). In part it was the political élite that had access to sufficient capital funds (Lapidus 1967:195–210), but also in an autocratic society it was not always wise for others to be ostentatious.

Trade and production

Several sections of medieval bazaars have been identified in excavation, such as at Siraf in Iran, and at Palmyra in Syria, but it is not possible to conclude much more at present than the simple observation that they were composed of small booths aligned on both sides of a street. In the state-built palace complexes, there is clear evidence of formal market construction composed of long lines of shops along an avenue, as found at Samarra' in al-Mutawakkiliyya (861) and Balkuwara (*c.* 854), and at Lashkari Bazar in Afghanistan (built 998–1030). Allen hypothesizes that a courtyard building attached to the market at Lashkari Bazar may have been intended for the market supervisor, the *muhtasib* (Allen 1990). These formal markets were probably intended for provisioning the army, as individual soldiers would have been responsible for feeding themselves.

The architectural evidence of the traditional Islamic trading system—the urban *khan* which served as an entrepôt for the arrival of a caravan's merchandise, and the caravanserai which served as a stopping point along the traditional high-roads of the Middle East—is rather late in date. Although admonitions to princes to provide halting places in the desert can be found in texts as early as the beginning of Islam, the earliest buildings one can identify as having been constructed as caravanserais may be as late as the eleventh century. The first great wave of caravanserai construction took place in Anatolia under the Saljuqs in the first half of the thirteenth century, and thenceforth the provision for the trains of donkeys and camels that criss-crossed the Middle East became more and more elaborate up to the nineteenth century. Earlier than this time, it may be that accommodation was provided in forts along the road, such as at Or nek to the east of Dzhambul in Kazakhstan (Northedge and Rousset 1995). Surviving urban khans go back to the fourteenth century in Cairo, but it is highly probable that earlier courtyard structures identified in archaeological work served similar functions of storage and exchange.

In comparison to the extensive lists in texts and archives of products traded, the archaeological evidence from excavation remains fragmentary for the moment. Although considerable success has been achieved in identifying products from the Indian subcontinent on ancient Near Eastern sites, such as cloves, a similar level of work for the Islamic period is only just beginning. An interesting comparison for the importation of woods has been carried out on the materials excavated at the port of Qusair al-Qadim on the Red Sea coast of Egypt; in the Roman period many of the wood types were typical of India, whereas in the Islamic period all the types could be accounted for from the Nile valley (Hiebert 1991). Without doubt this difference is an indicator of the activity of one port, for the texts indicate the importance of woods, notably teak, as imports from the Indian subcontinent in Islamic times.

The most extensive work in the domain of trade and production has been done on pottery. Pottery plays a much larger role in excavation finds in the Middle East than in some other parts of the world, because of its quantity and state of preservation even in adverse environmental conditions. Although relatively few kiln-sites have been excavated, more extensive work has been done on the geographical and chronological distribution of excavation finds. It is evident that near the beginning of the Islamic period, probably in the early ninth century, a revolution occurred in the production of finewares, which led to the replacement of the classical tradition of glossy finishes, and the Mesopotamian tradition of monochrome glazes, by polychrome glazed earthenwares (Northedge 1997). There is no doubt that the technical advances made in China a century earlier in the invention of stoneware, porcelain and T'ang three-colour earthenwares *(san-tsai)*—products imported to the Middle East (Rougeulle 1991)—stimulated Middle Eastern potters to new ideas, which then spread rapidly. The new ideas included decorative techniques not thought of in China, particularly metallic lustre painting. Nevertheless over the centuries the new advances which emerged from China, such as blue and white porcelain from the fourteenth century onwards, continued to dominate Muslim taste; for example, fifteenth-century finewares are frequently imitations of blue and white or celadon. In the twelfth century, or possibly a little earlier, a new stonepaste body, of silica with a small admixture of white clay and glaze, was invented to simulate the undiscovered secret of porcelain, and this fabric was used on finewares until modern times.

While Islamic pottery was much exported to East Africa and elsewhere in the Indian Ocean from the ninth century onwards (Horton 1986), the Chinese seem not to have been interested in pottery from the Middle East; however, they did appreciate Islamic glass, which has been found in a number of tombs, and temple treasuries. Although the quantity of Islamic glazed wares found on European medieval sites is not large, the technical superiority of Islamic pottery was appreciated by medieval Europeans, as can be seen in the *bacini,* Islamic glazed bowls which were used to decorate the exterior of two eleventh-century churches in Pisa, and the invitations to *mudéjar* potters living in Valencia in Spain after the *Reconquista* to work in France (Amigues 1992). The interesting point to note is that the technical advances in ceramics made by the Chinese were already having a world-wide effect, if indirect, long before the arrival of European explorers in the Indian Ocean in the sixteenth century.

It is equally interesting to note that excavation has shown that the increasing sophistication in fineware production, concentrated in a few specialist centres, was accompanied by a decline in unglazed commonwares. From the thirteenth century onwards, in the regions of the Arab Middle East, commonwares in rural areas are often handmade, roughly potted, and painted with elaborate primitive designs. A cognate process took place in North Africa, where the modern traditional pottery of Tunisia, Algeria and Morocco reflects a similar evolution, and probably also appeared not earlier than the thirteenth century. It remains controversial why this happened, but it probably reflects the economic relationship between village and city.

Rural settlement and agriculture

Study of the evidence for the evolution of rural society in medieval times has been limited. Many archaeologists have observed that occupation of the land in Islamic times was slighter in terms of numbers of sites than in the Roman or equivalent periods. For example, the UNESCO Libyan Valleys Survey in the region south of Tripoli found many fewer Islamic sites than Roman (Sjöström 1993). Large areas of Iraq surveyed by Adams had no Islamic occupation (Adams 1965, 1981). On the other hand in Syria there are more thirteenth-century sites than Roman ones in some survey areas (Bartl 1994; Northedge 1981).

Watson suggested that importation of new crop types from the Far East may have reduced the land area necessary for cultivation (Watson 1983). The truth is certainly more complex. Nomadic animal-breeding was more important than before. Farmers may have adapted better to the possibilities of the land, and given up the cultivation of steep slopes which were exposed to erosion. Minor environmental changes made different areas more productive. The most important factor, however, was probably security. Agglomeration of settlement into hilltop villages typical of medieval Italy was not possible in the Middle East, apart from in mountain areas. Security was in the fortified town, and the areas which could be cultivated around it. Nevertheless, in the only detailed study of the character of rural settlement made so far, at Khirbat Faris on the Kerak plateau in Jordan, Johns (1994) has concluded that the evidence shows a continuum of occupation in the area from Roman times to the present.

CONCLUSION

This brief survey points to the usefulness of archaeology as a source for the history of Islam. The archaeology of Islam is not the archaeology of a religion, but rather of a single world culture in the same way as Roman archaeology. However, Islam is a much more diffuse culture combining many different geographical regions in a single civilization. Over most of its spread, though not all, it took with it the cultural baggage of its Middle Eastern origins: the architecture, the patterns of living, and the styles of art. It is for this reason that it is possible to compare the fortress-palace of Tughluqabad outside Delhi in India (1321) with the Alhambra at Granada in Spain, developed over several phases in the same century. In the east, it was mainly of Iranian inspiration, though the Iranians themselves drew heavily on ancient Mesopotamia. In the Mediterranean it was principally Syro-Egyptian. The role of archaeology in Islam, as everywhere in historical archaeology, is to explore the alternative visions of the past that material evidence offers, and to fill out the aspects of that past that authors of the time were unable to see, or thought too familiar to explain.

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At the time of writing there are no worthwhile general studies of the archaeology of the Islamic world, or even interpretative studies of particular periods. It is particularly important to have an understanding of the history of the Islamic world: the *Cambridge History of Islam* provides a brief introduction, and the Longman *History of the Near East* series, edited by P.M.Holt, provides sufficient detail for archaeologists. Kennedy (1986) is the best introduction to the early period. For Iran, the *Cambridge History of Iran* is detailed and useful. For Islamic architecture, the most comprehensive starting point is Hillenbrand (1994). For the mosque, a particular but comprehensive approach can be found in Golvin (1974–78). Adams (1965, 1981) provides a classic discussion of long-term patterns of rural settlement and irrigation in Mesopotamia as reconstructed from air photography that includes Islamic settlement, and there are useful papers on settlement issues in G.R.D. King and A.Cameron (eds) *Studies in Late Antiquity and Early Islam II. Settlement Patterns in the Byzantine and Early Islamic Near East* (Princeton: Darwin Press, 1994). Redman (1986) describes the detailed excavation of an Islamic city, and other site-based studies include Hansman (1985) on Julfar, Kiani (1983) on Gurgan, McNicoll *et al.* (1982) on Pella, Northedge (1993) on 'Amman, Sourdel-Thomine (1978) on Lashkari Bazar, Whitcomb (1988) on Aqaba, and Wilkinson (1986) on Nishapur.

28

ARCHAEOLOGY OF THE MODERN STATE: EUROPEAN COLONIALISM

James A.Delle, Mark P.Leone and Paul R.Mullins

The historical archaeology of the modern state examines the various ways material culture is used by the state to generate and reproduce power over its essential creation, the individual. This intellectual enterprise analyses both the construction of the individual as a social unit and the ways power is mediated through the material relationships that exist between the modern state and this defined individual. The construction and reproduction of the individual within the state involves the interplay of two social mechanisms. First is the built environment which enables the state to command its subjects (defined as 'citizens' by the late eighteenth century). Second is a distinct social context which defines how that physical environment is experienced and successfully reproduced. This chapter examines a series of built environments, dating mainly from European colonial contexts, which illustrate how colonial and national states materially and socially reproduced their authority over the individual, whether as a subject or citizen. It is not our purpose here to offer a hegemonic definition either of historical archaeology or of the modern state. It is, rather, our goal to define a problem within the scholarly literature of historical archaeology, thereby unifying much otherwise scattered work done by archaeologists who conduct research on the modern era. We will thus not present an exhaustive survey of the canon of historical archaeology, but rather will examine a coherent research problem through which a set of objects and subjects will be seen more clearly. A further aim of ours is to show how archaeological knowledge can inform us on the creation and perpetuation of the state and its institutions.

Our definition of the relationship between the state and the individual is derived from the work of Michel Foucault and James Deetz. Our arguments build upon Deetz's use of the concept of individualism and on Foucault's definition of panopticism and his dismantling of the lengthy philosophical tradition by which individualism is defined. As anthropological archaeologists, we bring two additional aims to Deetz's and Foucault's projects. The first is to expand the traditional definition of historical archaeology. We believe it is profitably understood as the archaeology of the modern state, its institutions and political economy. This enterprise therefore entails an analysis of the mechanisms of surveillance and the social definition of the individual. We hope to demonstrate that state mechanisms operate in common ways regardless of whether they were employed by the Spanish, French, Dutch, British or North American state authorities.

MECHANISMS OF SURVEILLANCE: THE PANOPTICON, THE BAROQUE, AND SURVEILLANCE INSTITUTIONS

Modern states use a variety of mechanisms through which centralized authority is created and reproduced. For the purpose of this chapter, we will consider two such mechanisms whose logic of control was based on surveillance, and which left distinctive imprints in the archaeological record. The first of these is actually the later phenomenon: the panopticon and the related ideal of panopticism. We will then consider the antecedent to panopticism, the baroque architectural order, as a type of surveillance mechanism crucial to understanding the material manifestations of the authority of colonial states in North America and beyond.

We begin our discussion of surveillance mechanisms with the concept of panopticism. In the late eighteenth century, Jeremy Bentham theorized and designed a building he called the panopticon. In Bentham's ideal panopticon, one centrally positioned person could watch everyone held in an institution's care or custody. Panoptic buildings have several characteristics crucial to the creation and maintenance of state power. At the periphery of Bentham's idealized panopticon was a circular row of cells oriented towards the centre of a circular or octagonal building. Each cell had two windows or sets of windows, one set orientated towards the centre of the building, the other facing outwards. At the centre of the building was situated a separate tower or platform with windows facing towards the row of cells. From the tower a supervisor could see into every cell in the complex, with the cells' outer windows backlighting each individual occupant (Foucault 1979). The ceiling of the central part of the building was open, or featured skylights, lighting the interior of the structure (Fig. 28.1). The panopticon makes greatest sense when viewed from within. The panopticon inverted the dungeon's imprisoning principles of darkness and solitary enclosure by using light and constant visibility to confine the individual in each cell. While the guardian in the central tower could see into every backlit cell, the occupants could not see anyone except their watcher. Each inmate, patient, student, or worker in a panoptic complex was thus impressed with a 'conscious and permanent visibility'. Escape plots between prisoners,

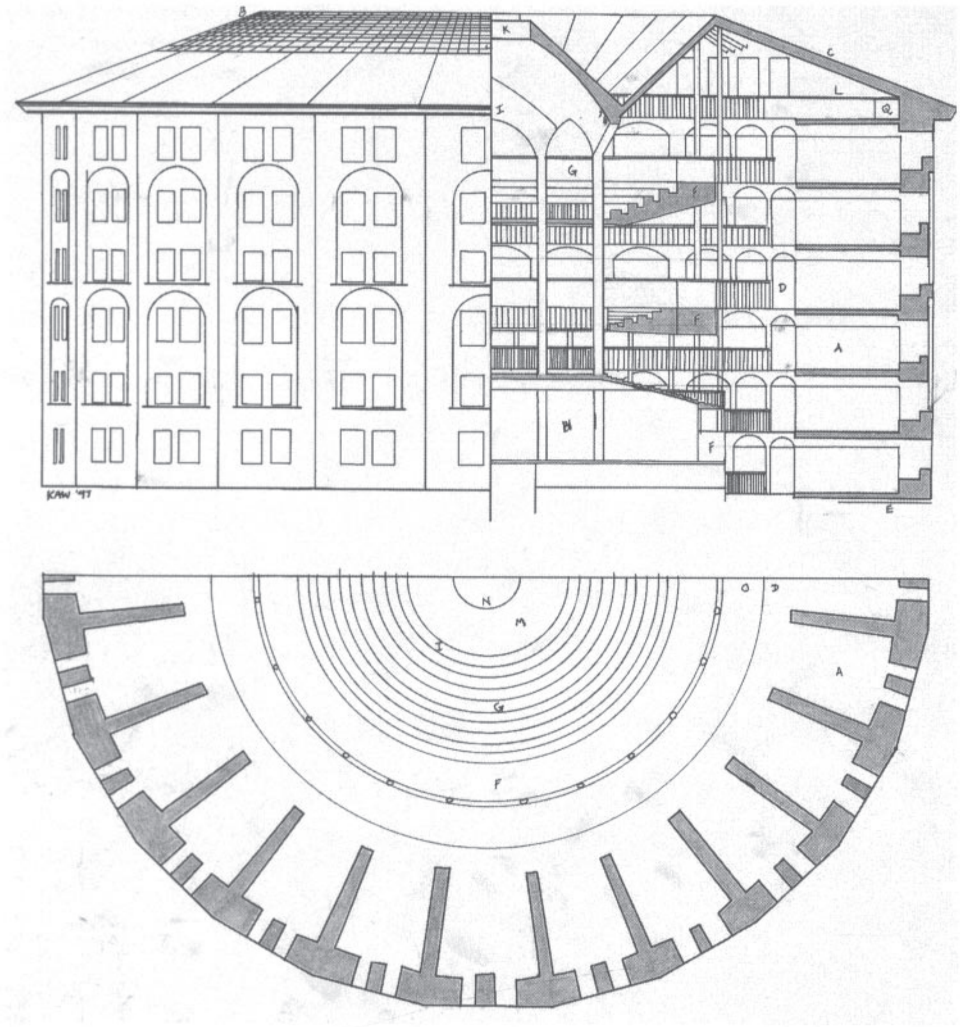

Figure 28.1 Jeremy Bentham's plan for the ideal panopticon, first published in 1790. Note the orientation of the cells towards the central tower, the backlighting provided by the pairs of windows in each cell, the circular shape of the building, and the huge skylight, all elements underscoring the importance of the watcher's gaze. Source: P.Kaw.

contagion spread among the sick, and the threat of violence among the insane were to be eliminated by the separation of the masses into individual spaces characterized by a solitude dominated by the tower's visual omnipresence which reminded each occupant that s/he could be observed at any moment (Foucault 1979).

In North America, the panopticon was widely used throughout the early nineteenth century for a number of purposes; numerous panopticon forms were developed to fit specific surveillance contexts. Some examples of these buildings still exist, while others exist only in the archaeological record. The most obvious panoptic form is the prison (Fig. 28.2). More subtle examples include octagonal buildings, national libraries such as the Parliamentary Library in Ottawa and the reading room in the United States Library of Congress, and university libraries. Grade schools, hospitals, and some churches used the panopticon as a model (Fig. 28.3). When the panoptic principle is illuminated in each of these apparently dissimilar contexts, it becomes evident that surveillance of people's behaviour was employed on a very wide scale by institutions controlled by, or inherent in, the state.

Foucault's analysis of surveillance institutions elaborated on Bentham's model. By philosophically placing himself in the mind of the observed, Foucault was able to portray

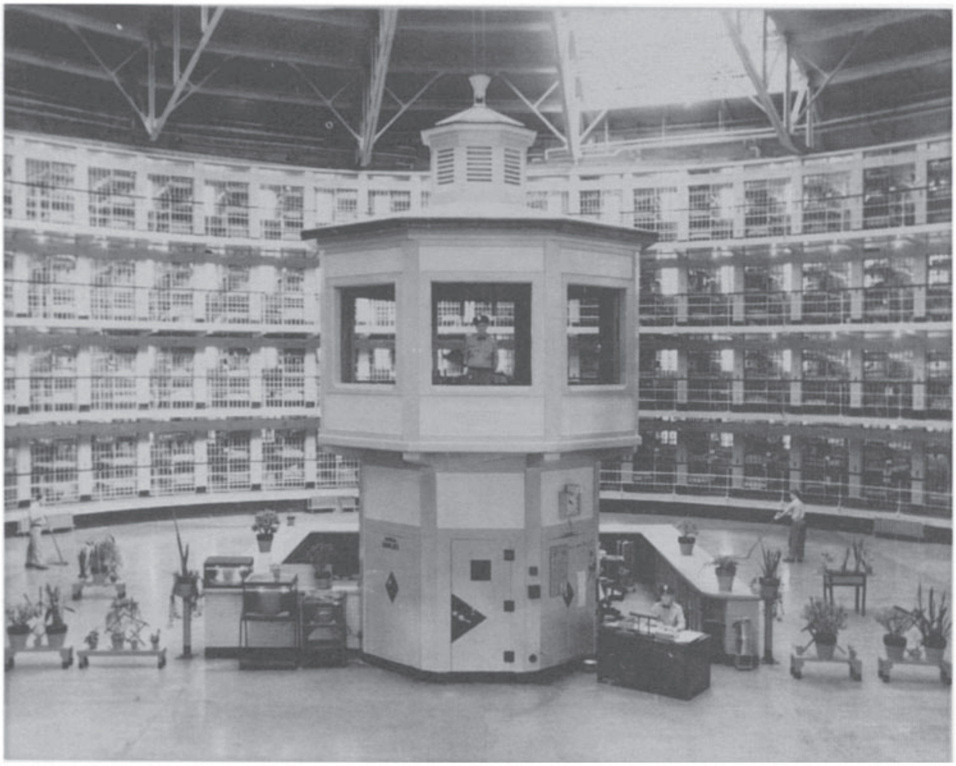

Figure 28.2 Illinois State Penitentiary: several key elements of panoptic surveillance are visible, including the central guard tower, backlit cells and polygonal skylight. Courtesy: Illinois Department of Corrections.

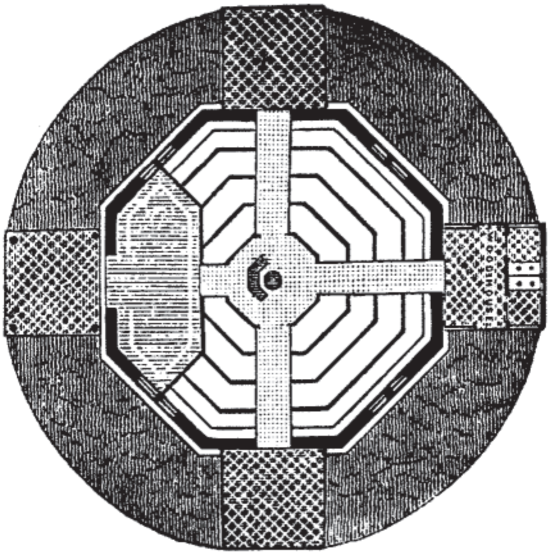

Figure 28.3 Plan of rustic octagonal schoolhouse, designed so that panopticism could be used to control the behaviour of young scholars (the dark circular area represents an exterior pavement). Here, scholars' chairs could be swivelled to face the schoolmaster at his central desk or the blank wall. Either way, the pupil would be subject to the teacher's gaze. Reproduced by permission of the publisher from J. and R.McClintock (eds), *Henry Barnard's School Architecture* (New York: Teachers College Press, © 1970 Teachers College, Columbia University. All rights reserved), Figure 12, p. 137.

the observed as capable of imagining the process through which s/he was being watched. Bentham's placement of a tower at the centre of the panopticon provided a platform from which such a watcher could operate. Foucault realized that power over inmates was not exercised so much from the tower, but from the impact the tower had on the mind of the person who imagined s/he could be viewed from it. Foucault recognized the psychological process whereby the watched became inured to an imagined discipline which produced the kind of behaviour desired by the watcher. Once Foucault made this connection, he quickly saw that there needed to be no consistent gaze from the centre, only the suspicion of one. Such observation sustained from within is the key to the panoptic discipline which was employed simultaneously as state- and self-scrutiny, or what Foucault called surveillance (Foucault 1980). Foucault defined critical surveillance phenomena of panopticism 'gaze' and 'interiorization' (Foucault 1980:155). Gaze, or observing social agents in order to normalize or control their behaviour, was nothing new to the eighteenth century. Indeed, monumental baroque architecture always contained some element for observing society (Foucault 1979:216). However, the interiorization of the panopticon's gaze, to be observed not simply by something external but by the self, was a quite new form of surveillance of the individual in which subjects became their own disciplinarians.

Foucault's greatest insight into modern disciplinary principles stemmed from his analysis of panoptic architecture. Foucault argued that Bentham's panoptic prison was evidence of an eighteenth-century shift in built forms, from architecture which commanded authority through visibility to built spaces which addressed 'problems of population, health and the urban question' (Foucault 1980:148). Examples of such built spaces include prisons, hospitals, schools, sanitariums, and the urban street plans which linked such institutions. During the eighteenth and nineteenth centuries, many of these institutions throughout the world copied or adapted the panoptic principles which Bentham outlined. Often they did so by modifying earlier baroque architecture which was also built to solidify state authority by calling the individual's attention to it.

The immediate antecedent to panopticism was the baroque order. Expressed through a style of architecture, interior decoration and exterior urban and rural landscaping, the baroque order is a combination of political theory and created physical environment. Baroque theory attempted to address the issue of how to sustain a public hierarchy within the state when there was a conflict between the actual existence of many centres of wealth, but a desire for one centre of power. At the core of baroque theory was a tension within the state's attempt to create uniform loyalty in a world which featured many actual sources and centres of power. From this tension emerged a discourse centred on the individual as subject to the state. The ideal mechanism of the baroque state was the dual acceptance by subjects of personal liberty and submission to a central authority, whose place at the head of the social order was, to both the state and the subject, self-evident. By the late eighteenth century, the baroque theory of society had become ineffective. Baroque states had failed to maintain the loyalty and discipline they required of their subjects. In the closing decades of the eighteenth century the baroque was succeeded in some places by its own creation: a panoptic view of the state with a particular definition of the individual as citizen.

We agree with the now nearly standard definition of historical archaeology as the study of the material culture of European colonial expansion, a phenomenon we believe was integral to the development of the modern state (Deetz 1977, 1991). Because colonialism is, in essence, a discourse of power, we are concerned with the institutions through which power was negotiated by the colonizing state. Colonialism is a process which assumes the expansion and maintenance of state control over subjected areas and peoples. This process therefore produced a panoply of both baroque and panoptic manifestations which ranged in form from missionary compounds, forts, plantations, frontier schools, mining machinery, haciendas and ranches, and factory clock towers. Many of these built environments incorporated a tower—bell tower, clock tower, watch tower, anthracite breaker (Fig. 28.4) — from which a person could see panoptically and which could be seen from many directions around. These institutions are normally described as functionally distinct,

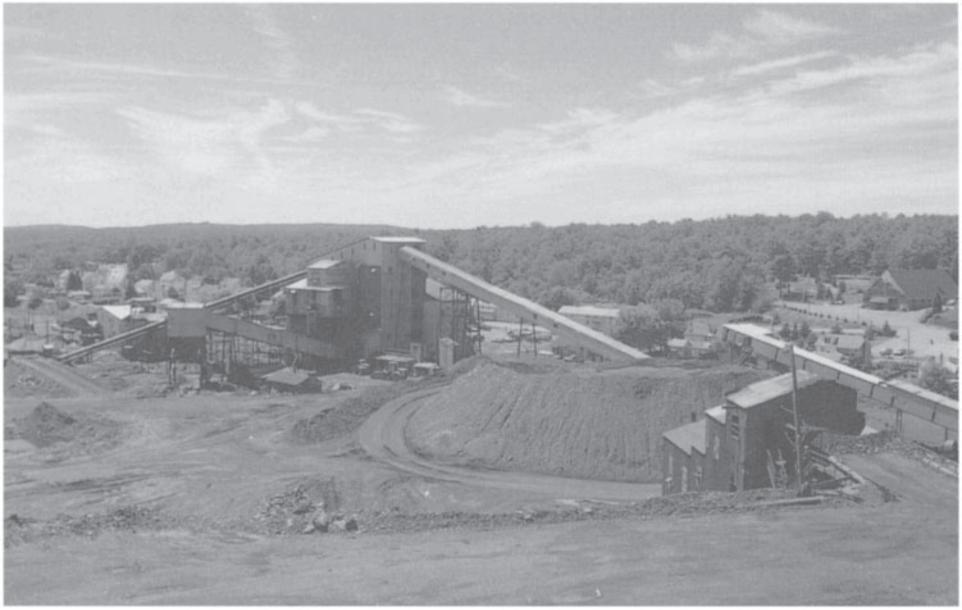

Figure 28.4 A late nineteenth-century anthracite coal breaker from Pennsylvania: from the upper stories of this building, mine supervisors could observe activities occurring in the yard, the railroad loading area, and in the nearby town. © Pendor Natural Color, Dartonsville, PA, USA.

yet each possesses the possibility of watching and inculcating among the population the capacity to imagine that each individual is constantly being observed. It is this internal observation that is the consistent panoptic effect in the republican state of all these otherwise disparate institutions.

HISTORICAL ARCHAEOLOGY IN THE CHESAPEAKE REGION

The Chesapeake Bay region, as thoroughly excavated as any region in colonial North America, offers a useful archaeological illustration of both baroque and panoptic mechanisms of state power. Historical archaeologists of the Chesapeake have established the relationships between buildings in topographic space, and have established reliable chronologies among them and their planned landscapes—landscapes often marginalized, abandoned, or built over during the later evolution of the modern state. Out of the material recovered from the numerous excavations conducted in the Chesapeake, we can examine how urban plans, everyday ceramic tableware, and formal gardens can reveal key transformations in the relationship between material culture and state authority.

Material forms which simultaneously commanded and observed people were included in numerous seventeenth-century North American settlements. In the Chesapeake, examples include the church tower at Jamestown, Virginia, the 1676 statehouse in St Mary's City, Maryland, the 1660s baroque town plan of St Mary's, and the 1694 baroque plan of Annapolis, Maryland (Miller 1988; Shackel 1994). All are examples of material forms built to command people's attention. These architectural examples were associated with the effort to manifest church and state authority. Without the weight of other forms of surveillance, these towers and cityscapes were essentially restraining mechanisms which could not alone create the effect of interiorization. Their 'gaze' tended to act only on the level of the social group, like the ancient amphitheatre; that is, they did not really monitor individuals, rather they watched the entire undifferentiated social body. Perhaps more importantly, their gaze was part of a broad range of practices which patrolled society through physical violence and harsh socio-economic penalties. Consequently, Jamestown's church tower and Annapolis's statehouse reminded people they were being monitored and regulated by a powerful institution, but there remained numerous spaces in which to hide effectively from this gaze.

The urban plans of St Mary's City and Annapolis, both cities located in Maryland, provide a suggestive indication of the shift from a generalized state observation to interiorized individual discipline. St Mary's City became Maryland's capital in 1634. The predominantly Catholic settlement remained the state capital until 1694, when it was moved to Annapolis in the wake of the Glorious Revolution. The capital city was a small settlement; historians have generally, though wrongly, assumed that it was an unplanned colonial frontier town. In contrast, Annapolis was intentionally designed by Maryland's second royal governor using typical baroque planning principles. The baroque urban plans of European cities used institutions of symbolic significance in positions which were emphasized visually through geometric approaches (e.g., long streets) and positioning (e.g., high points). In Annapolis, the church and statehouse were seated within two neighbouring circles on the town's highest points, with streets radiating out from the circles (Fig. 28.5). These two seats of power were visible from everywhere in Annapolis, much as they were in contemporaneous baroque European cities (Shackel 1993, 1994).

Despite their apparent differences, the two Maryland cities were both planned to enable surveillance. Extensive archaeological investigations at St Mary's City indicate that key elements of the city's layout were taken from baroque urban design principles (Miller 1988; Shackel 1993). In an apparent contrast to baroque European cities, St Mary's had only a few dozen buildings prior to the 1660s. During this era, the town's centre featured four wooden structures: two taverns, a lawyer's home and office, and a building that doubled as a government meeting place and inn. In addition to these wooden buildings, the St Mary's town centre had four brick structures. Two of those, the chapel and statehouse, were exactly a half-mile apart, with each structure 1,400

Figure 28.5 The 1718 Stoddert survey of Annapolis, as redrawn in 1743; the baroque order is apparent in the layout of the city. Reproduced with permission of Maryland State Archives.

feet from the town centre. The other two brick buildings, a prison and a Jesuit school, were an equal distance from the statehouse and chapel respectively, roughly 800 feet. Consequently, the early capital was laid out on two symmetrical triangles extending from the town centre, with a symbolically significant brick structure at each corner and principal roads leading to these corners (Miller 1988:65–66; Shackel 1994). It is unlikely that this landscape alone produced enough conscious apprehension that people interiorized surveillance to become their own disciplinarians. The long-term impact of the city plan remains enigmatic as the city was abandoned as Maryland's capital soon after its initial layout. The plan never was linked with surveillance forms related to eighteenth-century transformations in, for instance, class dynamics (Isaac 1982) or discourses on individuality (Shackel 1993).

The construction of church towers or street plans could not alone produce the type of interiorization that Foucault recognized in late eighteenth-century Europe.

Foucault argued that such an internalization of personal control required a dense network of mechanisms that conditioned both the social whole and the individual existing within that whole. While urban plans and clock towers like those in St Mary's City monitored the social body, eighteenth-century institutions developed mechanisms like school training and personal etiquette to discipline quotidian behaviour. It is the distinction between societal and individual surveillance that characterizes the difference between baroque and panoptic disciplinary mechanisms.

Even so, St Mary's is suggestive of the directions that individual surveillance would take into the eighteenth century. In addition to the hallmarks of colonial authority, the plan's symbolically important points included a prison, a Jesuit school, and a cluster of public taverns. While the church, state, and prison are primarily repressive institutions, the school is typical of institutions which would come to regulate society from within rather than from above (Foucault 1980:39). For Foucault, the shift from the infliction of repressive penalties to the willing self-discipline of individuals was critical to understanding the exercise of power in the eighteenth century and beyond. We suspect that such a transition to the self-disciplined individual had already begun at St Mary's.

Annapolis's 1694 city plan was larger and somewhat more complex than the plan for St Mary's, but it too was based on principles which used perspective and topography to stress symbolically important points. In Annapolis, church and state circles were built beside each other, integrating their interests and blurring distinctions between political authority and religion. In Annapolis's plan, the state was projected as a union of those two forms. At St Mary's, church and state were spatially alienated at the furthest reaches of the plan, despite their symbolically significant positions. Perhaps a more critical difference between the two plans was the position of the school and prison, two modern surveillance institutions which ultimately depended upon the definition of individual citizenship. While the St Mary's plan accorded significant, separate positions to the school and prison, the Annapolis plan subordinated both to the state by placing them along a street like a house or a business. Prisons and schools were certainly as important to the development of discipline in Annapolis as they were in St Mary's, yet their unobtrusiveness in the Annapolis cityscape may have made their disciplining power seem less repressive.

The emergence of surveillance institutions certainly promoted the technologies of individualism, yet the seemingly organic and even innocuous appearance of jails, schools, and asylums was dependent upon changes in everyday material culture: domestic architecture and standardized tablewares are the sort of objects which projected surveillance technologies into everyday life, thus acting as mechanisms through which discipline was internalized by individuals. For example, historical archaeologists of the Chesapeake have recently shown how portable material culture, particularly ceramics, played a part in the construction of individualism, and thus can be interpreted as a form of surveillance mechanism. At the turn of the eighteenth century, the American colonial gentry began conspicuously to consume material goods, a phenomenon which distinguished them as the dominant class. Conspicuous consumption was part of an elaborate set of mutually dependent material and social discourses which separated the élite from the lower classes and situated their power in a presumed natural order (Leone 1988). Explicit behavioural rules defined personal interaction, dining, and material presentation (Shackel 1993). For example, élite tables were set with an elaborate material assemblage, including forks and knives, individual ceramic dishes intended for particular functions, and certain types of food. All these items were associated with specific rules. Deetz was the first archaeologist to explore these relationships, which had not been noticed by many other scholars, principally historians (Deetz 1977). Following Deetz's work, it became possible to understand why ordinary colonial farmers used globes and maps, or a telescope, sextant and a clock, to explain the world and divide it into orderly units. Historical archaeologists have been the first to notice these many connections and to tie them to prevailing notions of individualism (Leone 1988).

There are two components to the logic that connects tableware, tea ware, furniture, room patterns, disposal patterns, gravestone decoration, landscapes, and scientific and musical instruments to the concept of individualism. The first, and the one emphasized by Deetz, considers that the forms of all these things change when people see themselves as separate from all others, as potentially equal, or having histories, futures, and rights (Deetz 1977). Each individual sees himself or herself as a distinct individual when items like these become equal, contain separate functions, are segregated, stress achievement, or are used to illustrate control over natural principles. Second, in use, these objects produce people who believe they are separate, have special knowledge, are meritorious, and deserve a place in a natural order, but who are in fact rule-abiding and thus, from the perspective of the state, profoundly interchangeable.

The ambiguity produced by individualism can be appreciated through an analysis of eighteenth-century Chesapeake landscapes. Mid-eighteenth-century architecture was one mechanism used to distinguish the gentry while promoting social deference to the gentry's 'natural' right to rule society, and did so through the use of the idea of individualism. This may be nowhere more evident than in the architecture of élite gardens (Kryder-Reid 1994; Leone 1984, 1988). For example, in the 1760s, the Annapolitan lawyer William Paca built a Georgian home at the top of a 'pleasure garden' (Leone 1984, 1988). Paca, who would later sign the Declaration of Independence and become a prominent constitutional lawyer, was one of a series of Chesapeake gentry who built such formal gardens during the late eighteenth century. The gardens were characterized by rolling topography (i.e., flat terraces alternating with sloping falls) and carefully manicured spaces which distort optical perception within the garden. The gardens contain shrubs, trees, some exotic plants, ponds and fountains arranged in geometric forms reflecting the symmetry of Georgian architecture. The expression of distances and the relative size of objects in the garden is distorted visually by the effect of the topography, prominent features (e.g., gazebos, houses, vegetation), and shades of green in the vegetation which manipulate the impact of lines of sight on a visitor. Although the style itself was originally most popular in England beginning a century earlier, a series of such gardens was built in eastern Maryland, including a dozen in Annapolis alone (Leone and Shackel 1990). Hundreds of gardens were built in the Chesapeake during this period; hundreds more were built throughout the British North American colonies.

Formal gardens created two fundamental ideological effects. First, they ordered nature in a specific way, and, second, they constructed a distinct past for that nature. The ordering of nature included systematic observation done in the garden, enabling the gardener to predict natural growth cycles. This ability to deploy precedent, control optical relations, and display that comprehension in the garden created a social space which displayed a class's ability to order time and nature. Second, the gentry hoped that members of other classes would see the garden as a metaphor linking their owners to a postulated right to rule others. Gardens linked a tangible understanding of natural law to the enaction of that law in everyday social relations. Gardens were thus a material mechanism to legitimize class relations because they were intended to promote underclass deference to gentry decision-making grounded in natural law. They were one of many efforts to project class authority onto nature itself and further the notion that the gentry possessed a specialized knowledge which was necessary to administer society. Such means of social control required the attention of the individual subject; since the master's view was returned, the double looking found within baroque and early modern institutions offers a prelude to classic panopticism.

DISCIPLINE AND PLANTATION SLAVERY

The political economy of the Chesapeake, as was the case in much of eighteenth-century North America, was driven by plantation production. During this time plantations were worked by slaves, managed by overseers who were sometimes slaves themselves, and owned by people who ranged from the phenomenally wealthy to those who were slightly less than wealthy. The larger plantations were run by a regime of terror, violence, and overwork. These were exploitative colonial institutions, based on the crudest abuse of human beings. Most eighteenth-century plantations employed baroque principles embodied in both architecture and landscape on the one hand, and in a quest for absolute hierarchy on the other.

We have dealt so far with baroque settings in which the members of all classes were nominally considered to be free. In these settings there were slaves from place to place and from time to time, but we have not argued that they were included in the designs of baroque planning. We therefore cannot definitively demonstrate the effects this ostentatious kind of rule had on enslaved populations. We can, however, suggest how both baroque and modified panoptic principles were installed in the material culture of slave-based plantation agriculture. In doing so, we must deal both with violence and with a kind of explicit surveillance that itself could lead to acts of violence. Plantations do not incorporate panoptic surveillance in the truest sense, which presupposes either common citizenship or common values, but they do demonstrate how the architecture of baroque hierarchy and the deliberately focused gaze of surveillance institutions acted as a modified form of panoptic discipline.

The intentions and effects of treating a large segment of society neither as individuals nor citizens are nowhere better expressed than on agricultural plantations. The design and management of plantations were largely baroque, even into the nineteenth century, but, we argue, came to include some of the surveillance disciplines of panopticism. For our purposes, we follow Orser's definition of 'plantations' as economic institutions which exist primarily to increase the wealth of the plantation owner or owners through agricultural production. The plantation is further defined by its distinctive power relations between owners, defined as planters, and its primary producers, who may either be wage labourers or slaves. The social relations between the two groups are best understood in terms of class relations, often reproduced by a socially created racial hierarchy, through which the planters extracted surplus through the exploitation of the labour power of the workers. Defining the relations between the two groups are the dialectics of discipline and resistance: the planters attempt to create a disciplined workforce while the workers resist the inequity promoted by those disciplined social relations (Epperson 1990, forthcoming; Orser 1988a, 1988b, 1988c).

Discipline among plantation slaves was in part created through the public spectacle of corporal punishment, a means of discipline which the later panoptic ideal hoped to replace (Foucault 1979). Slaves were required to perform specific tasks at specific times; both work and social routines were imposed upon them. If an individual failed to keep the specified regimes, s/he could be the victim of physical torture. In the case of West Indian sugar plantations, that punishment could come in the form of flogging, being held in 'bedstocks' (i.e., literally with the feet held in a stock at the end of a bed), or having an iron mask or collar secured over the head or neck to prevent drunkenness or geophagy ('dirt eating'), a disorder brought on by malnutrition.

Crippling punishment was a crucial form of plantation discipline regulated by the state but dispensed by local planters. As colonial plantations were an integral part of pre-industrial European states, the state regulated the type and severity of punishment to be meted out to slaves (Epperson 1990:29; Tomich 1990:242). Despite attempts at state regulation, the individual planters and their agents exerted great control over disciplining their own labour force. For example, Matthew Lewis, a Jamaican planter who knew both Coleridge and Goethe, reported in his published journal that he implemented a code of laws upon one of his plantations which included a registry of punishment (Lewis [1834]1929:195). A passage in Lewis's journal underscores the relation of punishment to the work expected by the plantation labourer. During one of Lewis's absences, several injuries against the plantation were committed. In the first, a slave referred to as Hazard stole sugar from a second slave named Frank who had previously stolen the sugar from the plantation boiling-house. The resolution of this conflict came when 'Frank broke Hazard's head, which in my opinion settled the matter so properly, that I declined spoiling it by any interference of my own' (Lewis [1834]1929:315). Lewis reports that no action was taken against Frank despite the fact that he had both stolen sugar from the plantation and apparently killed another slave. In a second incident, which Lewis refers to as being 'more serious', a slave named Toby refused to load sugar cane onto a cart. Lewis reports that as a result the sugar processing for that day had stopped. Of the two incidences the latter was considered to be more serious, as the action taken by Toby threatened the labouring discipline of the plantation, and in Lewis's words 'amounted to an act of downright rebellion' (Lewis [1834]1929:316).

The punishment dealt to Toby demonstrates how the planters attempted to internalize discipline among the plantation workforce. During the Easter holiday, a time during which the slaves were allowed to celebrate with salt-fish, rum, and sugar dispensed by Lewis, Toby was confined in a small room within earshot of the raucous festivities. Upon his release the following Monday, other slaves began to 'censure his folly…advising him to humble himself and to beg [Lewis's] pardon' (Lewis [1834]1929:316). Upon being humiliated by his fellow workers, Toby returned to work. Thus, at least according to Lewis's account, the individual, in this case Toby, experienced a humiliation by breaking the social code of the plantation as defined by the planters. The scorn that Toby faced, reinforced by his ostracism from society during his confinement, was a mechanism through which Lewis hoped Toby would become a self-regulating, disciplined worker. This is a fundamentally different kind of discipline from inflicted violence.

The plantation was a distinct type of surveillance institution in which planters attempted to supervise ('oversee') completely the lives of the workers. There was considerable variation in the disciplinary strategies adopted by planters, depending on the intensity of cultivation and the labour requirements demanded by specific plantation crops. For example, historical archaeology has informed our knowledge of material and social relations on seventeenth- and eighteenth-century tobacco plantations near the Chesapeake Bay (e.g., Carson *et al.* 1981; Deetz 1977, 1988; Epperson 1990; Hudgins 1990; Kelso 1984, 1986; Klingelhofer 1987; McKee 1987; Neiman 1978; Noël Hume 1982; Pogue 1988a, 1988b; Reinhart 1984; Upton 1985, 1986, 1990). The historical importance of tobacco plantations is reflected in the simple reality that four of the first five United States presidents were tobacco planters (Carson *et al.* 1981; Menard *et al.* 1988:185). Historical archaeology has played a significant role in interpreting seventeenth-century Chesapeake plantations, primarily because few of the wooden buildings that characterized Chesapeake architecture remain standing for traditional architectural analysis. Seventeenth-century buildings in the Chesapeake were generally of impermanent, earthfast timber construction; no more than six such structures remain standing (Carson *et al.* 1981).

To be effective over a large population, however, not all forms of plantation discipline could be physically coercive; many strategies relied on panoptic surveillance. The most evident material expressions of such strategies on tobacco plantations are the relationships between the landscapes of the planters and the landscapes of the slaves (Upton 1988). Chesapeake tobacco plantations were generally isolated and self-contained communities which Dell Upton has likened to a village, with the planter's house serving as the centre of power. As a centre of administrative and economic power, the planter's house was both physically and socially elevated above other buildings and was physically separated from the surrounding countryside by systems of terraces and fences. Plantation houses were intentionally constructed to dominate the landscape. Philip Fithian, a tutor employed at Nomini Hall, reported in his journal that the plantation house could be seen from a distance of six miles. By the late eighteenth century, plantation houses like Thomas Jefferson's Monticello were constructed to command an enormous view of the landscape, to both see and be seen (Upton 1988). The effect of such a spatial division was that both slaves and masters shared an attitude about the possession of space (Upton 1988:367). This afforded some measure of spatial proprietary rights to the slave. For instance, Upton reports that Fithian was obliged to pay a forfeit to several slaves for trespass. Yet such a shared consciousness, if it did indeed exist, reified the work discipline of the plantation because the space that planters and slaves acknowledged as the domain of the slaves included the work spaces: bakeries, blacksmith shops, fields, and so on (Upton 1988:367). This spatial division of the plantation created a disciplined labour force out of enslaved people by internalizing and naturalizing the social and racial hierarchies embedded in plantation production.

By the middle of the nineteenth century, the cotton plantation had replaced the tobacco plantation in relative economic importance in North America. The importance of the cotton plantation has not been lost on historical archaeologists, who have studied both pre-emancipation and post-emancipation plantations (e.g., Adams and Smith 1985; Ascher and Fairbanks 1971; Fairbanks 1974; Moore 1985; Orser 1988a, 1991; Orser and Nekola 1985; Otto 1977, 1984; Reitz *et al.* 1985; Singleton 1985a, 1988). The archaeology of cotton plantations in the American South can be divided along a common line drawn in United States history, the *antebellum* and *postbellum* periods (i.e., before and after the American Civil War). This historical division is significant, for both the relations of production in the American South and the power of the United States federal government *vis-à-vis* the individual states changed dramatically with the defeat of the Confederate States of America and the concomitant abolition of slavery in the United States. Taken together, two influential works of historical archaeology, Otto (1984) and Orser (1988a), can shed light on how our interpretations of surveillance mechanisms defined social relations on *antebellum* and *postbellum* cotton plantations.

Otto excavated an *antebellum* cotton plantation, Cannon's Point, which is located on one of the barrier islands off the Georgia coast. Otto infers that, taken collectively, plantations which existed along the stretch of the coast between South Carolina and northern Florida constituted 'a distinctive environmental zone, cash crop region, and cultural area of the Old South' (Otto 1984:9). According to Otto, because this 'cultural area' was distinguished by labour-intensive large-scale rice and cotton planting, only the larger plantations were economically successful. Otto builds this argument by examining and comparing the houses and middens of slaves, an overseer, and the planter at Cannon's Point, offering a site-specific study of a stratified society which he considers a microcosm of the *antebellum* cotton plantation south. The plantation's material division of space defined the relationship between Otto's three status groups (i.e., planter-overseer-slave). The planter's domain, which Otto defines as the 'administrative and technical nucleus' of the plantation, consisted of the planter's house, kitchen, cotton houses, and store houses (Otto 1984:13–14). According to Otto, the family who owned the plantation, the Coupers, were considered to be 'conspicuous consumers' by their planter peers (Otto 1984:127); that is, they expressed their power and status through the purchase and display of material culture. The house in which the family lived was 'a massive 2 1/2-story frame structure' with as many as ten rooms and as much as '1786 square feet of living space, excluding stairways, basement, and loft' (Otto 1984:132).

The domestic space over which the planter exerted direct control included a detached kitchen, which was separated from the great house by approximately 20 metres. While the distance between the structures can be partially explained by the desire of the planter to remove the smells and sounds of cooking from the immediate living space and to limit the danger of fire to the great house, this can also be seen as the intentional distancing of a work space dominated by slaves from those they served, underscoring the social distance between the cook and her staff and the planter, his family and guests. The cotton gin houses in which the crop was prepared and stored for export were within 30 metres of the great house. The proximity of this industrial space to the planter's domain allowed the planter direct surveillance of the crop as it was prepared for export down the river which fronted the house (Otto 1984).

Otto suggests that surveillance technologies were used by the planters to create a status hierarchy among the slaves. Drivers responsible for assigning daily tasks had the power to punish their fellow slaves and carried the symbol of their disciplinary authority, a short whip with a heavy handle. During the excavation of Cannon's Point, one of the eight slave houses examined differed from the others by being set on brick piers rather than on sills lying on the ground. It had a plank rather than a dirt floor, and the cabin was somewhat larger than the other cabins on the plantation. Otto suggests that this dwelling may have housed the drivers and their families. If Otto's suggestion is correct, then this house would be a visible material representation of the extended disciplinary power required to run a slave-based plantation (Otto 1984).

It was the ultimate responsibility of the overseer to establish and maintain discipline over the enslaved labour force; similar surveillance mechanisms were thus used to mediate the relationship between these men and the enslaved population. For example, Otto reports that the overseer's house at Cannon's Point was situated approximately half-way between two groups of four slave cabins. The size and form of the overseer's house more closely resembled the great house than the slave quarters—not surprising considering that William Couper, one of the sons of the planter John Couper, served as overseer for a time at Cannon's Point. Otto reports that the overseer's house at Cannon's Point had exterior dimensions of 34 by 36 feet, and the interior was divided into four rooms each measuring 12 by 15 feet, plus a central hall, providing about 790 square feet of living space (Otto 1984:99). While not nearly as massive as the great house, the one and a half storey overseer's house would have stood in stark and imposing contrast to the small slave cabins which would have housed as many as ten people. The symbolic expression of power and authority vested in the overseer and displayed to the field slaves provided everyday reminders that they were under someone else's authority (Otto 1984).

In contrast to Cannon's Point, which was abandoned before the Civil War, Millwood Plantation, located along the border between South Carolina and Georgia, operated during both the *antebellum* and *postbellum* periods (Orser 1988a). The planter-owner of Millwood plantation was James Edward Calhoun, a well-connected member of the southern élite. As early as 1833, Calhoun began the system of plantation tenancy which would become the dominant regime at the plantation after the Civil War (Orser 1988a). The defeat of the Confederacy forced planter élites like Calhoun to reorganize their system of production and élite/ labourer relations. According to Orser, although the planters were confused and frightened about their future after the war, there was general resolve not to transfer plantation ownership to the emancipated slaves. As a result, several strategies of labour extraction were established, including farm wage-labour and systems of time and crop sharing. During the years following the war, the South Carolina élite created new systems of discipline at both the state level, through the establishment of a so-called 'Black Code', and on the level of the individual plantations. The Black Code, established in 1865, legally restricted the movements and labour of black workers and their families. Individual planters entered into contracts with labourers which sought to construct a labour discipline that would be beneficial to the planter (Orser 1988a, 1991). Two classes of tenancy resulted: renting and share-cropping. A legal distinction was made between renters and sharecroppers *vis-à-vis* the crop they produced, with renters considered legal owners of their crops and sharecroppers merely cultivators of a landlord's crops (Orser 1991).

The restructuring of labour resulted in the restructuring of plantation settlement space, which has been discovered archaeologically (Fig. 28.6). Unlike *antebellum* plantation settlements which put a premium on both physical violence and the direct

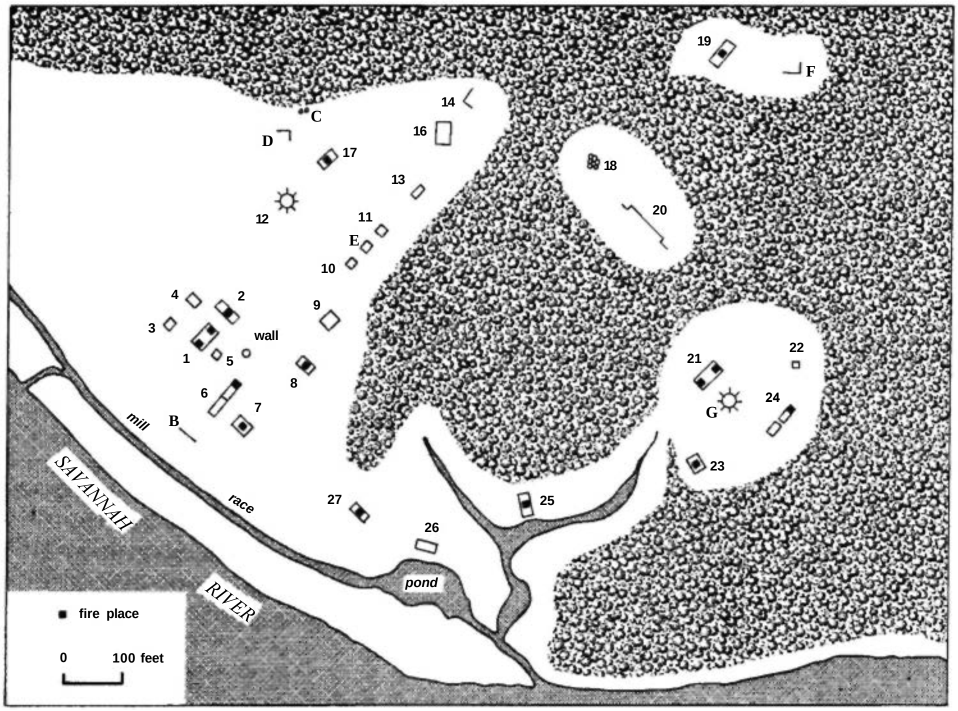

Figure 28.6 Plan of Millwood Plantation: the spatial relationships between the great house (1), overseer's house (8), and the slave houses (10, 11 and E) were designed to reinforce the social hierarchy of the *antebellum* South. Illustration by Charles E.Orser.

surveillance of the labourers, *postbellum* plantation settlements tended to be dispersed. Each farmer, whether renter or sharecropper, lived with his or her family near the fields which they worked. Significantly, Orser suggests that where sharecroppers made up the bulk of the plantation tenants, the settlement form would resemble *antebellum* spaces more closely, with the barns, sheds and other outbuildings located near the planter's central home. This provided the planter-landlord with the capability of supervising the sharecroppers directly. When a farmer wanted to use a mule or a plough, s/he would be forced to approach the planter's house under the direct observation of the landlord. Likewise, by locating the barns within sight of the house, the landlord could maintain direct surveillance over the harvested crop. Renters were the objects of relatively less surveillance because the landlords had less direct interest in the renters' crop (Orser 1988a).

Sugar plantations have been thoroughly examined by historical archaeologists, especially in the Caribbean (e.g., Armstrong 1985, 1990; Craton 1978; Craton and Walvin 1970; Delle 1989, 1994; France 1984; Handler 1979; Handler and Lange 1978; Higman 1974; Lange and Handler 1985; Pulsipher and Goodwin 1982b). In addition, scholars recently have turned their attention to maroon (escaped slaves) villages in sugar-producing areas (e.g., Agorsah 1990; Orser 1992, 1993, 1996). A consideration of sugar plantations is crucial to our purposes here, for of the several cash crops raised on slave-based plantations, sugar demanded the most highly disciplined labour force.

The majority of labourers on sugar plantations were forced to toil in unsafe conditions under strict surveillance. On some plantations, surveillance did not end with the work day but was extended into the domestic world of the slaves. For example, the first of two slave villages at the Seville Estate in St Ann's Parish, Jamaica were located immediately behind and up slope from the planter's great house, allowing the planter increased visibility during daylight hours and when the moon was bright. At this same plantation, a separate building, the overseer's house, was located in front of the great house, commanding a view of both the industrial complex and sugar-cane fields. A single person standing on the veranda of this structure could supervise all the workings of the plantation. Notably, several small cannons from its period of operation still exist in front of the overseer's house. Permanently aimed towards the cane fields, the cannon symbolized the power exerted by the planter and his overseers over the lives of the labourers. The overseer's complex would in turn have been visible from the cane fields and the sugar works, creating and maintaining the surveillance required to enforce and internalize the self-discipline of the enslaved workforce (Armstrong forthcoming).

The centre of industrial life on a sugar plantation was the sugar mill/boiling house complex (Delle 1989, 1994; Pulsipher and Goodwin 1982a, 1982b; Tomich 1990). It was in this series of structures that cane was reduced into exportable form. The planters were concerned with the close supervision of labour during this crucial processing phase. Schwartz (1985:142–49) reports that on plantations in Brazil, managers and foremen kept constant supervision over labour during each stage of the sugar-making process. Genuine terror was used by these overseers to maintain industrial discipline and an alert labour force. Schwartz (1985:143) notes that it was common to keep a small axe near the mill machinery to amputate any limbs that were inadvertently caught in the machinery. The sight of such a hasty amputation would have underscored the importance of maintaining concentration on the tasks at hand. The boiling house and mill structures were often the most physically imposing structures on a plantation (Delle 1994; Pulsipher and Goodwin 1982b). Given the intense surveillance inside the structures and their imposing forms, these buildings were a significant part of the plantation's disciplinary reproduction.

This brief analysis does not cover all New World plantation systems that have been studied by historical archaeologists. For example, there is a wealth of literature on rice plantations (e.g., Ferguson 1991, 1992; Lewis 1984, 1985; Singleton 1992), and some work has been done on indigo plantations (e.g., Friedlander 1985; Wheaton and Garrow 1985) and more recently on coffee plantations (Delle 1996, 1998; Joseph *et al.* 1987). There has also been a recent trend to take a more critical approach to the discipline of plantation archaeology (e.g., Epperson 1990; Ferguson 1992; Orser 1988b, 1988c, 1989; Potter 1990, 1991; Singleton 1990).

SURVEILLANCE IN INDUSTRIAL LANDSCAPES

During the course of the first half of the nineteenth century the economic base of the northeastern United States shifted from agriculture to industry, a shift that involved the transformation of a rural agricultural peasantry into a disciplined industrial labour force. This social transition was drastic as it involved the redefinition of the relationship between workers and both time and space. The regimen of the factory demanded a disciplined workforce which would arrive to work at a specific time, operate machinery for as long as possible, and then return the next day to do the same repetitive tasks. This routine was radically different from the seasonal cycle of agricultural work and demanded that people work indoors in what amounted to very unsafe and unhealthy conditions. In order to discipline the workforce to operate in such an environment, new landscapes of surveillance were intentionally created by the factory owners. Historical archaeologists have studied several of these industrial landscapes (e.g., Beaudry 1989; Beaudry and Mrozowski 1987a, 1987b, 1988, 1989; Beaudry *et al.* 1991; Candee 1985; Gross 1988; Kulik 1988; Langhorne 1976; McGuire 1991; Miller and Pacey 1985; Mrozowski 1987, 1991; Nassaney and Abel 1993; Orr 1977; Paynter 1988; Sande 1977; Starbuck 1983; Wurst 1991), but we shall concentrate on two case studies examined by historical archaeologists: Lowell, Massachusetts, a planned industrial urban centre (Mrozowski 1991; Mrozowski *et al.* 1996) and Harper's Ferry, Virginia, the seat of one of the first United States government firearms manufactories, or armouries (Shackel 1996).

Lowell presents an interesting case because of the amount of historical archaeology that has been completed there over the years (e.g., Beaudry 1989; Beaudry *et al.* 1991; Beaudry and Mrozowski 1987a, 1987b, 1989; Mrozowski *et al.* 1996). The historical significance of Lowell lies in the deliberate spatial organization of the city, designed and implemented by a group of founding capitalists to maximize the efficiency and profitability of industry. That city plan was based on the principles of surveillance to ensure an industrial discipline among the working class and to secure profits for the capitalist class.

Mrozowski reports that the design of the city was intended to function as a system of moral policing (Mrozowski 1991:90). The mill, workers' housing and overseer's and mill agent's housing were built in close proximity to each other in such a way that the overseer could supervise both the working and private lives of the labourers with the intention of creating a disciplined workforce. The manufacturing corporations owned, controlled, and supervised both work and domestic space. Such control served to unite the conception of work and home, reinforcing a sense of discipline in the workers.

The latter were housed in a series of large, multi-storeyed boarding houses. At the Boott Mill complex, eight blocks of such boarding houses were constructed. Each block was flanked at either end by a tenement meant to house a mill agent and his family. These supervisory employees could thus maintain surveillance over two blocks of boarding houses at a time, and thus a worker could be supervised from either or both of two perspectives at any given moment (Beaudry 1989:23). An additional layer of surveillance existed in the placement of the mill agent's house. The rear of this duplex house was oriented to command a view of the overseer's housing; the supervisors were thus supervised. This house was raised above the tenements and boarding houses on an artificial terrace, providing a material symbol of the industrial social hierarchy (Beaudry 1989:23) and a visible reminder of industrial discipline.

Beaudry and Mrozowski suggest that the domestic interiors of the boarding houses were often the only areas over which workers exercised control (Beaudry and Mrozowski 1988:5), as these were the only areas which could not be seen by the industrial supervisors. However, in early nineteenth-century Lowell, the mills employed boarding-house keepers who were responsible for feeding the tenants, cleaning the house, and maintaining 'order and discipline, and for upholding morality within the boardinghouse' (Beaudry and Mrozowski 1988:6). Clearly, the industrialists who designed Lowell had every intention of supervising the domestic as well as the work environments of the employees with the hope of creating and maintaining an industrial order that would ensure profit maximization.

This social control was extended into the domestic lives of the mill employees through a series of regulations. Employees were required to attend Sunday worship and refrain from alcohol consumption. All workers were required to live in the mill-owned boarding houses unless they secured special permission from the company. The boarders were not allowed to entertain guests after ten o'clock at night (Bond 1989:24). Bond reports that individuals who failed to keep to this social discipline were often fired or expelled from the boarding houses. From her interpretation of the documentary evidence of the Boott Mills, Bond suggests that alcohol consumption and inebriation were among the most serious offences against the discipline of production. She suggests that the corporation would interpret drunkenness as the breakdown of self-control, which would threaten the 'industrial work ethic', which we believe can be equated with industrial discipline. Bond examined thirty-three letters written by Boott Mills paymaster James G. Marshall to keepers, overseers and mill workers: of these, sixteen complained of workers' drinking (Bond 1989:29). The surveillance and regulation of behaviour was clearly an important component in the creation of industrial discipline at Lowell.

Similar processes were at work within the industrial landscape of Harper's Ferry, an industrial city situated at the confluence of the Potomac and Shenandoah Rivers, in what is today the state of West Virginia (Shackel 1996; see also Shackel and Winter 1994 and Shackel and Larson forthcoming). In the middle of the nineteenth century, the organic landscape of this small city was intentionally reconfigured, Shackel argues, as part of a larger project to increase the efficiency of arms production. A key element within this project was the transformation of armoury workers from skilled artisans to semi-skilled machine tenders. In the effort to accomplish this radical transformation in the relations of production, armoury supervisors, beginning in about 1840, instituted a number of reforms, including regular work hours, the introduction of a time clock and bell, the surveillance of visitors to the factory, and, notably for archaeologists, the reconfiguration of the factory complex layout and the street grid for the city. Shackel argues that the construction of standardized factory buildings and the imposition of a geometric city plan were part of a strategy intended to increase the ability of armoury managers to supervise the workers, as well as to break down the traditional craft-based nature of arms manufacture (Shackel 1996).

REFORM AND INCARCERATION AS SELF-DISCIPLINE

In the late eighteenth century, prisons and asylums began to re-conceive their central mission as one of rehabilitation, rather than simple incarceration. The Walnut Street Prison in Philadelphia is one example of such an institution in the early stage of this transition which has been examined archaeologically (Fig. 28.7).

The city built the prison in 1775 to replace its public gaol. The new prison eventually became partly like Bentham's panoptic jail: when originally constructed, it was a baroque Georgian building, but with a renovation executed in 1797, a workshop building was added to the complex. The new two-storey workshop building was a five-sided structure, resembling an unfinished octagon. The prison's adoption of panoptic workspaces, together with its reform strategy, reflects panoptic philosophy: inmates learned a trade as part of a programmme intended to reform them and return them to society as productive and rehabilitated citizens. The prison also adopted solitary confinement as a punishment for its worst offenders, in the hope of isolating them from bad influences. This adoption of panoptic principles resulted in a decrease in the Walnut Street prison's rate of recidivism, but the building gradually fell into disrepair, was replaced by the Eastern State Penitentiary, and was eventually torn down in 1835 (Cotter *et al.* 1992:175; Cotter *et al.* 1988; Upton 1992).

In the United States, the panoptic reform concept was probably most systematically followed at the Eastern State Penitentiary (Fig. 28.8), which was designed in 1821 and remained a working prison until 1970. The 10-acre granite fortress had a central observation tower with seven rows of cellblocks radiating from it like spokes, contained within four massive walls with corner turrets which wholly concealed the outside. The rows contained as many as 250 cells which could not be individually monitored from the central tower, as they would be in a true panopticon; the prison adapted Bentham's notion of constant surveillance by attempting to make each individual his or her own confiner. Upon entry to the prison, inmates were hooded and placed in one of the solitary cells, ostensibly never to be seen by another prisoner. They were trained in crafts and received a Bible and regular visits from Quakers, all of which were intended to turn the prisoner to a more useful calling upon their release. The complex was the state of the art in its time and was one of the largest and costliest buildings in the United States—Charles Dickens even listed it, along with Niagara Falls, as one of the two sites he most wanted to see on his 1842 tour of America! When he arrived at Eastern State, Dickens quickly comprehended that the prison's reform principles relied upon prisoners' eventual consent to the mores of their captors: to re-enter society, inmates had to discipline themselves to the values of their keepers and eliminate all of the signs of their criminality.

Both baroque and panoptic modes of discipline were used to restrain and rehabilitate other individuals defined by the state as aberrant or as dangerous to society's order, including criminals, prostitutes, and those defined as insane. The best example of an insane asylum known to archaeologists is the now reconstructed public hospital for the insane in Williamsburg, Virginia. This institution first opened in 1773, and eventually developed a rehabilitation philosophy similar to that espoused at the Walnut Street prison, and used music, games, and dancing in

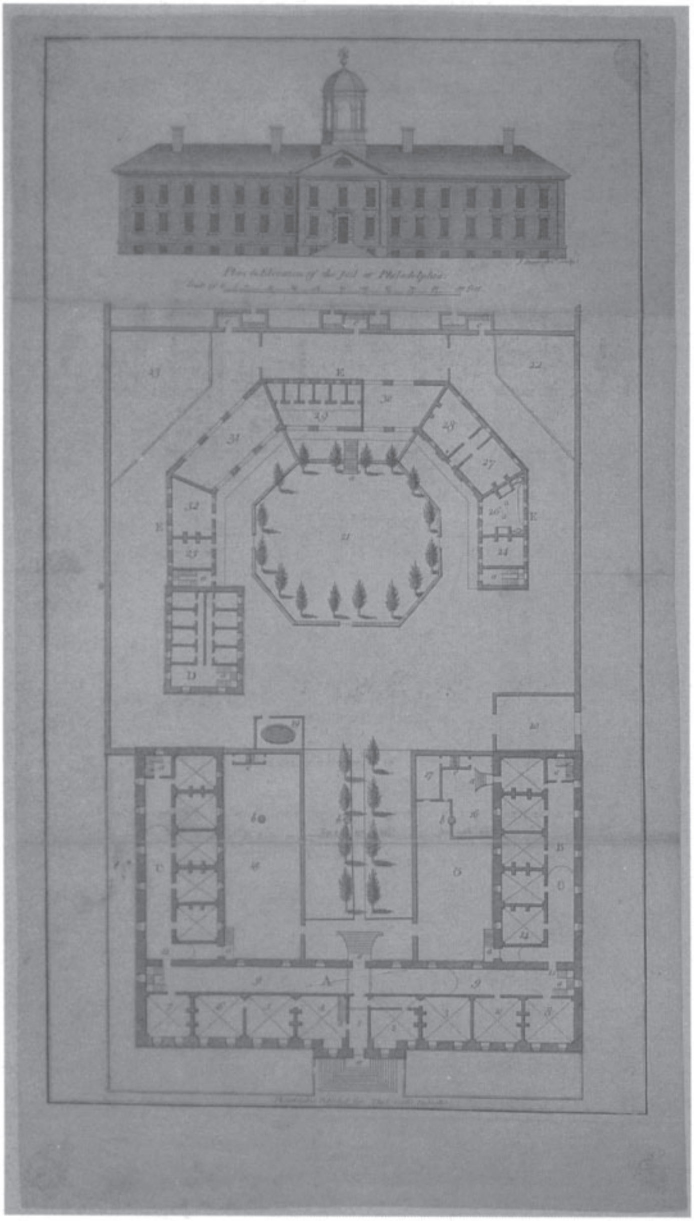

Figure 28.7 The Walnut Street Prison, Philadelphia: (above) 1798 illustration and plan and (opposite) 1970s excavation of the part of the prison workshop, as seen from an adjacent building. Source: Historical Society of Pennsylvania (plan) and Cotter *et al.* 1988 (photograph).

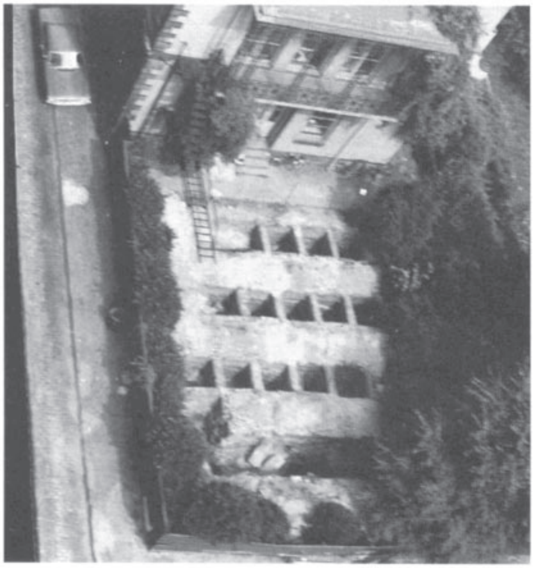

Figure 28.7 (continued)

attempts to cure the insane. The public hospital did not originally attempt to reform or rehabilitate its inmates; solitary restraint of patients was commonly used into the nineteenth century. A 1796 visitor to Williamsburg commented that the hospital was 'a fine building; but in it the unfortunate maniacs are rather abandoned to their wretched state than subjected to any treatment which might tend to their recovery' (Dain 1971:26–27). The hospital experimented with new scientific modes of caregiving based on observation, plans to return citizens to conventional, productive life, and other panoptic practices. The hospital officially began to organize patient interaction and activities in the 1840s, making it appear to be a panoptic organ of the state.

The mechanisms of social reform were extended in the attempt to control what was considered sexual deviance. Archaeologists know the material expression of this element of social control through the Magdalen Society of Philadelphia, which operated between 1800 and 1850. The excavations conducted and analysed by Lu Ann De Cunzo (1995) have shown that this organization for reforming prostitutes provided workshops and a store for selling goods made by its inmates. The primary purpose of this institution was to teach prostitutes how to return to respectable society by becoming members of the industrializing workforce. De Cunzo has recognized the relationship between such reform institutions, and other forms of social control:

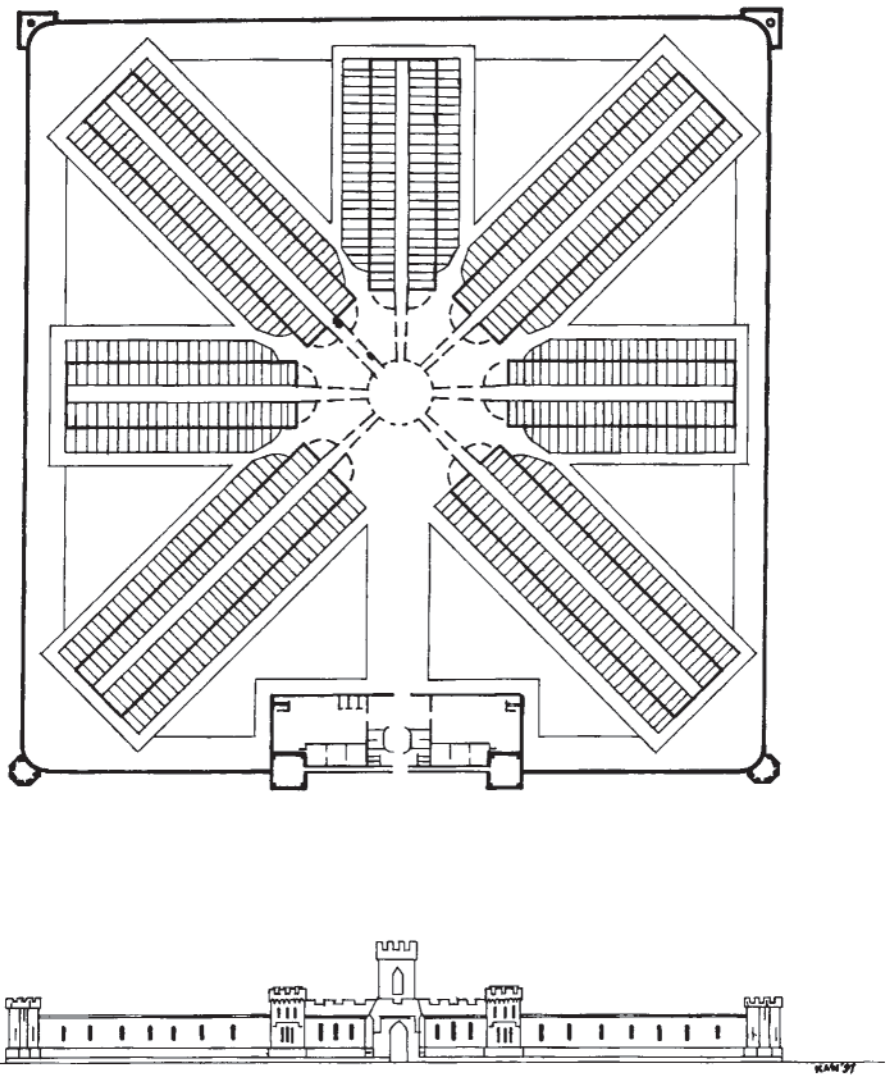

Figure 28.8 (above) Plan of the Eastern State Penitentiary, built in the early nineteenth century, and (opposite) that of the reference area of the Cecil H.Green Library at Stanford University, built in the late twentieth century: note the similarity of design, the emphasis on control of space, and the adaptation of panoptic principles. Sources: Eastern State Penitentiary: P.Kaw and P.D.Leighton; Stanford Library: D.C.Weber, *Planning Academic and Research Library Buildings*, 2nd edn (Chicago and London: American Library Association, 1986).

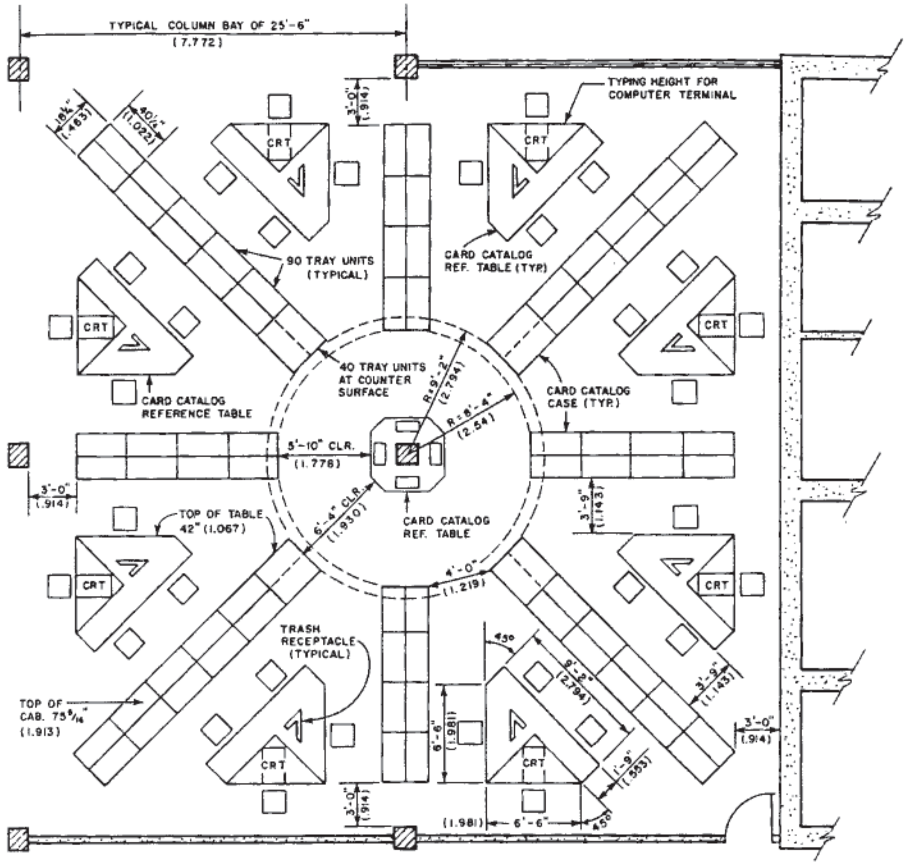

Figure 28.8 (continued)

> the early 19th century prison and asylum shared with the cloister, school, military regiment, family home, boarding house, almshouse, hospital, and…workshop…[the] commonalities…of the new discipline of the modern world and [functioned] as mechanisms of a pervasive, insinuating, naturalizing power.
>
> (De Cunzo 1995:34)

Having concentrated thus far on how disciplinary mechanisms were used by the British colonial state in eastern North America, and by its successor the United States, we shall now consider briefly how such mechanisms were manifested in other colonial contexts, taking as examples the Dutch colonial state that developed in South Africa, the Spanish and later American states that developed in the North American Southwest, and the colonial expansion of the United States into the North

American West, and the role consumerism has played in creating a population of individual, disciplined consumer-citizens in the United States.

SURVEILLANCE INSTITUTIONS IN DUTCH SOUTH AFRICA

Historical archaeology in South Africa is relatively new and was founded and is now widely practised in the area around the Cape of Good Hope and Cape Town. The Cape was settled in the mid-seventeenth century by the Dutch as a station for resupplying ships on their way to the East Indies. In the course of the seventeenth and eighteenth centuries, the Dutch, Germans, and French established plantations throughout the interior of southern Africa beyond Cape Town (Hall 1992; Schrire 1991, 1992, 1996; Schrire and Merwick 1991). The colonizing process disrupted indigenous lifeways whenever native people came into contact with Europeans. The colonizing process was taken over by the British later in the eighteenth century and affected all of what is now the Republic of South Africa, parts of Namibia, Botswana, and Zimbabwe, as well as areas farther into the interior.

As part of the material expression of their colonizing process, the Dutch built a star-shaped fort near the shore of what was to become Cape Town. Although it has been modified several times, including a heightening by the British, this structure, known as the Castle, still stands and has been carefully excavated and restored (Fig. 28.9). Over the years, several archaeologists have worked on the Castle and its environs. The Castle is a standard planned military enclosure, similar to those seen all over the colonial world from the seventeenth century on. From without, the fortress in its final form is tall and imposing and can be seen from all directions. It is clearly an object of view and is meant to be the centre of attention. Regardless of how the surrounding landscape was planned, the fort was deliberately situated to be viewed from the water and land. It was thus in the way of everyone in the environment. Like baroque planning in general, it represented the power of the state by capturing each individual's attention. While force guaranteed rule in the Cape, central placement guaranteed attention on a daily basis.

Although little scholarly attention has been paid to the interior of such forts, recent archaeological investigations have provided indispensable information. The Castle at Cape Town has a double row of two-storey buildings which were placed back to back and which were situated on the fort's longest axis. This acts to cut the interior of the fort in half. In front of each row of buildings was a large courtyard into which all openings went. These parade grounds were viewing spaces and acted to keep all passers-by under surveillance. This would have included indigenous Africans, slaves, civilians, soldiers, officers and even the élite of the Dutch East India Company. The Castle has to be thought of as a prison, in so far as it contained slaves. But its disciplinary powers enhanced the hierarchy of the Dutch East India Company because all its inhabitants were on view at predictable times throughout

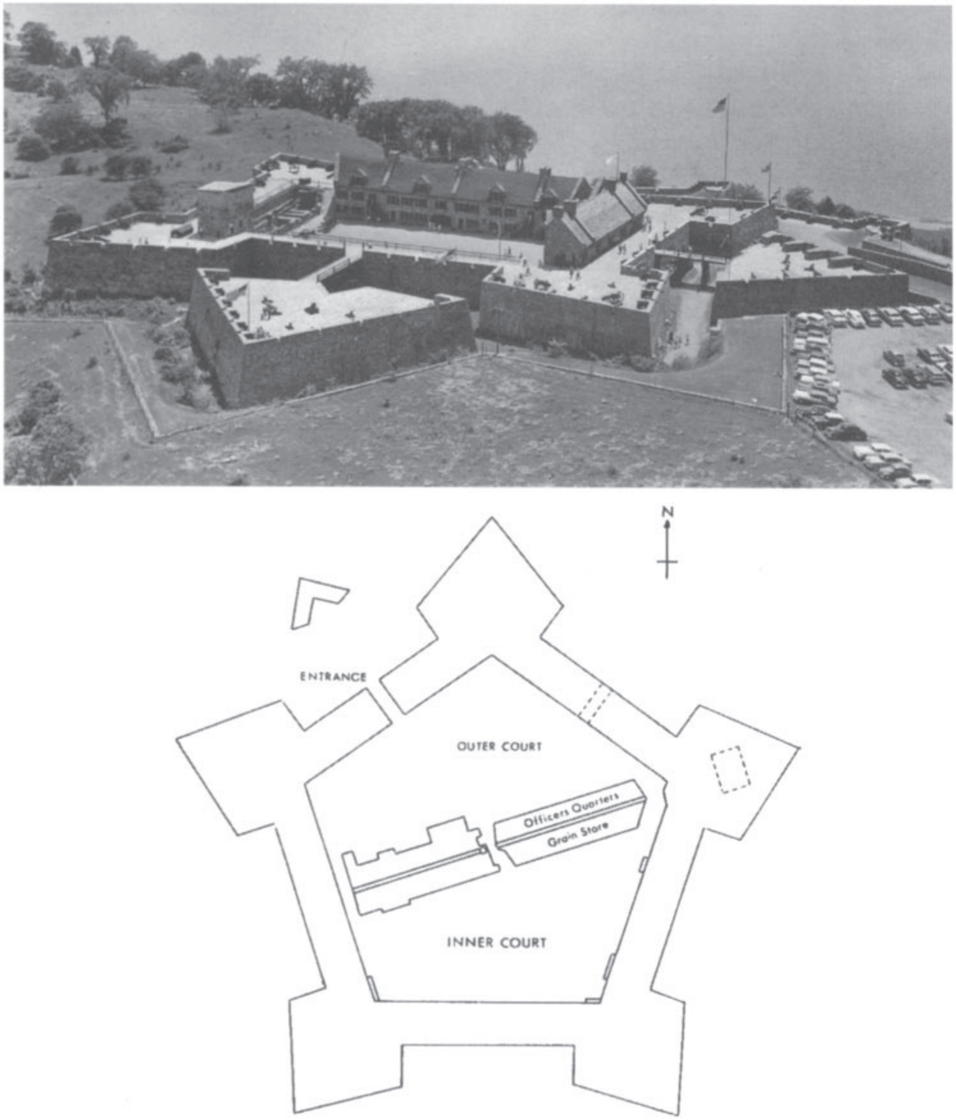

Figure 28.9 Star-shaped forts, like Fort Ticonderoga in New York (above), and (below) the Castle at Cape Town in South Africa, used a rudimentary form of panopticism to monitor activities both inside and outside the fortress walls. Fort Ticonderoga photograph reproduced with permission of *Fort Ticonderoga Museum*. The Castle at the Cape of Good Hope plan reprinted with permission from A.Yentsch and M.Beaudry (eds), *The Art and Mystery of Historical Archaeology: Essays in Honor of James Deetz,* Florida: CRC Press, 1992. Copyright © CRC Press, Boca Raton, Florida.

the day. Since there is no citizenry in the republican sense involved in the Cape area, it would not be appropriate to call the Castle a true panopticon. This structure was, however, designed for surveillance and to discipline and subordinate individual subjects (Hall 1992).

The plantations of the Cape, usually referred to as farms, are historically the most important feature of Dutch settlement. These very large private holdings produced wine, wheat, and cattle. The plantations were centrally planned and their regularity can be seen both in surviving plans and the material remains of the surviving farms. The great houses typically have the famous Dutch gable which adds height and calls attention through baroque elaboration. The houses were frequently surrounded by walls and gardens, and the corners of the property were frequently marked by mills, barns, pigeon houses, and slave quarters. All of these structures could be built in the baroque style, which featured gables, cupolas, domes, barrel vaults, mission-like belfries, and similar architectural devices intended to impress the eye. All of these structures were designed and laid out according to a fairly standard plan and were combined with topography and other buildings so as to call attention to a hierarchically organized central authority (Hall 1992). All served to discipline individuals in colonial South Africa.

RELIGION, STATE POWER AND THE AMERICAN SOUTHWEST

During their colonization of South Africa, the Dutch introduced a severe form of Calvinism: Reformed Dutch Protestantism. The association of this variation of Puritanism with baroque architecture in South Africa seems anomalous until the architectural style is associated with planned landscapes and street plans, as well as with the public buildings in and along them. Baroque architecture and landscape planning used the laws of perspective to focus the human eye. Through the baroque built environment, authority governed by commanding the vision of the individual. Europe's colonizing nations used these techniques and definitions as they developed their imperial churches and missions, plantations, shipping institutions, administrative centres, forts, prisons and hospitals.

The use of hierarchical institutions built in baroque style appear to characterize power already achieved. However, archaeological chronologies show that such building episodes were much more likely used to centralize authority at times when it was weak or marginal. This can be seen in the material manifestations of colonialism in the North American Southwest. In the Southwest we not only see an attempt to build state authority from scratch, but we also see the use of baroque architecture to achieve it. In the Southwest the baroque order developed into a fully panoptic form, coupling religious zealousness to a developing sense of nationalism which governed baroque and panoptic expressions.

During their colonization of the Southwest, the Spanish built several sets of missions. Once a chain of at least two dozen missions went through what is now the Mexican state of Sonora into southern Arizona. Tucson's well-known San Xavier del Bac is the most visible survivor of this mission chain (Fig. 28.10). These institutions were built in the later eighteenth century and represent an attempt to colonize Native Americans in the hope of transforming them into agricultural workers. Mission chains were used throughout the northern Mexican frontier, including what is now the American Southwest and California (Cheek 1974; Farnsworth 1986; Farnsworth and Williams 1992a, 1992b; Hoover 1992).

Mission establishments were used as colonizing instruments by the Spanish in Mexico from the beginning of the Conquest in the 1520s. Virtually all the architecture of these churches is baroque, which range from the relatively

Figure 28.10 Mission San Xavier del Bac: the white towers of the mission compound literally rise out of the desert floor, dominating the viewscape of the small village which surrounds the mission. Photograph: Ansel Adams. © 1997 by the Trustees of the Ansel Adams Publishing Rights Trust. All rights reserved.

undecorated to those which are quite elaborate. San Xavier is typically baroque, featuring two front towers with octagonal tops and a central dome. It towers over a relatively small Indian village today but can be seen from miles away; it is a central point in a familiar landscape. The towers are pierced with eight openings, one on each side, and, while they were not intended as viewing platforms, it is quite possible to imagine the view from them. That view would be in all directions through the entire southern part of the Tucson valley. The mission buildings in this chain and in many of the others have been criticized frequently as wasteful expressions of wealth. It is apparent that these churches are far more substantial and more highly decorated than some would judge necessary. These larger and more decorated churches usually succeeded simpler ones as the archaeology of San Xavier mission has shown. The purpose of these baroque architectural elaborations was to impress local Native Americans. Since the Southwest experienced a series of bloody and effective native rebellions against the Spanish, and because the missions existed to create cheap labour bases for Spanish enterprises, the political environment was never stable. Thus, baroque architecture on a grand scale accompanied political weakness (Arthur *et al.* 1975; Cheek 1974; Olson 1985).

The place of the pulpit and the place of the towers indicates an early understanding of panoptic techniques. Since these were preaching churches, the pulpit's view and shadow reached into the middle of the congregation, just as the towers' view and shadows reached into the middle of the village. The viewing platforms command attention and returned it, bringing in the westernizing and disciplining arm of the state via the established church. Religion was to teach 'salvation' by adherence to rules which touched all aspects of life.

Spanish missions have been excavated widely in the United States by historical archaeologists (e.g., Barbolla-Roland 1983; Costello 1991,1992; Costello and Walker 1987; Deagan 1983; Deetz 1968; Farnsworth 1985, 1987, 1992; Hoover and Costello 1985; McEwan 1992, 1993; Saunders 1996; Thomas 1993; Williams 1992). Little historical archaeology has been done on them in Latin America, which is unfortunate since the colonial documentation there is extensive (Cohen-Williams 1992; Fournier-Garcia and Miranda-Flores 1992; Gasco 1992; Joseph and Bryne 1992; Myers *et al.* 1992; Reitz 1992; Skowronek 1992). On the other hand, Spanish missions in what is now the United States are rarely if ever compared to Protestant missions in similar frontier areas, or even to Utopian compounds such as those constructed by the Shakers or those built by the early Mormons (Leone 1973; Savulis 1992). The all-seeing eye which stems from the panoptic quality of these sets of buildings is largely unrecorded. No comparison between such institutions has been completed, largely because no theoretical model has yet been available through which such a comparison could be attempted.

With an appropriate model, we can begin to address the socio-political issues characteristic of colonial areas which change hands and identities, but not the structure of governance. The Southwest was absorbed by the United States following a war of conquest in the 1840s; a new building style arrived with the new government. Traditionally, south-western history is segregated chronologically into four periods: prehistoric, Spanish, Mexican, and American, the latter referring to the period of United States hegemony in the region. Each of these is treated in popular and scholarly writing as a horizon. Under this schema, the United States presence in the Southwest appears short and unarticulated to any local past group. This is essentially misleading as the appropriation of the Southwest by the United States was in many ways simply an extension of the programme of European colonization begun by Coronado in the 1540s. The extent and continuity of European colonization in this region can be revealed through an analysis of the building called Old Main, the building which was built as the initial structure for the University of Arizona in Tucson in the late 1880s.

San Xavier del Bac and Old Main are structurally the same despite the different state authorities under which they were built, and despite their superficially different functions. Old Main is a cruciform building with towers at the ends of each of its four arms. The towers have louvred openings in their peaks and the building in turn is placed in a circle at the chief intersections of the campus. It thus sees in all directions. The building is situated in the middle of a planned landscape where, originally, it could be seen from any direction. Today it is in the middle of a developed landscape whose centre it still dominates.

The church and the school, San Xavier and Old Main, are baroque and panoptic buildings, respectively creating centralizing power where little or none existed before the structures were built. Their interiors are characterized by corridors and rooms where visibility is at a premium. The church and school were both colonizing institutions, and both used the interiorization of surveillance to create believers and citizens, one hierarchical, the other democratic. Rote learning, lectures, rituals of cleanliness, recitations, and supervised daily living routines characterize their functions. Analysing these structures through the logic of state power allows us to unify the Spanish and the US periods in the Southwest. This region has experienced a long-term European colonizing presence. The conventional interpretation of the region, which depicts a short-term US presence featuring American ideals of independence and freedom triumphing over superstition, is patently misleading, as can be seen when one uses anthropological archaeology to focus on colonialism, as opposed to trivializing historical detail.

Old Main was built in the 1880s and is more than a manifestation of baroque planning. It builds upon the self-disciplining attitudes taught at San Xavier in order to create a fully panoptic environment. In it, students were taught and watched by teachers and they learned to teach and watch themselves in a way that was more effective because it was free and voluntary. Thus the all-seeing eye of the panopticon could be more effective because it was done in the name of public education and rational advancement. Any discipline involved was clearly for one's own good. Old Main has not been archaeologically investigated in the conventional sense, but one can clearly see that lines of sight inside and outside the building, the position of windows, doors, rows, desks, and hallways should be recorded. Old Main's interior and exterior landscapes are of equal importance to the ceramics and glass assemblages a historical archaeologist would normally analyse.

IDEOLOGY, THE INDIVIDUAL, AND THE AMERICAN WEST

Although the great majority of American historical archaeology has been conducted on the eastern seaboard, there is a rich and growing literature on the historical archaeology of the nineteenth-century American West (e.g., Adams 1976; Evans 1980; Hardesty 1986, 1988, 1994; Henry 1987; Pastron and Hattori 1990; Praetzellis and Praetzellis 1989, 1992; Purser 1991, 1992; Riordan and Adams 1985; Staski 1993; Szuter 1991; Zeier 1986). The conquest of the American West—that is, the territory lying between the Mississippi River and the Pacific Ocean—has played a crucial part in defining the American imagination, character, and the ideology of the 'rugged individual' (Athearn 1986; Truettner 1991). In many ways, the birth and proliferation of many archetypal western myths—the lone cowboy riding the range, the hermit mountain man, the solitary fur trapper—can be seen as simultaneously *resulting* from the fragmentation of American society from communities to individuals and *creating* an ideology which reifies the central importance of the individual. This ideology contends that just as the United States succeeded in conquering the continent by itself, so too will strong and dedicated individuals— the cowboy, mountain man, or trapper—succeed in bettering their own lives. Those who do not succeed must likewise be to blame for their own failure; the ideology of the individual lays responsibility for the very existence of institutionalized systems of inequality on those who suffer most from them.

As it involved the conquest of people and territory, the western expansion of the United States should be seen as a colonial process. As was the case in other colonial contexts, in the American West surveillance technologies were used to divide society into a series of nominally independent and disciplined individuals; these mechanisms are retrievable archaeologically. While such negotiation can be seen to have occurred in many contexts—for example, through the proliferation of consumer culture (Henry 1987; McDougall 1990) or the negotiation of gender relations in brothels (e.g., Costello 1998; Spude 1998) —the two contexts most thoroughly known are mining camps and Chinese American sites.

Donald Hardesty has been studying the historical archaeology of mining camps in the West, particularly Nevada, for over a decade (e.g., Hardesty 1986, 1988, 1994). His analysis does much to disprove the myth that the social structure of frontier mining towns in the American West was based on an ideology of personal freedom and social egalitarianism. Quite on the contrary; mining, as it was practised in the nineteenth-century American West, was an activity that required strict labour discipline. Social and spatial segregation is evident in the archaeological records of even small, temporary mining camps like Gold Bar, Nevada, which employed fewer than a hundred people for less than a decade. Hardesty notes that there are several types of houses identifiable archaeologically: family houses which included, minimally, an adult male and an adult female; boarding houses which sheltered as many as sixty miners; and superintendents' bungalows, which at Gold Bar apparently housed a single supervisor (Hardesty 1988). As was the case in both eastern industrial and southern plantation contexts, the domestic and work lives of the miners were controlled through panoptic supervision. Mining camps were often located downhill from the mine shifts and associated mills. From the industrial structures, miners could be seen on their way to work and in their domestic settings. The presence of the superintendent's bungalow among the houses and tents of the miners would be a constant reminder that they were under the surveillance of their employers. While inexpensive to build, boarding houses would serve to contain the miners in an easily controlled and supervised area; the camp superintendent could keep a watchful eye on the bodies housed therein. Most importantly, the looming shadows of the mills, furnaces, and mine headframes would remind the miners of their position as the dependent, individual, watched employees of a mining company.

For over two decades, historical archaeologists have identified the presence of Chinese immigrants on archaeological sites based on the recovery of high percentages of Chinese porcelains and the presence of opium-smoking paraphernalia (Etter 1980; Evans 1980; Sando and Fenton 1993; Stenger 1993; Wylie and Fike 1993). The presence both of large numbers of Chinese labourers and opium pipes can be seen as the consequence of British colonial expansion in the Far East. The forced introduction of opium into the Chinese economy following the Opium Wars of the mid-nineteenth century resulted in the widespread use of opium among Chinese men, filling the coastal Chinese urban centres with populations of relatively impoverished mobile, unattached men, many of whom hoped to travel to the United States, make their fortune, and return to China. The population that did emigrate to the United States was primarily young and male; in 1870 only 8.5 per cent of the Chinese population in the United States were female (Greenwood 1993).

At first glance the use of opium might seem to run counter to the state's desire to create a disciplined, individualized workforce. However, the use of opium created a dependency on the purchase of the drug, and thus to wage labour in order to afford its purchase; it has been estimated that between 15 and 50 per cent of Chinese labourers' wages went on opium (Wylie and Fike 1993). Furthermore it has been suggested that the use of the drug may have enhanced the work performance of labourers in railroad camps and mines (Wylie and Fyke 1993). The experience of the Chinese immigrants in the nineteenth century was marked not only by the negotiation of consumer and wage-earner identities but also by new expressions of gender and racial identities. As so few women emigrated to the United States in the nineteenth century, and, as it has been argued, the ratio of European women to men in urban centres was relatively small, Chinese men found employment in what might otherwise be female spheres: as launderers, cooks, or domestic servants for wealthy Euro-Americans in the cities, and for labour gangs in the country. The Chinese were also racially segregated into 'Chinatowns'; while it is certain that Chinese emigrants found some measure of comfort living and working in close proximity both to relatives and to fellow Chinese, such segregation facilitated the surveillance and control over the Chinese by the Euro-Americans. As the state did not want to incorporate the Chinese as citizens, and indeed since many Chinese hoped to return to China once they had earned their fortune, surveillance was of a somewhat different nature. The Chinese simultaneously were defined as individual, disciplined wage-earners and consumers, and were segregated out from the citizenry. Where they refused to accept these conditions they were likely to meet with violence, as was the case with the Douglas Bar massacre of 1885, in which thirty-two independent Chinese miners were killed by eight Idaho cowboys (Sisson 1993).

CONSUMER DISCIPLINE AND THE IDEOLOGY OF INDIVIDUAL IDENTITY

Surveillance mechanisms were structured by more-or-less complementary discourses of inequality, such as racial and gender ideologies. These discourses took myriad material forms whose success was dependent upon individuals' capacity to accept systemic and even personal inequality as appropriate to their identity. Many of these inequalities were played out in the consumer culture which developed in America between the 1870s and 1930s. In the final quarter of the nineteenth century American consumer space's rapid expansion was fuelled by a flood of new commodities, novel marketing venues, and innovative marketing and advertising strategies. Beyond these objective material mechanisms, consumer space moved ever-closer to the heart of American identity because Americans internalized a distinct consumer discipline. It was a discipline in which consumption—and the fiction of impending universal affluence—was more critical to individual identity than any other totalizing discourse (e.g., religion, nationalism, ethnicity, etc.). Marketers explicitly promised an affluence which inevitably would reach the masses, and mail order 'wish books', credit sales, and densely stocked sales spaces implicitly emphasized the vast abundance of objects available to all American consumers. This mass vision of material abundance was entertained by many Americans who were willing to ignore or endure their present material and social subordination. At the same time, many Americans tacitly were considered unsuited to an even share of this universal abundance: African-

Americans, for instance, were considered racially incompatible with the white consumer ideal, and most European immigrants and women were extended circumscribed privileges in consumer space.

Venues such as department stores disciplined consumers to a distinct form of genteel social behaviour and encouraged a somewhat paradoxical embrace of individual material desire (Campbell 1987). Through their strategic abundance of vast quantities of commodities arranged by form and style, the proximity of shoppers to goods, and the powerful displays of pane glass display windows, department stores radically changed the material desire once stifled in modestly stocked general stores. The disciplined genteel shopper absorbed tacit codes for how to imagine the possibilities of seemingly innocuous mass-produced goods; for department stores, this day-dreaming dimension of consumption was critical because it produced consumers who tolerated or ignored inequality in lieu of the profound possibilities of consumer goods. Department stores aspired to fuel a hedonism in which consumers were driven not by functional need but instead by the capacity of an object to negotiate, evade, or symbolically reconfigure contradictions in their lives. Whether objects actually can mediate social contradiction is at best questionable, but consumer spaces thrived on their capacity to produce a self-monitoring consumer who at least entertained the notion that commodities could recast everyday repression.

The contradictions in affluence ideology were constantly being masked and negotiated in department stores. Plate glass window displays, for example, were introduced in American stores in the 1870s and were a staple element of all urban department stores by 1910 (Leach 1993:61–63). Mid-nineteenth-century shoppers were instructed that it was indiscreet to stare at goods or handle commodities which the consumer did not intend to purchase. In 1860, for example, etiquette writer Florence Hartley (1860:112–13) observed that ‘A lady who desires to pay strict attention to etiquette, will not stop to gaze in at the shop windows. If she is alone, it looks as if she were waiting for someone else; and if she is not alone, she is victimizing someone else, to satisfy her curiosity.’ An 1869 guide succinctly dictated ‘Do not enter a store unless you have some errand’ (Shields 1869:92).

However, such puritanical counsel stood on unstable ground by the 1890s, when spectacular window displays arranged objects in settings which encouraged active day-dreaming. Indeed, some stores hired people to stand in front of windows and encourage the assembly of crowds (Leach 1993:61). Displays arranged objects in settings which ambiguously suggested their symbolism in domestic space, what English traveller Katherine Busbey (1910:158) called ‘glass-enclosed rooms’ which ‘resemble the various exhibits in the Eden Musee’. Such displays hoped to muddle the distinction between fantasy and reality, encouraging consumers to envision the fantastic possibilities of material goods. These displays were made particularly magnetic by bright lights, rich decorative backgrounds, and an army of mannequins which gave the displays a certain theatricality whose implied subject was the consumer staring into the tableau.

Window displays created the suggestion of intimacy between object and consumer, apparently leaving only the immaterial glass itself between consumer and commodity. At once they stimulated desire but deferred it. Yet the implication that display windows democratized desire, if not consumption, was an illusion. Department stores overwhelmingly were located in élite downtown shopping districts rarely frequented by marginalized consumers, and in some cases such stores barred African-Americans from entry. Other stores arrested 'undesirable' window shoppers: in 1908, a young man pondering a women's underwear display in Spokane, Washington was escorted to jail after his refusal to leave, and in 1915 a crowd of African-Americans window shopping in Washington, DC were arrested on the wishes of apprehensive anti-Black marketers (Leach 1993:66; Mullins in press). Stores in the American South often placed numbers by goods being sold in the window so that African-Americans could request a good by number (Mullins in press). Such a marketing strategy secured the spending of African-Americans but denied them the privilege of shopping a store's full stock.

Inside department stores, consumer discipline faced a persistent flood of challenges. Perhaps the most interesting reflection of gender ideology and the contradictions of affluence was the phenomenon of middle-class women shoplifters. During the late nineteenth century and the early twentieth, department stores were plagued by a rash of shoplifting by 'respectable' genteel women (Abelson 1989). Rather than scattered irrationality by disconnected shoppers, Elaine Abelson (1989) observes that shoplifting was a pervasive social negotiation of class and gender inequalities which converged in consumer space.

The department store floors which witnessed such shoplifting were spectacular shows of an enormous range of splendidly displayed goods. Unlike rarely pilfered general stores or public markets, department stores were intense spaces in which crowds gathered in mass affirmation of material desire. Yet for some shoppers rational consumer restraint, the ambiguity of genuine 'need', and the constraints of class and domestic subjectivity harboured profound contradictions. Most shoplifting women were homemakers, with no economic independence and little power over their lives, who were driven by no universal impetus. Their transgression of consumer discipline and the domestic ideal threatened mainstream morality by illuminating the incongruities of rational desire and femininity. Public thievery by such 'upstanding' women also was a class violation; it starkly demonstrated codes of conduct which separated genteel classes and the undifferentiated masses who had not secured the privileges of consumer citizenship.

Observers concerned with the reproduction of consumer discipline and domesticity used the foil of the 'kleptomaniac' female shopper to outline the inverse of the ideal consumer. Ideologues ranging from store managers to ministers fostered consumer discipline by demonstrating its polar opposite, the uncontrolled middle-class female shopper. Physicians publicly situated shoplifting in women's essential nature, an illness which amplified the attributes lurking beneath the surface of all women. Ostensibly commentators were concerned with the reform of respectable women gone wrong, but the real target of such discourse was other consumers. The police columns, society pages, and community news in every local paper reported shoplifting religiously as a mechanism to display the opposite of the ideal disciplined consumer. Such discourses disciplined consumers not by outlining codes of conduct but instead displaying the inverse of that common-sense discipline. Advertising did the same thing by depicting ideal consumers, men and women who always were white and middle class, with women serving in domesticated roles and African-Americans appearing as service labourers (e.g., domestics, waiters, etc.) to 'real' consumers. Through such mechanisms, disciplined wage labourers with particular racial and social attributes were extended the potential promises of material affluence provided they internalized consumer discipline, a consumer discipline which ultimately served the state's interests in a disciplined workforce.

CONCLUSION: UNCOVERING THE MATERIAL CULTURE OF SURVEILLANCE

The archaeological consideration of baroque and panoptic architecture built in colonial contexts—be they North American, Spanish or Dutch—reveals the importance of surveillance in the construction and maintenance of expanding colonial states. In this chapter, we have touched upon several of the mechanisms through which state institutions have organized technologies of seeing and self-watching. The material manifestations of these mechanisms are often retrievable from the archaeological record. In this concluding section, we would like to suggest, first, how the material culture of surveillance can be found archaeologically, and, second, why such an enterprise should be undertaken. In doing so, we would like to reiterate that historical archaeology is really a composite, or interdisciplinary, enterprise through which scholars interpret the material remains of the recent past. As such, there are a number of data sets to which an archaeologist concerned with the material manifestations of colonial states can turn.

As the creation of a disciplined citizenry or subject population often requires the recreation of spatial logic or the imposition of landscapes of surveillance, and because these efforts are often preconceived, historical archaeologists should turn to the cartographic record of colonial expansion. Many colonizing states made meticulous maps of their conquests and colonies, on many different scales, from the continental to the individual estate. Such records often reveal the intended or actual layout of settlements, as we have demonstrated in our discussion of the landscapes of St Mary's City and Annapolis. Analysing such records can reveal the intentions and results of preconceived surveillance landscapes (Delle 1998; Shackel 1994). Similar cartographic sources can be examined in the interpretation of industrial urban landscapes (e.g., Mrozowski 1991; Mrozowski *et al.* 1996), as well as agricultural landscapes such as those incorporated on plantations (e.g., Delle 1996, 1998).

Historical archaeologists can, and should, turn to a variety of documentary sources in the effort to interpret the material culture of surveillance. Surveillance is carried out from towers. Many of the illustrations featured in this chapter depict external towers and façades which rise up over people, congregations, inmates, and students. Surveillance surrounds with a gaze from these peaks in a landscape. These are not small mechanisms for they can compose whole villages, factory towns, and the mountains of waste produced by mines and other extractive industries. These mountains all have ramps and roads on them, allowing a type of moving surveillance. Round and octagonal schools enclose, on the one hand, and pivot all bodies to the centrally placed master on the other. A careful inspection of Figures 28.4 and 28.10 will reveal houses and villages in view of the anthracite breaker and mission San Xavier, respectively. Each typifies the mechanisms of surveillance.

The internal side of surveillance is the creation of an individual who thinks he or she belongs to the watchful community. Benedict Anderson (1991) calls the result of such external and internal colonialism *Imagined Communities*. Anderson discusses the role of schools in producing colonial administrations, a special kind of cultural half-breed, who, once trained in bureaucratic techniques, becomes the kind of watcher who makes maps, takes censuses, writes dictionaries, and makes inventories of local ruins. Imagined communities can be created by printing, reading, and writing uniform scripts in languages defined as legitimate. This process automatically relegated other languages to illiteracy.

The negotiation of such imagined communities has resulted in what historical archaeologists typically call the documentary record. The analysis of both private and public papers held in various archival repositories will often reveal the social conditions which agents of colonial states hoped to transform, or to maintain. Such records can be found in national libraries in metropolitan colonial capitals (e.g., Library of Congress, British Library, Public Record Office), in the capitals of colonized states (e.g., the Jamaica Archives), in regional libraries and archives (e.g., state or county courthouses), and often in the private libraries of the descendants of colonialists. The archaeological record itself contains both subsurface and architectural evidence for the mechanisms of surveillance. While standing architectural remains can be complex, particularly in cases where buildings have been reconstructed one or more times, this class of record often provides the best evidence for the mechanisms of surveillance. Before excavations begin, historical archaeologists should examine the architectural remains of any buildings on the surface which might date to the colonial episode in which they are interested. The subsurface remains of buildings, including foundations, disused walkways and pavements, yards, and gardens, all can provide evidence for how individual houses or estates served as surveillance mechanisms. Similar features can be uncovered during the excavations of prisons, insane asylums, factories, missions, or other types of state institutions. Excavations of each of these latter examples will reveal features unique to the type of institution in question. However, once excavated, the architectural remains should be plotted on larger maps in order to interpret the relationships which existed between structures, which is a key to understanding the landscapes of surveillance.

Other types of material culture recovered from excavations can reveal how surveillance mechanisms worked. For example, the regularity of the individual conforming to a state-imposed order can be interpreted from the appearance of standardized ceramic assemblages. Diachronic studies of such small finds can reveal changing consumption patterns, and how those patterns of behaviour in turn created a consuming citizenry, disciplined in their participation as both producers and consumers in a national economy (Mullins 1996). While such studies have to date concentrated on refined earthenwares, interpretations of other types of material culture are possible, including locally produced earthenwares, opium pipes, and glass, to name just a few (Adams 1976, 1982; Mullins 1992; Riordan and Adams 1985; Spencer-Wood 1987; Turnbaugh 1985; Wylie and Fike 1993).

If, as most practitioners accept, the field of historical archaeology is concerned primarily with the expansion of European states and the impacts they have had on indigenous peoples (Deetz 1977, 1991; Orser and Fagan 1995), then a central focus of the enterprise should be on the mechanisms of state expansion and control. In this chapter we have outlined several of those mechanisms, particularly the mechanisms of surveillance of the individual, and how these have been interpreted archaeologically. We believe that when historical archaeologists use this approach they can produce studies of great interest, not only to other historical archaeologists but also to those interested in the political and social dynamics of complex societies in general. Matthew Johnson's *An Archaeology of Capitalism* (1996) is both such a book and an illustration of how to tie historical archaeology back to modern colonialism's European home. Johnson examines the ways, habits, and institutions that England used to create a nation out of itself. He describes landscapes of enclosure, building a national culture through the use of parish churches, house placement, the use of curtains and shutters for privacy, the building of inventories, maps, and the employment of the technical knowledge associated with the Renaissance. Johnson shows how the seemingly unrelated celebration of local histories, improvement of farming methods with how-to books, elimination of the category of witchcraft, and use of mould-made tablewares, were all employed in homogenizing a population—in creating a disciplined English citizenry.

Analyses such as Johnson's should be pursued, not only for their intrinsic scholarly interest but because each one of us in the modern world is still subject to increasingly powerful disciplinary mechanisms. By understanding how state power is reproduced at the level of the individual we can begin to reveal the processes through which individuals in the contemporary world are shaped by existing institutions, controlled today by both state and corporate powers. Quetzil Casteñada's *In the Museum of Maya Culture* (1996) provides an important description of how the state can use a rebuilt ruin, in this case Chichén Itzá, to contain and control a local population. While Benedict Anderson amply shows the colonial origins of ruin cataloguing and landscaping, Casteñada goes far beyond the building of tourist monuments into the state's negotiating of what is and is not authentic culture and thus the domestication of anthropology's central concept, culture, for state control. The physical site for surveillance is the tall ruin with its usually immaculate surrounding lawn. The inner world of self-monitoring involves both the tourists, who seek (and find) something each has learned is not yet in their lives, concerns, or resumés, and the guides and hawkers, who as residues of those who built the wonders can only sell the invented fragments which doubly prove they are incomplete individuals, subject not only to the eyes of the state but also to the gaze of the tourist.

As surveillance technologies become more sophisticated, each of us continues to be monitored in increasingly hard-to-detect ways by centralizing agents not only of the state, but of the evermore powerful gaze of multinational corporations. Both seek to create of us a fragmented, disciplined population of consuming individuals. It is well worth our time, as students of material culture, to examine how these mechanisms work to create and perpetuate the modern state.

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29

THE ARCHAEOLOGY OF INDUSTRIALIZATION

Marilyn Palmer

INTRODUCTION

Industrialization brought about a fundamental transformation in the social and economic structure of the western world in a very short space of time. Within a century, the adoption of sources of power other than human or animal muscle, together with the use of artificial lighting, meant that the lives of men and women need no longer be governed by the rhythm of the seasons, or even those of each day and night: they became subservient to the incessant demands of a machine which never slept. Traditional craft skills were no longer a valuable asset, since the machines could guarantee a standardized product which satisfied consumer demand, and speed of output was the main requirement. The nature of technological innovation meant that the production process was broken up into a number of discrete stages, since all processes were not mechanized at once: the yeoman clothier of Yorkshire in England, who had taken in wool and marketed his finished 'piece' in the cloth halls of Halifax or Leeds, was replaced by a spinner working in one place and a weaver in another. This fragmentation of the production process gave much greater powers of control to the capitalist entrepreneur, who could manipulate its different stages to satisfy market demand. His ability to control his workforce was assisted by its changing composition, since a man's strength was no longer a prerequisite for many of the tasks he had once carried out and these could now be undertaken by women and children. Of necessity, the workforce lived near the mill, factory or workshop, enabling the entrepreneur to exercise some surveillance over their domestic as well as their working lives. The settlement pattern was transformed, and the pace of urbanization quickened. Increased output demanded a change in the transport infrastructure, and within the same century tracks became paved roads and river navigation was supplemented by canals and railways. The construction of these still made use of human muscle, as machines were slow to replace a male workforce eager for employment when strength and persistence were the main requirements: technological innovation *per se* is a product of the twentieth rather than the nineteenth century, when manufacturers and employers were only too ready to spare their capital if people were available to undertake the tasks at a cheap rate. Such attitudes also prevailed in the extractive industries, where what was possible technologically was not necessarily employed when a cheap labour force was available.

What therefore characterizes the period of industrialization in Europe is not so much the power of the machine as the increasing ability of employers to exercise control over their workforce, whose proliferation in numbers was perhaps the dominant feature of the late eighteenth and early nineteenth centuries. In America, on the other hand, where industrialization was largely a nineteenth-century phenomenon, technological innovation was encouraged by the scarcity of labour, although immigration on an immense scale supplemented the indigenous workforce.

Since the purpose of archaeology is to ascertain changes in the human condition through analysis of the material record, the period of industrialization offers unparalleled opportunities because of the wealth of artefacts, standing buildings and alterations to the landscape which it brought about. But archaeology, like landscape history, has tended to stop short of the period of industrialization, perhaps overwhelmed by its enormity. The great landscape historian W.G.Hoskins resented the 'tide of industrialism' which overtook the rural communities in which he was interested, and regarded the whole process as the replacement of a qualitative by a quantitative culture. To him, it created 'landscapes of horror': between the new industrial towns, he says:

> stretched miles of torn and poisoned countryside—the mountains of waste from mining and other industries; the sheets of sullen water, known as 'flashes', which had their origin in subsidence of the surface as the result of mining below; the disused pit-shafts; the derelict and stagnant canals.
>
> (Hoskins 1955:229)

The very unattractiveness of the material record, then, hindered its study. The process of industrialization was the province of the economic historian, who was protected from the realities of its human outcomes by the nature of the archive material. The social historian did become immersed in the conflicts generated by the changing relationships between employer and employee, but since most of the latter were illiterate, the written sources indicate what it was assumed they felt and are not firsthand accounts in most instances. This is where archaeology becomes important, since for all periods it has been concerned with explaining changes in the human condition and deducing reactions to those changes without the benefit of documentary material. Archaeologists also deal, in general, with the nameless and the faceless rather than the individual, and so it is an ideal discipline for understanding the workforce of the industrial period, as well as for analysing changes in the landscape. Until recently, however, few practising archaeologists have ventured into the period.

The wealth of standing buildings and even surviving machinery has, however, encouraged the growth of a rather separate discipline known as industrial archaeology. For reasons which will be explained below, both in Europe and America its practitioners have largely been concerned with the functional descriptions of sites and buildings and the elucidation of the technologies involved. The very wealth of material evidence has encouraged concentration on the processes of production and distribution, without much thought either for the products themselves or the people involved in making and selling them. Yet, in the early days of the discipline, a leading industrial archaeologist could write:

> Industrial archaeology is, of course, ultimately concerned with people rather than things: factories, workshops, houses and machines are of interest only as products of human ingenuity, enterprise, compassion or greed—as physical expressions of human behaviour. From whatever standpoint the subject is approached, man is the basic object of our curiosity.
>
> (Smith 1965:191)

Few industrial archaeologists have, however, followed his lead, yet that is what must happen if industrial archaeology is to be synonymous with the archaeology of industrialization. It is now a well-established term in world-wide usage and should not be abandoned in favour, say, of historical archaeology. It is undoubtedly part of that discipline, but its parameters of interest are more closely defined. Industrial archaeology is the study of the physical evidence of past industrialization, but needs to embrace not only the workplace but also the workforce and the wider cultural context in which its members functioned.

The remainder of this chapter will look at the origins of the discipline of industrial archaeology and suggest how its scope could be widened so that it becomes the archaeology of industrialization. Its main focus will be Britain, but reference will be made to parallel developments in Europe, America and Australia.

ORIGINS

Industrial archaeology originated in Britain in the 1950s, after the post-war preoccupation with renewal had led to the destruction of much of the landscape associated with early industrialization. Its initial impetus was an attempt to catalogue and preserve selected relics of the period when Britain was the world leader in the process of industrialization. Industrial archaeology was a spontaneous growth, resulting in volunteer activity on a considerable scale in both preservation and recording. The Council for British Archaeology tried to give some shape to the latter by the introduction of record cards, which eventually grew into the National Record of Industrial Monuments (NRIM) based first at the University of Bath under R.A.Buchanan and later subsumed into the National Monuments Record (NMR) of the Royal Commission on the Historical Monuments of England (RCHME). The Commissions in England, Scotland (RCAHMS) and Wales (RCAHMW) have come to play an important role in industrial archaeology, undertaking specific surveys (for example: Douglas and Oglethorpe 1993; Giles and Goodall 1992; Hughes 1988, 1990) and spearheading attempts to ensure that sites and structures dating from as late as the twentieth century are included on both national and local Sites and Monuments Records. English Heritage has gone so far as to state that 'if there is one archaeological topic in which England can claim to have international pre-eminence, it is in the industrial archaeology of the post medieval period' (English Heritage 1995).

Concern with selection for preservation is no longer, therefore, entirely in the voluntary sector, and English Heritage, as part of its Monuments Protection Programme (MPP), commissioned the first comprehensive surveys of a range of industries so that priorities could be assessed and more industrial monuments included in the list of Scheduled (that is, protected) Monuments. The Association for Industrial Archaeology, which was set up in 1973 to represent the interests of industrial archaeology, still attempts to hold a balance between the volunteers, who have dominated industrial archaeology in the past, and the professionals, now the major players in the field, as well as publishing the major British journal in the field, *Industrial Archaeology Review*.

In Europe, the value of the physical remains of industry took rather longer to be appreciated. Although French historians had for a long time been interested in industrial history, little notice was taken of industrial sites until the 1970s and it was not until 1983 that the *Inventaire Générale* began to include industrial sites with the foundation of an industrial heritage group within it, the *Cellule du Patrimoine Industriel*. Various thematic surveys are being undertaken by this group and several regional publications have emerged (Belhoste 1988; Belhoste *et al.* 1984, 1994). A long-term project to create a national database of French industrial sites was initiated in 1986, and a similar database project has begun in the Netherlands where responsibility for the industrial heritage has now passed to the Projectbureau Industrieel Erfgoed (PIE), created in 1992. In Belgium, various categories of industrial building have been surveyed, particularly watermills and windmills, and a national survey published (Viaene 1986). The Scandinavian countries have an important industrial heritage which is increasingly being recognized by their governments. In Norway, buildings and sites of industrial interest have been recorded both by the Council for Culture and the Norwegian Technical Museum, while in Sweden the Central Office of National Antiquities is monitoring various recording initiatives. The ending of the Cold War has resulted in various east European countries having greater contact with western traditions and recognizing the wealth of their industrial heritage. Further afield, industrial archaeology has made rapid progress in Australia since the 1960s with National Trusts in each state including industrial sites and buildings in their registers (Donnachie 1981).

In the United States, the Historic American Buildings Survey (HABS) was created in the 1930s as a means of providing work for unemployed architects. Industrial buildings fell within their remit, but responsibility for recording them is now shared by the Historical American Engineering Record (HAER), established in 1969 under the aegis of the National Park Service, which itself dates back to 1916. The records are maintained by the Library of Congress in what is termed 'preservation by documentation', a concept similar to the British NMRs. Whereas the NRIM in England utilized amateur enthusiasts in the recording process, the HAER surveys are undertaken by university staff and students working under contract to the National Park Service. They have usually been architects and engineers: only after twenty-five years of activity did the National Park Service first employ an archaeologist on an HAER project, a survey of a hard-rock mining site in the Mojave Desert of California, and they envisage further cooperation between the various disciplines (Andrews 1994). Recording has not always ensured preservation and the HAER records form an invaluable inventory of the industrial built environment of the United States (Burns 1989).

At an international level, the General Council of UNESCO has adopted a policy of designating important cultural and ecological sites as World Heritage Sites (see Chapter 10). Around 300 have now been accorded this status, but only a handful are industrial sites. These range from the Ironbridge Gorge in Britain to the Potosi tin mines in Bolivia and a salt mine at Wieliczka in Poland. The International Committee for the Conservation of the Industrial Heritage (TICCIH) was established in 1973 and has led to increased awareness of the importance of the industrial past. It is seeking a more formal organization and consultation by UNESCO on further industrial World Heritage Sites. Many of its members have contributed to *The Blackwell Encyclopaedia of Industrial Archaeology* which seeks to set the discipline in its world context (Trinder 1992).

DEFINITIONS AND SCOPE

Industrial archaeology, then, unlike other period studies in archaeology, grew from concern about the future of standing structures rather than as an academic study concerned with deriving information from the tangible evidence of a period of the past. It has proved difficult to detach it from the complementary, but not identical, concept of industrial heritage, yet that is essential if it is to take its proper place as a component within the academic study of archaeology as the archaeology of industrialization.

Most early definitions of 'industrial archaeology' included elements of recording and preservation in their phraseology, and defined the period of interest as that of the Industrial Revolution (Buchanan 1972; Cossons 1975; Rix 1967). Other practitioners chose a less restrictive definition, arguing that the discipline was a thematic rather than a chronological one and could range from the prehistoric to the modern period (Hudson 1963; Raistrick 1972). This dilemma, frequently discussed (for example: Palmer 1990), needs resolution if industrial archaeology is to develop the necessary theoretical foundation it has so far lacked. If it is accepted that 'archaeology' can reasonably include the systematic study of standing as well as sub-surface structures, and few would now disagree with this, then it is the term 'industrial' which requires further analysis. It is generally taken to mean organized production of artefacts on a scale larger than a craft, but there are elements of this kind of production in most archaeological periods.

As suggested earlier, what perhaps characterizes the classic period of 'the Industrial Revolution' is capital investment on a large scale in both buildings and machinery and the consequent organization of the labour force to maximize production. It is with this development that industrial archaeology is largely concerned, although it must be recognized, first, that 'industrialization', in this sense, began earlier in some industries than others and, second, that the domestic method of production continued to coexist with factory production, albeit with many changes in the lifestyle of the workforce (Bythell 1978; Samuel 1977; Timmins 1993). Industrial archaeologists should therefore be concerned with interpreting the physical evidence of the vast social and economic changes which have overtaken society in the past 250 years or so. Within this period, like other archaeologists, they are contributing towards 'the basically anthropological task of understanding everyday life in the past and what accounts for its structure' (Leone and Potter 1988:372).

INDUSTRIAL ARCHAEOLOGY AND HISTORICAL ARCHAEOLOGY

Since industrial archaeology began as a campaign to preserve, or at least to record, selected sites and structures deriving from the industrial past, it is hardly surprising that its practitioners were so concerned to assert the significance of their field evidence in the archaeological record that they tended to minimize the importance of other sources of evidence in giving meaning to those sites and structures, except in a technological sense. While some of the work has contributed considerably to a greater understanding of the typological development of particular structures (see Palmer and Neaverson 1989; Patrick 1996; Sharpe *et al.* 1991), the relationship of these sites and structures to the social development of industrialized society has rarely been considered. The latter dimension has been regarded as the province of the economic historian, and British industrial archaeologists in particular have fought shy of making as much use of documentary sources as historical archaeologists in America and Australia. Yet, as Deetz has said, 'the combined use of archaeological and documentary materials should permit us to say something about the past that could not have been said using only one set of data' (Deetz 1996:32). The combination of both types of evidence, for example, has made it possible to demonstrate the longevity of outwork alongside factory production in a number of nineteenth-century British industries (Palmer 1994). Industrial archaeologists are fortunate among archaeologists in the range of sources at their disposal for the interpretation of physical remains and should regard this as a strength rather than a weakness in their discipline.

Artefacts are the main component of the archaeological record, yet historical archaeologists and industrial archaeologists are at opposite ends of the spectrum in their consideration of these. To most historical archaeologists, artefacts comprise the main body of evidence from which information about the lifestyles of past societies is derived. Variations in the type and distribution of artefacts indicate material change and prompt investigation into its causes. Industrial archaeologists, however, have chronicled the development of the means of production in terms of textile mills (for example: Giles and Goodall 1992), pot-kilns (Baker 1991) and so on, but have paid little attention to the consequent effect of this development on the nature of the artefacts produced, and therefore of material change.

This is clearly a field in which the two disciplines need to work together, as has been done, for example, in aspects of the nineteenth-century glass industry in America. Here, archaeological work on production sites has produced typological sequences (for example: Lorrain 1968; Miller and Pacey 1985; Starbuck 1983) which demonstrate the progress of standardization in the products, and the increasing use of moulds and pressing machines rather than the traditional free-blowing techniques. The evidence prompts questions about the causes of technological change, for which changing levels of demand would be the traditional explanation: a rising population needing increased supplies of everyday items. However, technological change also implies a change in the nature of the labour force, with traditional skills less in demand and the speed of output the key element in production. The artefactual evidence therefore also prompts an enquiry into the changing nature of labour relations in the glass industry, which could be reflected in the design of the workplace and any associated housing. This kind of extrapolation from the nature of the artefacts to the labour force responsible for their production and to the physical nature of the environment in which they were produced is as essential for industrial as for historical archaeologists. The former have much to learn from the theoretical approach so powerfully advanced by American historical archaeologists (for example: Glassie 1975; Leone and Potter 1988).

AN ARCHAEOLOGY OF CAPITALISM?

The industrial archaeologist is therefore concerned with documenting and explaining the changes in material culture which took place in a period of rapid social and economic development. Patterns of mass consumption led to new systems of production involving considerable technological change, which in turn created new systems of discipline in the workplace. It is very tempting, therefore, to accept the Marxist model as a means of explanation, since undoubtedly in this period much social change was generated by the contradictions arising between the forces and the relations of production; that is, between a capitalist organization utilizing new technology and the social organization of the workforce which had to adapt to a new working and often also a new domestic environment. Looked at in this way, the introduction of a new steam engine into a previously water-powered mill, a common phenomenon in the nineteenth century which can be identified both from physical and documentary evidence, probably involved the workforce both in learning new skills and also in more rigorous shift work, since the owner would wish to recoup his capital expenditure by keeping the engine working on a continuous basis. Such shift work would have repercussions in the domestic environment and necessitate residence close to the place of work. The resolution of this conflict between the new technology and the social organization of the workforce which operated it would be, in Marxist terms, an example of the way in which society advanced.

Some European industrial archaeologists, especially those working on the textile industries, have accepted this mode of explanation, for example Manuel Cerda in Catalonia (Cerda 1991). In America, Paynter has argued that capitalist-worker conflicts underlie many of the innovations which appear in the archaeological record and that class models go a long way towards explaining change in the material world (Paynter 1988). But such a monocausal explanation is too restrictive: not all sites and structures of the industrial period, anyway, lend themselves to generalizations. Most industrial archaeologists are, in fact, content with what might be called a historical explanation of their site: that knowing as much detail as possible about the chronology of events accounts for the nature of the material record, without going beyond that to look at its general significance in accordance with any accepted models of explanation. This is obviously not sufficient if they are to contribute to a broader understanding of the development of human society, and a solution may well be to adopt the link between description and explanation offered by Hodder's definition of 'contextual archaeology'. He argues that description and explanation are indissolubly related as the whole network of associations and contrasts is followed through in order to arrive at a picture of the total context (Hodder 1986:143). In industrial archaeology, these associations include not only labour relations but also sources of raw materials, methods of processing and transport networks: these are all part of the capitalist mode of production, but lead the archaeologist into a careful examination of changes in the landscape; that is, changes in spatial organization, which are linked to, but not identical with, changes in social organization. The Marxist model of explanation is useful but not all-embracing.

Matthew Johnson has argued that an important facet of capitalism is the placing of the individual at the centre of its ideological base (Johnson 1996:203). This echoes Hodder's view of the active role of material culture: it is not a passive reflection of society but has been deliberately used by individuals to negotiate social position and bring about social change (Hodder 1982, 1986). The form of objects and

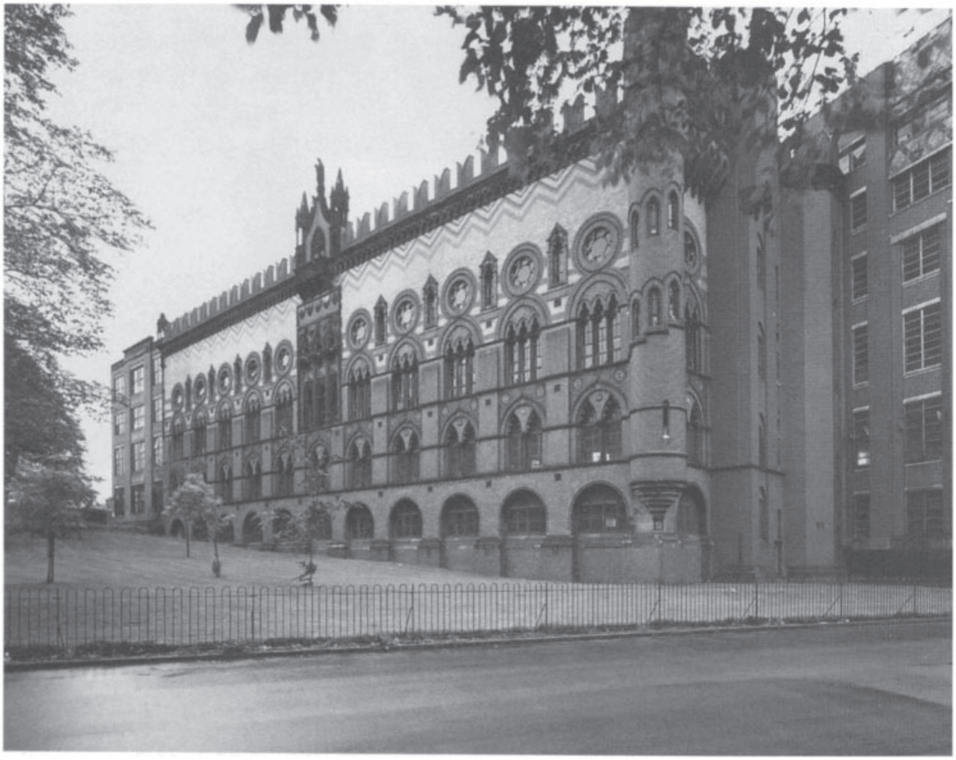

Figure 29.1 Individualism: the former carpet factory built for James Templeton in Glasgow, Scotland, in 1889. Designed by William Leiper, the polychrome brick and stone façade is in the Venetian Gothic style. Crown Copyright: Royal Commission of the Ancient and Historical Monuments of Scotland.

structures is the result of deliberate choice rather than environmental determinism. Of course, on industrial sites environmental factors like the presence of raw materials, the existence of a good water-power site and the immediate topography all influence its location, but human agency is ultimately responsible for the form (Palmer and Neaverson 1994:1–17). Typological study of a series of structures may enable generalizations to be made about their development, and may also help to establish the position of a particular object or structure in a chronological sequence, but the role of the individual cannot be omitted from the equation. The capitalist could design the structures he financed not only to maximize production along Marxist lines but also to emphasize his social position: for this reason, many nineteenth-century textile mills are models of polite rather than functional architecture. Josiah Wedgwood's personal interest in classical prototypes can be seen in Staffordshire pottery of the late eighteenth century, especially in the development of pastel-coloured, white-sprigged jasperware. The individual influence is discernible in the archaeological record: the industrial archaeologist is often fortunate in that

Figure 29.2 Standardization: one of the many cotton spinning mills built in Lancashire, England, using Accrington brick. The only concession to individualism is the name of the company on the corner tower housing the water sprinkler cistern. Photograph: M.Palmer.

the range of sources available for the period may enable the individual to be named, which is not often possible for earlier archaeological periods.

Industrial archaeology, therefore, is the study of a period dominated by the growth of capitalist organization in industry, and the archaeological record can add much to an understanding of the influence of capitalism on society. It should not, however, be seen only as an adjunct to theoretical models of class analysis, although undoubtedly the material record can shed considerable light on the adaptations made by the workforce to new modes of production as well as their resistance to them. Capitalist organization can be detected in the landscape: in the large-scale development of extractive industry; transport networks on a scale never previously seen; and new kinds of settlement patterns, such as the model villages of the early cotton industry in Britain. The standardization of products is very obvious in the artefact patterns of the period, but equally so are the attempts to resist this—for example by the Arts and Crafts movement of the late nineteenth century. Buildings, too, exhibit a degree of standardization, but many indicate the individualism characteristic of many entrepreneurs: one only has to contrast the red-brick

Figure 29.3 Individualism displayed on a coal-mining complex in southern Spain. The functional pit head structures contrast with the bartizan-bedecked electricity transformer house on the right. Photograph: M.Palmer.

nineteenth-century textile mill characteristic of the Lancashire cotton industry with James Templeton's bizarre carpet factory in Glasgow built in polychrome brick and stone in the Venetian Gothic style to appreciate this point (Figs 29.1 and 29.2). Figure 29.3 illustrates how standardization and individualism could be combined in a single site, in this case a coal-mining complex in southern Spain.

INDUSTRIAL LANDSCAPES

Landscape is, of course, often taken to mean natural scenery to which the onlooker reacts aesthetically and is therefore devoid of human interference. But to the historian and the archaeologist, landscape is the physical manifestation of changes wrought by people in both space and time. It therefore includes buildings, not as discrete entities but in their relationship to one another and to their topographical setting—in other words, their spatial distribution.

One of the major reasons for studying industrial landscapes is to transform a collection of individual structures into a coherent whole which has meaning in both technological and cultural terms. Technologically, the interrelationship of buildings and features in the landscape is usually determined by sequences of industrial production, as in the landscapes of metalliferous mining considered below (pp. 1186–91). Culturally, these interrelationships can reveal systems of industrial organization and social relationships, particularly those between the employer and his workforce as previously discussed. These spatial relationships are horizontal ones, manifested on the surface of the land. There are also vertical or sequential relationships which are equally components in the industrial landscape, the results of both technological and cultural change through time. The task of the industrial archaeologist is to analyse the industrial landscape in terms of both the spatial and the sequential relationships of structures and features in order to illuminate the process of industrialization.

Early definitions of industrial archaeology emphasized the importance of the industrial monument, an inevitable consequence of the need to protect selected examples of the industrial past, which in turn has led to the creation of inventories of sites and monuments in many countries. The site-specific tendency has been increased by volunteer participation, since few local groups possess the resources to undertake far-ranging studies. Increasing professional activity in the field has begun to reverse this trend, and most fieldwork and research programmes now reach beyond the structures of prime technological significance to consider their wider context, examining sources of raw materials, provision of power, transport systems, associated industry and accommodation (Crossley 1994; Palmer and Neaverson 1994:13–17). Studies of industrial landscapes normally take one of two forms: extensive surveys of particular areas; or more limited surveys of features associated with a particular site or structure.

In Britain, foremost in the former category is the Nuffield-funded survey of the internationally important landscape of the Ironbridge Gorge, which sought to reveal change over time by means of detailed plot surveys (Alfrey and Clark 1993). The methodology may well be applicable to other landscapes, although few have survived so well as this World Heritage Site. The RCHME has developed a variety of strategies for extensive landscape survey, both to make good deficiencies in the NMR and to meet the needs of a variety of users. One such strategy made use of map evidence and aerial photographs to create a database of sites which could then be followed up by field enhancement. Three areas have been covered in this way: the Yorkshire Dales, the North Pennines (the part formally designated as an Area of Outstanding National Beauty) and the National Forest. The RCHME concluded that these rapid surveys had limited use (sites were not sufficiently considered in their historical context, so they revealed spatial but not sequential relationships) and that a balance needed to be struck between rapid survey and the creation of an intelligent, usable, record which reflected the linkages between sites (Lang 1995).

A different strategy has been to undertake ground-based field survey on landscapes known to be important, such as the early coal-mining area of Clee Hill in Shropshire or the Honister slate quarries in Cumbria, with their well-preserved tramway systems. Such field surveys have made minimal use of background research because of time constraints, but the complex nature of other landscapes has demanded a more integrated approach. This has been especially true where structures from the production process survive in the landscape, involving understanding of the sequence of a particular industrial activity. The ending of the Cold War has released many previously classified sites, some of which are in need of decontamination, and the RCHME has been involved in recording and researching sites and structures of the defence industries, including that of the Royal Ordnance Works at Waltham Abbey in Essex (Everson 1995; Everson and Cocroft 1996; Fig. 29.4). Fieldwork *per se* would not have been appropriate, since these sites clearly needed a historical context if their significance was to be appreciated: equally, the archaeological survey has revealed adaptations of buildings to contain new processes which were never recorded in writing.

Landscape surveys intended to give a context to structures of technological significance have not been carried out as frequently as they might have been. Few have attained the depth of the survey and excavation of Chingley Forge and Furnace in Kent (Crossley 1975), although the RCHME is currently attempting to document the sources of raw materials and fuel associated with the important charcoal iron furnaces of the southern Lake District. A similar study sought to set in context the historic charcoal kilns near Eureka in Nevada, which provided fuel for the silver mining industry of the late nineteenth century (Zeier 1987).

Transport systems such as railways and canals have usually been studied historically, but landscape surveys can elucidate their relationship to the sources of their cargo—

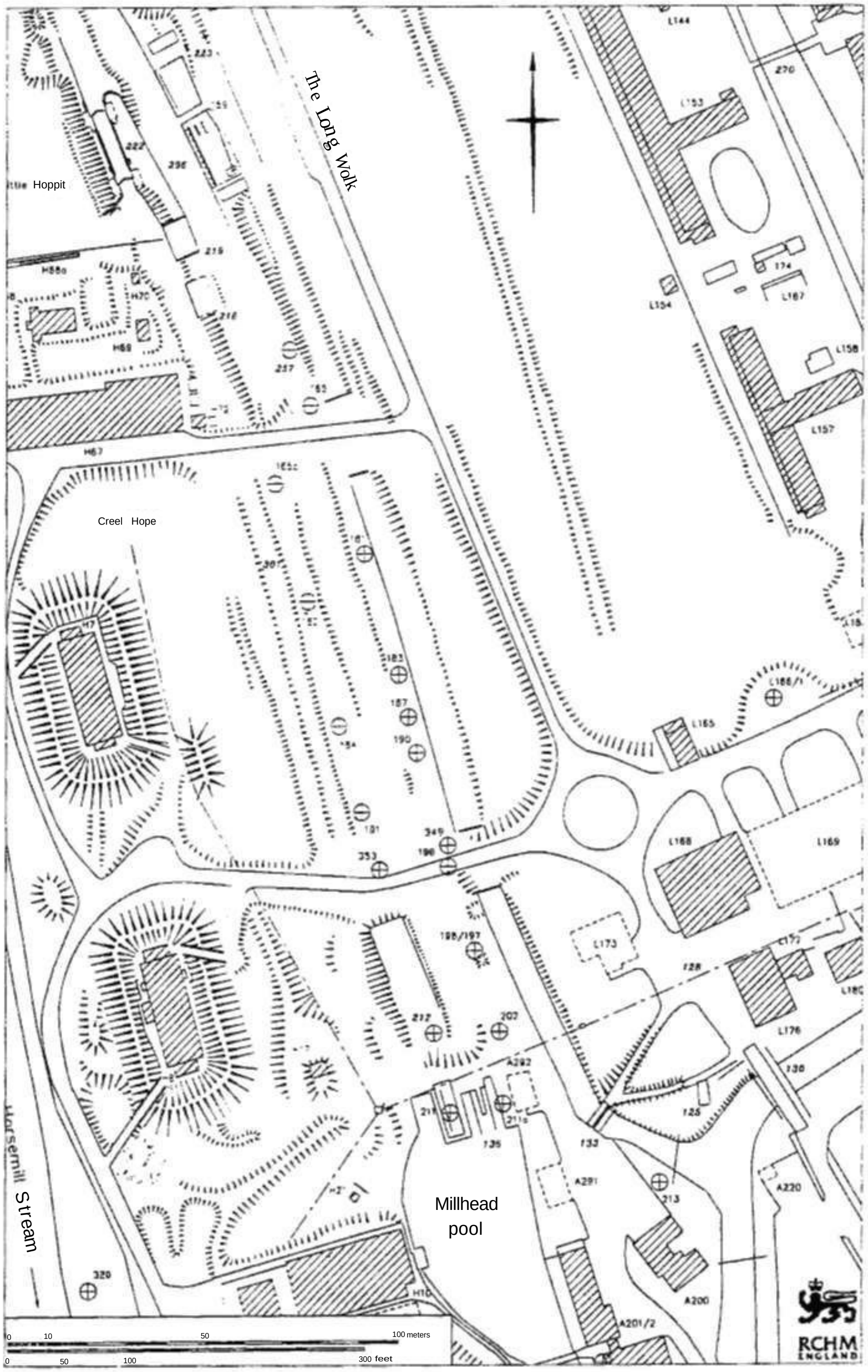

Figure 29.4 A complex industrial landscape: an extract from the Royal Commission on the Historical Monuments of England survey plan of Waltham Abbey Royal Gunpowder Factory. The plan shows both standing buildings and buried archaeology, the latter identified by numbered targets. Crown Copyright: Royal Commission on the Historical Monuments of England.

mines, quarries, limekilns, ironworks and so on. Stephen Hughes of the RCAHMW has illuminated the relationship between the linear features of the Montgomeryshire Canal and the Swansea Canal, together with a system of tramways which eventually extended the hinterland of the latter into the Brecon Beacons, and the trading patterns and settlements which they both served and generated. The canals and their feeders were also used as sources of power for the iron furnaces and foundries using water-wheels to drive bellows as well as a range of mills for corn-grinding, saw-milling and fulling. Limestone was an important cargo on the canals and recording work has been carried out on the limekilns to be found along the routes. The canals and tramways influenced settlement patterns, ranging from the isolated but complex depots at Sennybridge and Cnewr on the Brecon Forest Tramroad through the large warehouses at Newtown and Welshpool on the Montgomeryshire Canal to the many isolated houses at locks and wharves also to be found on the latter, many in a distinctive black and white patterned style (Hughes 1979, 1988, 1990). Studies such as these are the essence of industrial archaeology, revealing both the spatial links in the landscape and the social context of technological development.

Industrial archaeology can undoubtedly contribute to the understanding both of the physical changes to the landscape and of changes to the fabric of society which have been brought about by the development of capitalist industry in the last 250 years or so. It needs to move beyond the description of the surviving physical evidence to an understanding of the significance of that evidence, making use of all available sources in doing so. The adoption of a theoretical model of change, such as the Marxist one of class conflict, may be appropriate in helping draw out the full meaning of the evidence, but not to the exclusion of other interpretations. The remainder of this chapter will explore how industrial archaeology has contributed to the debate over the nature and progress of industrialization in two major arenas: the production of textiles and the extraction and processing of coal and metals. These case studies have been chosen to illuminate the importance of both social context and spatial organization in the study of the archaeology of this period.

SOCIAL CONTEXT: THE TEXTILE INDUSTRIES

The manufacture of textiles is probably the most widespread of all industries, since provision of clothing was a fundamental necessity of life. In the medieval period, production on any scale was an urban craft dominated by the guild system, but gradually spinning, weaving and knitting became a rural activity. The first application of water power other than for corn milling was to the fulling of woollen cloth in the twelfth century, which further located the industry in the countryside. Technological innovation came early, with the spinning wheel replacing the distaff and the horizontal loom the vertical loom: even more technologically significant was the invention in the late sixteenth century of the knitting frame (Palmer 1984; Wells 1972). All these devices could be used in the home, but nevertheless most of the industry was organized on a capitalist basis for the purposes of distribution and sale. It was, though, not until the eighteenth century that the further development of capitalism in the form of investment in power sources other than hand power revolutionized both the spatial and social organization of the textile industry. Individual entrepreneurs played a key role in this development, and it is in the textile industry above all others that new relationships had to be worked out between employer and employee.

Few of the standard histories of the textile industry make any use of material evidence, except as illustrations: Joseph Wright's painting *Cromford by Night* often serves to make the point about shift work by artificial light in the new cotton mills. Yet the industry created a completely new range of buildings and associated settlements which has hardly been subjected to social analysis. Ironically, it is the actual decline of the industry in both Europe and the United States in the late twentieth century and the consequent redundancy of large numbers of seemingly identical buildings which have prompted major studies of the material evidence of the textile industry. Once again, as in the 1950s and 1960s, it is the attempt to catalogue and preserve selected relics in the face of wholesale destruction which has prompted a re-evaluation of the contribution which the material culture of the textile industry can make to the historical debate over its development. Foremost among such studies in Britain have been those conducted by the RCHME at the request of various local authorities in the north of England. The large numbers of mill buildings in West Yorkshire prompted the development of a new methodology for investigation in industrial archaeology, using early twentieth-century 25-inch OS maps as a basis. A standard report form was used on brief site visits to over 1,800 sites, enabling comparisons to be made between mills which could be in the woollen, worsted, linen, silk, cotton, carpet, shoddy and mungo branches of the industry. This initial survey enabled a series of research questions to be framed, and the sites for more detailed study were chosen to demonstrate a range of criteria, including the development of the factory system, the structural evolution of textile mills and the effect of mills on the landscape: this resulted in detailed surveys of about a 10 per cent sample. The Greater Manchester survey followed a similar methodology, but, unlike in West Yorkshire, the mills were mainly for cotton and comparisons were simpler, resulting in a chronologically based typology in which size and layout, external details, methods of construction, internal organization and power systems were considered for each period of mill building. The East Cheshire survey concentrated on the housing and factories associated with both silk and cotton mills, and together these surveys provide a model for other large-scale surveys of industrial structures (Calladine and Fricker 1993; Giles and Goodall 1992; Williams and Farnie 1992; see also Watson 1990).

A similar decline in traditional textile industry prompted detailed studies of the Lower Merrimack Valley in Massachusetts, begun by HABS in 1968 and followed by the HAER survey of the water-power system at Lowell in 1974–75 (Molloy 1978). These were inventories of sites, concentrating on the industrial architecture and the water-power engineering, and can be contrasted with the more recent social analyses of material culture funded by the National Park Service, to whose care the city of Lowell passed following the work of HABS and HAER. These have been carried out by historical archaeologists (for example: Beaudry and Mrozowski 1988), and will be discussed in more detail below (p. 1183), but the two approaches provide an excellent illustration of the difference between industrial archaeology as usually defined and as possessing the wider meaning of the archaeology of industrialization.

Technological innovation in the textile industries is well documented, and numerous examples of both early and late machines survive in museum collections throughout Europe and the United States. Yet rarely has an overt connection been made between the machines and their products, possibly because of the lack of survival of textiles in the archaeological record. Museum textile collections focus on the unique, even the handmade, rather than the more mundane products of machines. One exception is the machine-made lace industry of Britain, where a clear relationship has been demonstrated between technical innovation and product design—for example in the provision of the lace curtains which graced so many Victorian homes (Earnshaw 1986). It is generally assumed that technological innovation in the textile industry was directed towards increased output, although the standardization of the product and quality control were part of the drive to meet the demands both of home consumers and the export trade. More investigation is needed into the relationship between investment in machines and the product they were intended for, as well as greater understanding of the way the machines were fitted into the workplace (see Calladine 1993; Markus 1993).

The pace of innovation varied considerably between different branches of the industry, and particular machines or sources of power remained in use long after more advanced versions were commercially available. Such technological inertia gives unique insight into past working practices: in Northern Ireland, for example, care has been taken to preserve examples of water-powered sites for scutching or breaking flax for the linen industry, while the National Trust cares for one of the last water-powered sites for beetling or imparting a shiny finish to linen cloth (see McCutcheon 1977). The Trust has also maintained a water-powered cotton spinning and weaving mill at Styal in Cheshire, while the National Park Service at Lowell, Massachussetts, maintains and runs the turbines which once powered the mills (Fig. 29.5). A visit to the steam-powered weaving shed of Queen Street Mills in Burnley, Lancashire, enables one to appreciate the intricacies of the power transmission systems as well as the human dimension of working in what is a noisy and dangerous environment by modern standards (Fig. 29.6).

The reasons for the longevity of a particular form of technology are as important as those for its first introduction, and bring into question the effectiveness of

Figure 29.5 The textile complex of the Boott Cotton Mills Corporation in Lowell, Massachusetts, USA. Originally powered by water turbines, the mills have been converted to a variety of uses. Photograph: M.Palmer.

aggressive capitalism. In many instances, as can be seen throughout the archaeological record, if a tool did its job efficiently, it continued to be used in preference to new-fangled versions not yet tried and tested—and sometimes well beyond that! Equally, a cheap labour force provided a viable alternative to investment in machinery if goods in demand could be manufactured at the right price. Technological inertia is a concept largely ignored by economic historians because their sources generally reveal change rather than continuity, but archaeology can assist in its elucidation and so make an original contribution to the continuing debate over the nature of industrialization.

In the 1780s and 1790s, a whole new range of buildings began to appear in the landscape, usually in a rural setting and many on a scale only comparable to the country seats of the aristocracy from which the people had been isolated by their formal settings. It is difficult to gauge the impact of the new textile mills on contemporary consciousness. Viscount Torrington in 1792 bemoaned the desecration of Aysgarth Falls in Wensleydale by the erection of:

Figure 29.6 The interior of the weaving shed at Queen Street Mills, Burnley, Lancashire, England, one of the last mills to be powered by steam. The tightly-packed looms and belt drives indicate the hazards experienced by the mill-hands. Photograph: M.Palmer.

> a great flaring mill, whose back stream has drawn off half the water of the falls above the bridge. With the bell ringing, and the clamour of the mill, all the vale is disturb'd: treason and levelling systems are the discourse; and rebellion may be near at hand.
> (Torrington [1790] 1934, 3:82)

But even he could not fail to be impressed by Arkwright's mills, one of which, in Wirksworth, 'seven storeys high and filled with inhabitants', reminded him of 'a first rate man of war, and when they are lighted up, on a dark night, look most luminously beautiful' (Torrington [1790]1934, 2:196). Many of the earliest mills in Britain survive because their isolated location has saved them from later development, but their original cultural context can only be deduced with the aid of these contemporary reports. Both verbal and pictorial images of early industrialization are an invaluable source for the industrial archaeologist but, as an individual viewpoint, have to be used with caution.

The surviving structures help the industrial archaeologist to understand the aspirations of the capitalist entrepreneurs responsible for their construction. The recording work of the RCHME in Derbyshire has greatly enhanced our understanding of these early mills: Menuge has shown that Arkwright's well-documented obsession for the secrecy of his patented machines was reflected both in his choice of a site in Cromford, situated in a narrow valley in the Derbyshire Peak District, and the layout of the mill yard itself, hidden behind a high perimeter wall with no ground floor windows overlooking the road (Menuge 1993:56–57). Equally, Thomas Lombe's island site, closed off by iron gates, for his pioneering silk mill on the River Derwent in Derby, enabled him to protect the machines he had already pirated from Italy! (Calladine 1993). The employment of local masons and builders gave a certain standardization to the style of these early mills, with Georgian features of various kinds such as symmetrical fenestration, but the owners occasionally embellished them with something more dramatic. Arkwright took the opportunity afforded him by the front elevation of the stair and privy tower on his Masson Mill in the Derwent Valley to add surface details like Venetian and Diocletian windows arranged in a regular pattern beneath a bell cupola. He had just broken his partnership with Jedediah Strutt, and Masson Mill reflects the social aspirations which later led him to build Willesley Castle in a dominant position above the valley. The use of mill buildings to make a social statement was widespread among the gentleman-clothiers of southwest England in the early part of the nineteenth century (Stratton and Trinder 1997) and rather later in the more utilitarian cotton spinning districts of Lancashire, where specialist firms of architects made considerable use of Italianate features to indicate their employer's understanding of the classical traditions (Jones 1985).

The role of the capitalist entrepreneurs is therefore manifest in the material evidence they have left behind, but the primary function of these mills was to provide workspace for a rather more faceless labour force. The form of the buildings was governed by the need to provide unbroken spaces which could both house machinery and enable power to be transmitted from a remote source, at first a water wheel and later a turbine or steam engine. Two or more storeys housing machines enabled efficient use to be made of the power source, and the structure had to withstand not only the weight but also the vibration of the machines. Brick and timber remained the most common building materials for factories almost until the end of the Victorian period, both in Europe and the United States, despite the fire risk which was extreme in cotton mills: these burnt down with monotonous regularity. Examples remain of early cast-iron framing, including the first wholly iron-framed building, the Ditherington flax mill in Shrewsbury. The structural principles incorporated in this building remained more or less the same for the next half-century, to judge from surviving mid-Victorian examples such as Saltaire Mill near Bradford (Stratton and Trinder 1997:66). The existence both of English-made textile machines and iron framing in European textile mills should help supplement the work on technological transfer carried out by economic historians such as Henderson once sufficient comparative studies have been carried out (see Gerber 1991;

Henderson 1954). The reasons for the persistence of timber framing are worth investigation: cast iron could fail because of poor foundry practice and certainly did not make mills totally fire-proof, as can been seen from the number which did (and still do) burn down. Where timber was readily available, as in central Europe and the United States, timber-framed mills remained the norm. Nevertheless, it was the textile mill, especially those where heavy machinery was used as in flax spinning, which pioneered the use of iron as a structural material, paving the way for the railway station canopies and great conservatories of the Victorian era. These linkages are important in understanding the impact of new technologies on related structures: the textile mill should not be studied in isolation.

Textile mills are therefore relatively well understood as a structural form, but far less attention has been paid to the buildings as spaces in which a whole new set of social relationships had to be worked out. This is generally assumed rather than analysed in any depth, although the source material exists not only in the buildings themselves but in engravings and documents such as fire insurance policies. The narrow, rectangular shape of each floor enabled daylight to penetrate to the machines, but also made the surveillance of the workforce a relatively easy task. The architectural historian Thomas Markus has made an attempt to apply the techniques of spatial analysis to some early Derbyshire mills, but has been more successful in his use of the concept of homology to explain the relationship between spatial structure and power transmission within a textile mill (Fig. 29.7).

Homology is the relation of corresponding parts forming a series in the same organism. Markus sees mill buildings developing to become like machines, with both static and dynamic systems within them. The static systems, that is the buildings themselves, changed over time, using different building materials and methods of construction. The machinery within the buildings, however, made them liable to movement, to become dynamic systems in themselves, and Markus shows how refinements were introduced to adjust them, such as the levelling devices on the basement supports in Strutt's Belper North Mill of 1804 (Markus 1993:279). The other dynamic system within the buildings was for movement—of people, material substances and energy. The static systems for movement, such as staircase towers, were replaced by lifts and hoists, dynamic systems in which people and objects became static in moving space. With power transmission, he suggests that the early system of a wheel driving one horizontal shaft, which in turn drove several vertical shafts through all floors, did not result in a homologous whole, since the vertical structures of the power transmission system crossed those of social control and space, i.e. the machines and their attendants on each floor. In the more developed cotton mill, on the other hand, a single vertical shaft drove a horizontal shaft on each floor, which in turn powered belts to individual machines. Rope drives were later substituted for the vertical shaft, but the logic was the same and the homology now perfect, with power transmission in line with, rather than cutting through, the social and spatial

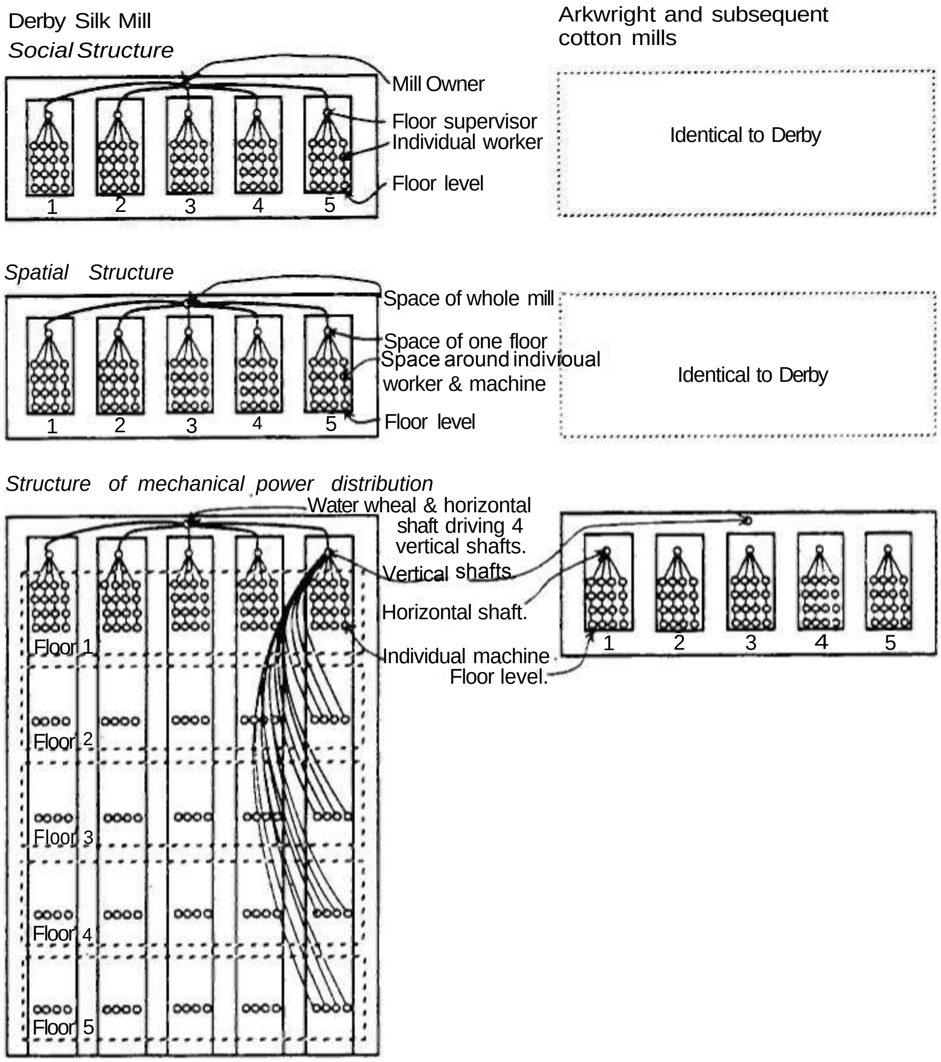

Figure 29.7 Thomas Markus's analysis of the homology of mechanical power distribution, social structure and spatial structure in some early textile mills in the English East Midlands. Source: Markus 1993.

structures of each floor (Markus 1993:264). Commercially, this also made room and power systems possible, whereby the mill owner could let individual floors to separate firms who utilized the common power source. Markus's methods of analysis have not been pursued by other historians of industrial architecture (for example: Menuge

1993; Stratton and Trinder 1997), but they are a step towards an understanding of the spatial logic of a mill interior in a novel and challenging way.

The surveillance exercised over the workforce within the textile mill was echoed in the new communities created to house them. The isolated location of many early mills made provision of housing a necessity if shift work was to be efficiently carried out, enabling corporate paternalism to be manifested in the landscape. Employment of child labour in the late eighteenth century is revealed in the apprentice houses attached to many of the British mills, while the boarding houses which are such a feature of Lowell and Lawrence in Massachusetts provided a home for mill girls from country districts in the early nineteenth century. Rows of standardized houses were provided for families in late eighteenth- and early nineteenth-century Britain, occasionally, as in Cromford, revealing in their structure the provision of loomshops for outwork, since it was women and children who were primarily required in the spinning mill itself. In nearby Belper, the existence of numerous nailshops indicates alternative employment for men, and documentary research has shown that these were provided by the entrepreneur himself (Charlton, pers. comm.). Gender roles in industrialization have been investigated by economic historians such as Berg (1994), but careful analysis of the physical context of both mills and their communities would add substantially to the literature on the subject. The communities reinforced the hierarchy of the mill, with larger houses for the overlookers: this can be seen very clearly in the model settlement of Saltaire, near Bradford, laid out by Titus Salt in the 1850s. In Europe, large tenement buildings were preferred to the English-style villages, perhaps reflecting the later date of development and the generally urban location of many of the mills. In Lódz, for example, 'the Manchester of Poland', Prussian capital financed the development of large mills in the late nineteenth century, which have strong spatial and architectural links with the huge blocks of workers' flats in close proximity (Poplawska and Muthesius 1986; Fig. 29.8). As in southwest England, the construction of the owners' mansions alongside the mills enabled close surveillance both of the mill operations and of the workforce.

The vivid image of corporate ideology presented by the built environment of so many textile communities has been questioned as a result of the detailed interdisciplinary work carried out on the Boott Cotton Mills Corporation in Lowell, Massachusetts (Beaudry 1989; Beaudry and Mrozowski 1987a, 1987b, 1988, 1989). Excavation and documentary research have indicated that paternalism may have strongly influenced the lives of the workforce in the early days of the Corporation, but that its reality waned with time. Artefacts recovered from the backlots of the houses reveal that the mill girls shared their domestic premises both with male operatives and with the families of skilled workers from the outset, and considerable differences in ethnicity, status, diet, personal possessions and so on developed among the inhabitants in later years. While the American cotton industry made more use of immigrant labour that did its British equivalent in the nineteenth century, similar

Figure 29.8 The blocks of tenement housing for the workers of the Schleiber mills in Lódz, Poland, built in the 1870s beside the huge factory. Surveillance of both mill and housing was guaranteed from the owner's nearby villa. Photograph: M.Palmer.

investigations at, for example, New Lanark in Scotland, might be illuminating on the extent of industrial paternalism in the post-Owen era. Many of the mill communities have been made Conservation Areas, terminating the natural evolution of the landscape and thereby presenting a false image of the living conditions actually experienced by those for whom they were built.

The textile industry in the industrial period, therefore, appears to have been dominated by change—mechanization of processes, the construction of large numbers of new buildings, women and children employed outside the home, the establishment of mill communities where the discipline of the mill followed its workers home. The mechanization of spinning seems to have met with little resistance, possibly because the imbalance in the relationship between spinning and weaving following the invention of the flying shuttle was accepted, but also perhaps because spinning was a process carried out by women, who were less able to resist. Not so when it came to the more skilled aspects of textile production which were male preserves, such as weaving, machine knitting of both stockings and lace, cropping woven fabric and so on. These were the flashpoints of Luddism in the early nineteenth century, although the riots were as much about declining economic status as about new technology. Luddism was publicly defeated, but the archaeological evidence in fact charts a mute but dogged persistence in retaining old ways of working, which was far longer lasting than that which was expressed in open conflict.

The new textile mills were built for spinning from the 1770s onwards, but loomsheds for weaving were in most cases not added to them until the 1840s or later (Giles 1993; Giles and Goodall 1992). Where were the weavers who coped with the greatly increased output of spun yarn? Examination of the landscape has revealed the construction in this crucial period of large numbers of houses adapted for weaving by the inclusion of large windows to admit light. In most areas, these usually took the form of top-shops, which gave better light and could be given independent access: they were at once part of, but separated from, the domestic environment. They could be urban, as in the silk-weaving towns of Macclesfield, Congleton and Leek (Calladine and Fricker 1993), or rural, as in West Yorkshire where weaving shops were attached to isolated farmsteads as well as built in large numbers in villages, such as those grouped in the parish of Saddleworth (Caffyn 1986; Palmer and Neaverson 1994).

The physical provision for handloom weaving is less obvious in the cotton districts, where cellar or ground-floor workshops were more usual to provide the necessary damp conditions (Smith 1971; Timmins 1977, 1979). Such houses, however, do not indicate that the weaver lived the independent life noted by Defoe in the 1720s, but only that he retained the ability to work at home. The thread was no longer spun by his womenfolk, but supplied by merchants or master clothiers, who then marketed the finished cloth. Careful analysis of textile mill complexes has also revealed that some weavers accepted an even greater degree of discipline by working their handlooms in purpose-built loomshops within the mill area as early as the late eighteenth century (Giles 1993), thereby separating their work and home life (Fig. 29.9). This trend was intensified by the provision of sheds for power-loom weaving within the mills from the 1830s onwards. The most remarkable accommodation between the factory and domestic environment, however, took place in the ribbon-weaving town of Coventry, where houses with top-floor loomshops were grouped around a central steam engine, so that powered looms could continue to be used in a domestic environment (Palmer 1994; Prest 1960). These 'cottage factories' were built between 1830 and 1860, and represent a unique combination of artisan determination to retain independence and entrepreneurial attempts at control of the workforce. The system was not adopted in other weaving colonies with access to coal supplies, and the nearest equivalents are the powered workshops for jewellery and small metalwares crammed into areas of Birmingham and the Black Country, where the workers continued to live in cramped courts adjacent to their place of work. Capitalist entrepreneurs clearly could not force through total mechanization, and the reasons for their inability or unwillingness to do so are important in understanding the complex process of industrialization.

Figure 29.9 A weavers' workshop in Rawtenstall, Lancashire, England. This building represents the first stage of the loss of independence, as the workforce was brought together under one roof for the purposes of supervision. Photograph: M.Palmer.

It is tempting to speculate that these efforts on the part of the workforce to retain what was in many ways an illusory independence were in fact highly beneficial to the employer, who was spared the cost of constructing workspace yet could retain control through provision of raw materials and marketing of goods. Nowhere was this more true than within the hosiery industry, which remained on a domestic basis until at least the 1870s. The surviving housing indicates three phases of the industry: the adaptation of existing buildings for knitting by the insertion of long windows from the seventeenth century onwards; the provision by speculative builders of purpose-built houses incorporating workshops from the late eighteenth century onwards; and the construction of workshops analogous to the loomshops of the cotton and woollen industries, where traditional skills could be preserved but surveillance practised by the master hosier (Palmer 1989, 1994). Some of the latter incorporated space for workshops within their own homes, but Campion has shown, by means of access analysis, that they were careful to preserve the distinction between private and public space by the provision of separate entrances and lack of physical communication between workshop and house (Campion 1996).

However, most hosiery manufacturers were as anxious as the knitters themselves to maintain the domestic system, since they were not only spared the necessity of providing workspace but were also able to rent machines out to workers in their own homes. Not until the 1870s do any substantial numbers of powered factories appear in the landscape, indicating the longevity of a domestic system of production despite the technical advances made back in the sixteenth century.

What an archaeological study of the textile industries indicates is that technological innovation did not necessarily give rise to deterioration in worker-master relationships to the point of conflict. The latter is emphasized in documentary sources, which then as now concentrated on the newsworthy rather than the mundane. Careful analysis of the surviving physical evidence in the form of buildings, products and machinery, in conjunction with the documentary evidence, shows a much more gradual process of adaptation on the part of both employer and employee to the complex process of mechanization. Industrial archaeologists need to be as sensitive to the *continuing* use of well-established techniques as to the *first* use of particular technological innovations, whose social and spatial impact have commonly been overemphasized by historians.

THE SPATIAL CONTEXT: MINING AND METALS

The dramatic decline of heavy industry in the western world has, as in the textile industries, made redundant within a very short space of time large numbers of sites and structures whose sheer scale daunts attempts at archaeological recording. In Britain, the virtual disappearance of coal mining has led to efforts by all three Royal Commissions on Historical Monuments to carry out rapid surveys of surface remains, including the associated housing, since mining communities have been such an integral part of the coal-mining landscape (Gould and Ayris 1995; Hughes *et al.* 1995; Thornes 1994). The difficulty of interpreting large industrial sites from surviving remains encouraged the RCAHMW to experiment with process recording at operational sites, the results of which can illuminate the study of incomplete, damaged, or long defunct sites (Malaws 1997). Malaws argues that the study of the techniques and operations of industry has been overshadowed by the architectural and historical aspects of monuments and their industries, ignoring the fact that many important processes were carried out in architecturally undistinguished buildings; he also re-asserts the human dimension in industrial production. A further plea that the archaeologist should act as a witness has been urged by Richard Hayman, following the recording of a foundry making harness furniture: he emphasizes that a firsthand knowledge of manufacturing techniques enables the archaeologist to understand the empirical adaptations which took place, a knowledge which can be utilized on sites where the techniques employed are now extinct (Hayman 1997). Such insights are a unique advantage enjoyed by the industrial archaeologist, who can make use of film and video to record working practices which elsewhere have to be deduced from physical remains alone.

The vast scale of many of these monuments of heavy industry has led to the preservation of a selected few for their tourist potential, and archaeological work has been carried out to provide an interpretative context. In Poland, recording programmes have been carried out on the numerous surviving headgears associated with the coal industry in the region around Katowice with a view to preserving the most important of these. In the United States, historical archaeologists have contributed to the Industrial Heritage Project in southwestern Pennsylvania, designed to interpret the remains of the important iron and steel industry of this area and particularly to look at its relevance to the labour movement, an aspect barely touched upon in British studies. In the southern states, the employment of negro labour in ironworks as well as in many other industries is a recurring theme in schemes of interpretation, and Congress in 1991 authorized a National Historic Landmark Theme study on American labour history, with a view to adding significant sites to those already in the care of the National Park Service. Exciting projects for the actual re-use of nineteenth-century steel-cased blast furnaces are already in place in Birmingham, Alabama, and in the Landschaftspark near Duisburg in Germany. In a world increasingly dominated by micro-technology, such preservation schemes will at least enable future generations to understand the impact of heavy industry on the consciousness not only of those who worked in it but also on the artists and writers who have left us contemporary accounts.

A further reason for accelerated programmes of archaeological recording and research on mining landscapes has been their threat from environmental improvement schemes designed to decontaminate or to rehabilitate what is perceived to be derelict land, thereby destroying a rich archaeological resource (Palmer 1993). In Cornwall, archaeological evaluation has usually preceded derelict land work, but accompanied by all the problems of developer-led archaeology: as Sharpe has said, ‘not only the initiative, but the agenda belong to other organisations’ (Sharpe 1995: 133). Nevertheless, Cornwall Archaeology Unit has produced what must be the most comprehensive set of field reports on the mining landscapes of any British county (for example: Sharpe 1993a, 1993b). Further east, in Devon, the Dartmoor Tin Mining Research Group has carried out extensive field survey and excavation on both tin-streaming sites and smelt mills, greatly enhancing understanding of the field archaeology of the post-medieval tin industry and giving some idea of its spatial organization (Gerrard 1994, 1996). A great deal of historical work on tin mining has been carried out by historians within the two counties, but the archaeological and historical data have yet to be brought together in any meaningful way.

Lead and copper mining landscapes have suffered on a greater scale because of the potentially contaminative effects of these minerals in the soil. The mines of Spain have been important in Europe since the prehistoric period, but although the earlier

Figure 29.10 The derelict headstocks and calcining furnace on the Cruz Chicita mine in the Murcian mining field of south-eastern Spain. Photograph: M.Palmer.

remains have received some attention (for example: Rothenburg and Blanco-Freijeiro 1981), the considerable physical survivals from the nineteenth century (Fig. 29.10) have been virtually ignored. In Britain, most of the work has been developer-led, and the archaeological evaluations have never found their way into accessible publications. Whole landscapes around Minera in North Wales and Snailbeach in Shropshire have been decontaminated and upstanding remains consolidated for their tourist potential, but without any real interpretation. There has been some interest in the archaeological potential of ore preparation sites, mundane structures usually ignored both by contemporaries and by historians of mining (for example: Cranstone 1989). Unfortunately, studies tend to be industry-specific (a trend encouraged by the Monuments Protection Programme) and few comparative studies have been carried out. Only these can really contribute to the debate over the nature and extent of industrialization, by revealing the contrasts between the effect of capital investment in mining technology in some areas and the extent of technological inertia in a great many others (Palmer and Neaverson 1989). Both spatial and sequential relationships need investigation in a wider context.

The difference between mining archaeology in Britain and in America is partly due to the long history of metalliferous mining in the former, where sites may reveal evidence of Roman and medieval as well as post-medieval activity, despite the destructive nature of extractive industry itself. In America, particularly in the West, mining was a phenomenon of the second half of the nineteenth century and characterized by the wholesale immigration of fortune-seekers, usually single males (Fig. 29.11). In Britain, the majority of metalliferous mines were comparatively small affairs and their workforce lived with their families in nearby villages, many of which are still populated and so not available for the kind of archaeological work on their domestic conditions which has been possible in America. As Hardesty has pointed out, surviving technology and buildings are not common on American mining sites, presumably because of the scrap value of the machinery, but rather they are rich in trash dumps, residential house foundations, privies and other remains of the miners themselves (Hardesty 1988:17). Mining camps, which barely feature in European contexts, were a feature of the American West, and both archaeological and historical work have revealed the immense scale of immigration, not only of skilled participants such as the Cornish miners but of unskilled labour, notably the Chinese. The material culture reveals the contrast between the living conditions of individuals seeking their fortunes by panning for gold in the '49 Californian Gold Rush and those working in the heavily capitalized hard rock mines of both California and Nevada, who had rather greater security and later brought their womenfolk to join them. Stores provided necessities as well as luxuries, the range of which has been indicated not only from artefacts recovered from the mining settlements themselves but also from the intensive excavation of sites like the Hoff Store site in San Francisco. This burnt down on 3–4 May 1851 and, because of its position on the waterfront, the contents formed a sealed deposit which was not recovered until the late 1980s and so is invaluable in indicating the range of goods imported into San Francisco, the prime trading centre for the Gold Rush area (Pastron and Hattori 1990).

In Australia, the pioneering work of Judy Birmingham and Ian Jack did much to encourage the archaeological study of mining landscapes (Birmingham *et al.* 1979). The comparative isolation of many of the sites in this vast, underpopulated country has assisted the survival of a considerable number of both buildings and machinery, and so their approach was more that of traditional industrial archaeology

Figure 29.11 A nineteenth-century image of prospectors seeking gold in California. Source: Malakoff & Co., California.

than the more ethnographic approach favoured in America. An important theme, given Australia's colonial status, has been technological transfer, much of the machinery as well as mining skills being imported from Britain. Cornish-style engine houses are a feature of several sites, notably the Burra and Moonta mines of South Australia, and Methodist chapels are cheek by jowl with outback saloons. The physical evidence provides information both about the adaptation of the imported technology to cope with the environmental rigour of Australia, and about the pioneering frontier or zone of experimentation, often littered with evidence of failure. The archaeological work which has taken place on the settlements associated with the mines is even more redolent of isolation, with few imported luxuries compared with similar settlements in America (Holmes 1983). Historians have investigated the migration of skilled labour from Britain, often characterized as 'cousin Jack down under'. As in America, the tourist potential of mining sites has been exploited extensively, for example the Sovereign Hill Goldmining township at Ballarat in Victoria (Brown 1989; Donnachie 1981).

The archaeological investigation of mining landscapes has, like those of the textile industry, been prompted by their imminent destruction, and much of the work has been carried out in a 'rescue' context in which research strategies have not been strictly defined. In Europe, most studies have been concerned with the technological elucidation of surviving sites and structures, unravelling the sequential relationships inherent in the methods of extraction and processing of raw materials, but often not having the scope to consider the wider spatial linkages between mining, transport, industrial production, and use within the human sphere. Where, for example, did the raw material for the iron and glass used in the Crystal Palace of 1851 actually come from? Prehistoric, classical and medieval archaeologists use scientific methods to determine the origins of metals and other artefacts retrieved by excavation, and so discover trade patterns (see Chapter 9); industrial archaeologists have the advantage not only of scientific analysis but also of documentary sources in making such linkages. The latter also help in establishing the cultural context, which has figured largely in studies from Australia and America, where the effects of both technological transfer and human immigration are revealed in the archaeological record. The use of archaeology has, therefore, already added greatly to our understanding of the landscape of past extractive industries, despite the difficulties imposed by the circumstances in which much of the research has been carried out. The acceptance of wider research agendas would enable it to contribute even more effectively to this particular aspect of industrialization.

CONCLUSION

Industrial archaeology grew from the perceived need to record and preserve the fast-vanishing remains of early industrialization in Europe, America and further afield. A largely volunteer movement at first, the importance of the physical remains, especially in Britain, has prompted the intervention of the statutory recording bodies and more recently of mainstream archaeologists, especially those concerned with contract archaeology. The compilation of inventories of industrial sites and monuments for most of the industrialized countries means there is now an accepted corpus of significant structures and, despite significant losses, a tendency towards the preservation or re-use of industrial structures rather than their rapid demolition. We have moved towards a concept of sustainable development, aptly defined in the British context as 'development which meets the needs of today without compromising the ability of future generations to understand, appreciate and benefit from Britain's historic environment' (Clark 1993:90). This has not yet been achieved everywhere, but it is at least a recognizable objective.

Industrial archaeology has not, however, just worked towards the preservation of the industrial heritage, but has begun to contribute towards the ongoing debate on the nature of industrialization. Archaeological work on derelict industrial landscapes threatened with rehabilitation has been extremely valuable in revealing the intricacies of past industrial activity, much of which was too mundane ever to be documented. Typological studies of buildings and structures have contributed not only to a fuller understanding of the development of particular industries but also to the realization of the importance of regional variation in the pace of change. Most important of all, perhaps, is the demonstration of continuity as well as change in the archaeological record, which prompts questions about the respective roles of the entrepreneur and the workforce in the take-up of technological innovations.

The future of industrial archaeology now lies in its practitioners adopting similar methodological approaches to historical archaeologists, and being ready to consider further the cultural as well as the technological significance of the physical evidence. They need to look more carefully at the relationship between the processes of production deduced from studies of sites or sequences of buildings and the artefacts which were generated: how were the latter transported, distributed, marketed and consumed? The work of Danny Miller and Matthew Johnson on the changing meanings of objects in different cultural contexts is relevant here (Johnson 1996; Miller 1987). Finally, they should not be reluctant to make use of the wealth of pictorial, documentary, and even oral sources available which can be used in conjunction with the physical evidence to arrive at a fuller understanding of the social as well as the economic and technological contexts of production. In these ways, industrial archaeology—while not changing its name—would mature into an archaeology of industrialization.

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Two classic books which demonstrate the original thematic approach to industrial archaeology in Britain are Buchanan (1972, reprinted 1980) and Cossons (1975, reprinted 1993). Raistrick (1972) deals with a longer time-span and includes a thematic scheme for industrial archaeology which has been used by English Heritage as the basis for their industrial Monuments Protection Programme. Methods for recording buildings and machinery are described by M.Palmer and P.A.Neaverson, *Industrial Archaeology: Principles and Practice* (London: Routledge, 1998). The development of industrial landscapes is described historically in B.Trinder's *Making of the Industrial Landscape* (1982), and thematically by Palmer and Neaverson (1994). Alfrey and Clark (1993) used detailed plot surveys for their in-depth study of the important Ironbridge Gorge, and the archaeology of transport systems is dealt with by Hughes (1988, 1990), whilst Crossley (1994) argues for wider spatial analysis of post-medieval industrial landscapes. Industrial buildings were first examined by J.M. Richards in his classic *The Functional Tradition in Early Industrial Buildings* (1958); Jones (1985) deals mainly with textile mills, whilst Stratton and Trinder (1997) attempt to look at buildings in relation to the people they accommodated. The more structured analysis of Markus (1993) on issues of freedom and surveillance has been better worked out for public institutions than for industrial buildings.

The literature on industrialization is vast, but the best recent book to examine the world of work is Berg (1994), which also contains a comprehensive bibliography. Trinder (1992) provides the best introduction to the international scene, largely from the point of view of the industrial heritage. The theoretical stance taken by east coast American historical archaeologists is best demonstrated in R.Paynter's powerfully argued 'Steps to an archaeology of capitalism' in Leone and Potter (1988), while the value of an interdisciplinary approach can be seen in the work of Beaudry and Mrozowski in Lowell, Massachusetts (1987a, 1987b, 1988, 1989) and Hardesty's 1988 study of mining. Much site-specific work is included in journals such as *Historical Archaeology* and *IA: Journal of the Society for Industrial Archeology* in the United States and *Industrial Archaeology Review* in Britain. Many British and Irish archaeological journals now include reports on sites of industrial interest and are usefully abstracted in the Council for British Archaeology's British and Irish Archaeological Bibliography.

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