

# Mediterranean Connections

Maritime Transport Containers  
and Seaborne Trade in the Bronze  
and Early Iron Ages

A. Bernard Knapp and Stella Demesticha

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*Mediterranean Connections* focuses on the origin and development of Maritime Transport Containers from the Early Bronze through early Iron Age periods (c. 3200–700 BC). Analysis of this category of objects broadens our understanding of ancient Mediterranean interregional connections, including the role that shipwrecks, seafaring, and coastal communities played in interaction and exchange. These containers have often been the subject of specific and detailed pottery studies, but have seldom been examined in the context of connectivity and trade in the Aegean and eastern Mediterranean.

This broad study:

- considers the likely origins of these types of vessels;
- traces their development and spread throughout the Aegean and eastern Mediterranean as archetypal organic bulk cargo containers;
- discusses the wider impact on Mediterranean connections, transport and trade over a period of 2,500 years covering the Bronze and early Iron Ages.

Classical and Near Eastern archaeologists and historians, as well as maritime archaeologists, will find this extensively researched volume an important addition to their library.

**A. Bernard Knapp** is Emeritus Professor of Mediterranean Archaeology in the Department of Archaeology at the University of Glasgow, and Honorary Research Fellow at the Cyprus American Archaeological Research Institute. He co-edits the *Journal of Mediterranean Archaeology* with John F. Cherry and Peter van Dommelen and is the general editor of the series *Monographs in Mediterranean Archaeology*.

**Stella Demesticha** is Associate Professor of Maritime Archaeology in the Archaeological Research Unit, Department of History and Archaeology, University of Cyprus. She specialises in maritime archaeology, with an interest in shipwreck amphorae, ancient seaborne trade routes and economy in the eastern Mediterranean.

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**A. Bernard Knapp and  
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With contributions by:  
Robert Martin and Catherine E. Pratt

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# Contents

	<i>List of Illustrations</i>	vii
	<i>Preface and Acknowledgements</i>	xi
1	Introduction	1
2	Maritime Matters	4
	<i>Shipwrecks</i>	4
	<i>Sailing</i>	9
	<i>Harbours</i>	11
3	Connectivity, Seaborne Trade and Maritime Transport Containers	30
4	Maritime Transport Containers	36
	<i>Amphora</i>	36
	<i>Shape and Function</i>	37
	<i>Maritime Transport Containers: The Bronze Age</i>	42
	<i>The Levant: Canaanite Jars</i>	46
	<i>Egypt: Egyptian Jars/Amphorae</i>	66
	<i>The Aegean: Cycladic Narrow-necked Jars, Oval-mouthed Amphorae (OMAs) and Transport Stirrup Jars (TSJs)</i>	70
	<i>Other Bronze Age Transport Containers?</i>	88
	<i>Maritime Transport Containers: Into the Iron Age</i>	102
	Iron Age Levant: Background and History of Research (Robert Martin)	102
	Cyprus (Stella Demesticha)	130
	The Aegean (Stella Demesticha and Catherine E. Pratt)	132

vi	<i>Contents</i>	
5	Maritime Transport Containers, Bulk Transport and Mediterranean Trade: Discussion	148
	<i>The Organisation and Mechanisms of Trade in MTCs</i>	151
	<i>The Political Setting of Late Bronze–Early Iron Age Trade in MTCs</i>	160
6	Conclusions: MTCs and Mediterranean Connectivity	164
	Appendix: Volumetric Analysis and Capacity Measurements of Selected MTCs	172
	<i>References</i>	185
	<i>Index</i>	250

# Illustrations

## Figures

<b>Map 1</b>	<b>a)</b> Bronze–Iron Age harbours (Aegean)	xiv
	<b>b)</b> Bronze–Iron Age harbours (Cyprus, Egypt)	xv
	<b>c)</b> Bronze–Iron Age harbours (Anatolia, Levant)	xvi
<b>Map 2</b>	<b>a)</b> Bronze–Iron Age sites with Maritime Transport Containers (west and central Mediterranean)	xvii
	<b>b)</b> Bronze–Iron Age sites with Maritime Transport Containers (Aegean, Anatolia)	xviii
	<b>c)</b> Bronze–Iron Age sites with Maritime Transport Containers (Crete, Cyprus)	xix
	<b>d)</b> Bronze–Iron Age sites with Maritime Transport Containers (Egypt, Levant)	xx
1	Bronze–Iron Age sites with shipwrecks mentioned in text	5
2	Bichrome ware jug (Cypro-Archaic, <i>c.</i> 750 BC)	25
3	Scene from Tomb of Kenamun	28
4	EB II–III Metallic Ware jars from Tel Dan	45
5	Canaanite Jars	53
6	Canaanite Jar types	54
7	Canaanite Jars from the Uluburun shipwreck	55
8	Collar-rim jar and Canaanite jar	59
9	Egyptian Jar and Canaanite Jar	66
10	Egyptian Jars from the tomb of Tutankhamun	67
11	Egyptian Amphorae	67
12	New Kingdom Tomb of Nakht, Thebes, with grape-harvest scene	68
13	Collar-necked Jar and Canaanite Jar	71
14	Cycladic EB I–II Kampos group bottle from Antiparos	71
15	Cycladic Collar-Necked Jars. a) from Skarkos, Ios	72
16	Yagana ‘ <i>hydria</i> ’, from Yagana wreck deposit	73
17	Oval-Mouthed Amphora and Canaanite Jar	75
18	Cretan Oval-mouthed Amphora, Knossos Temple Repositories	76
19	Oval-mouthed Amphora, from Pseira (Crete) and Koulenti	78
20	Transport Stirrup Jar and Canaanite Jar	79



21	Transport Stirrup Jar, Late Minoan III, from Episkopi <i>Bamboula</i>	80
22	Transport Stirrup Jars, from the Uluburun shipwreck and Point Iria wreck deposit	82
23	Cypriot <i>pithos</i> (Group II) and Canaanite Jar	88
24	Cypriot 'Group II' <i>pithoi</i> , from Point Iria wreck deposit and Uluburun shipwreck	91
25	Isometric reconstruction of Building II at Alassa <i>Paleotaverna</i>	92
26	Cretan Short-necked Amphora and Canaanite Jar	93
27	Short-necked Amphora from Kommos, Crete	95
28	Southwest Anatolian reddish-brown burnished jug from Kommos, Crete	97
29	Digital restoration of fragmentary <i>olla a colletto</i> , from Pyla <i>Kokkinokremos</i> , Cyprus	99
30	Plain, belly-handled pithoid jar from Modi shipwreck, off Poros	101
31	Map: Iron Age archaeological sites and shipwrecks mentioned in text	106
32	Reconstructed Iron Age Phoenician amphora, from Kommos, Crete	108
33	Iron Age I MTC typology	110
34	Iron Age I MTCs, from Tell Kazel, Maa <i>Palaeokastro</i>	110
35	Iron Age I MTCs, from Palaipaphos <i>Skales</i> , Dor Wreck 13	111
36	Iron Age I MTCs, from Palaipaphos <i>Skales</i> , Tell Keisan	113
37	Iron Age I MTCs, from Tyre, Deir el-Medina	114
38	Iron Age I MTCs, from Palaipaphos <i>Skales</i> , Amarna River Temple	115
39	Iron Age II MTC typology	122
40	Iron Age II 'Thick cylindrical storage jars', from Hazor, Saqqara, Pithekoussai	122
41	Iron Age II 'Cylindrical elongated jars', from <i>Elissa</i> shipwreck, Pithekoussai	123
42	Iron Age II 'S-shaped elongated jars', from Tyre and off southern Levantine coast	124
43	Diachronic Overview (Early Bronze–Early Iron Ages) of Levantine 'commercial jars'	127
44	Cypriot Basket-handled Amphora, from Salamis	130
45	North Aegean Group 1 and 'Transitional' Amphorae, from Troy, Kapaklı (Volos)	134
46	Methonian and Attic SOS Amphorae	138
47	Corinthian Amphorae, Type A and 'Transitional' type, from Inoronata, Metaponto	141
A1	Capacities of the Maritime Transport Containers measured	183
A2	Digital models of an Egyptian jar (9); a Canaanite Jar (12); and a Transport Stirrup jar (15)	184

**Tables**

1	Canaanite Jars from Cyprus	57
2	General Chronology for Iron Age I–II Levant	102
3	Iron Age I Typological Correlations	109
4	Iron Age II Typological Correlations	121
5	Maritime Transport Containers—Trade Mechanisms	152
A1	Calculated Capacities of Maritime Transport Container Types	176
A2	Capacities of the MTCs enumerated in Table A1	182

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# Preface and Acknowledgements

From the Early Bronze Age through Late Antiquity, maritime transport containers typically have been studied by pottery specialists focusing on specific, limited time periods. In this volume we—Bernard Knapp, an eastern Mediterranean prehistorian, and Stella Demesticha, a pottery specialist who focuses on Late Antiquity in the same region—look at some 2500 years of their development—in the Aegean, on Cyprus and in the eastern Mediterranean (the Levant, Egypt, Anatolia). This book arose from a question raised by Demesticha, who lectures in Maritime Archaeology in the Department of History and Archaeology at the University of Cyprus: what other kinds of transport containers existed in the Bronze Age Aegean and eastern Mediterranean beyond the Canaanite Jar and Transport Stirrup Jar? Knapp had no ready answer, and couldn't track down any study that dealt with such containers in a comparative manner, or really in any manner beyond individual types.

Thus began a long, four-year journey that has resulted in the present book. Along the way, and realising our own limitations when we decided to extend the study into the early Iron Age, we took on board two contributing authors, Dr Catherine E. Pratt (Department of Classics, University of Western Ontario) and Robert Martin, a PhD candidate in Near and Middle Eastern Civilizations at the University of Toronto, Ontario, Canada. They worked assiduously to produce sections on, respectively, the Iron Age Aegean (with Stella Demesticha) and the Iron Age Levant, which we have integrated into the flow of the text.

During the long period of writing and research, we called upon an endless number of colleagues in one way or another—for support, advice, criticism, references and unpublished papers or theses. We asked others to read drafts of various sections and we were met constantly with enthusiasm and encouragement. To all of them, we are not only extremely grateful but also well aware that without their help and input, this volume would simply not have been possible.

First of all, we wish to extend our sincere thanks to Christopher Monroe (Cornell University) and Jeremy Rutter (Dartmouth College) for their close reading and comments on a near-final version of the manuscript, and to Rutter and Andrew Bevan for comments on the final manuscript. We are also grateful

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Peter Day: for information on his and others' ongoing work with Transport Stirrup Jars found in mainland Greek contexts, and with Collar-necked Jars from Crete, Thera and Kea.

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Yannis Lolos: for discussion and references related to the Oval-mouthed Amphora and other possible maritime transport containers in the Bronze Age Aegean.

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To various scholars who provided images and/or the permission to use them: Christos Agouridis; Dionisios Evangelistis; Rafi Greenberg; Sophocles Hadjisavvas; Vassos Karageorghis; Ann Killebrew; Jeremy Rutter; Elias Spondylis; Vance Watrous; David Wengrow.

We thank Luke Sollars, Andonis Neophytou and especially Irini Katsouri for providing many of the original drawings used in this study; our contributing author Robert Martin provided several others. Robert Martin dedicates his section of Chapter 4 (Iron Age Levant) to Jack S. Holladay Jr., and we dedicate it to maritime archaeologists and pottery specialists who always knew there should be such a study, but just couldn't find it.

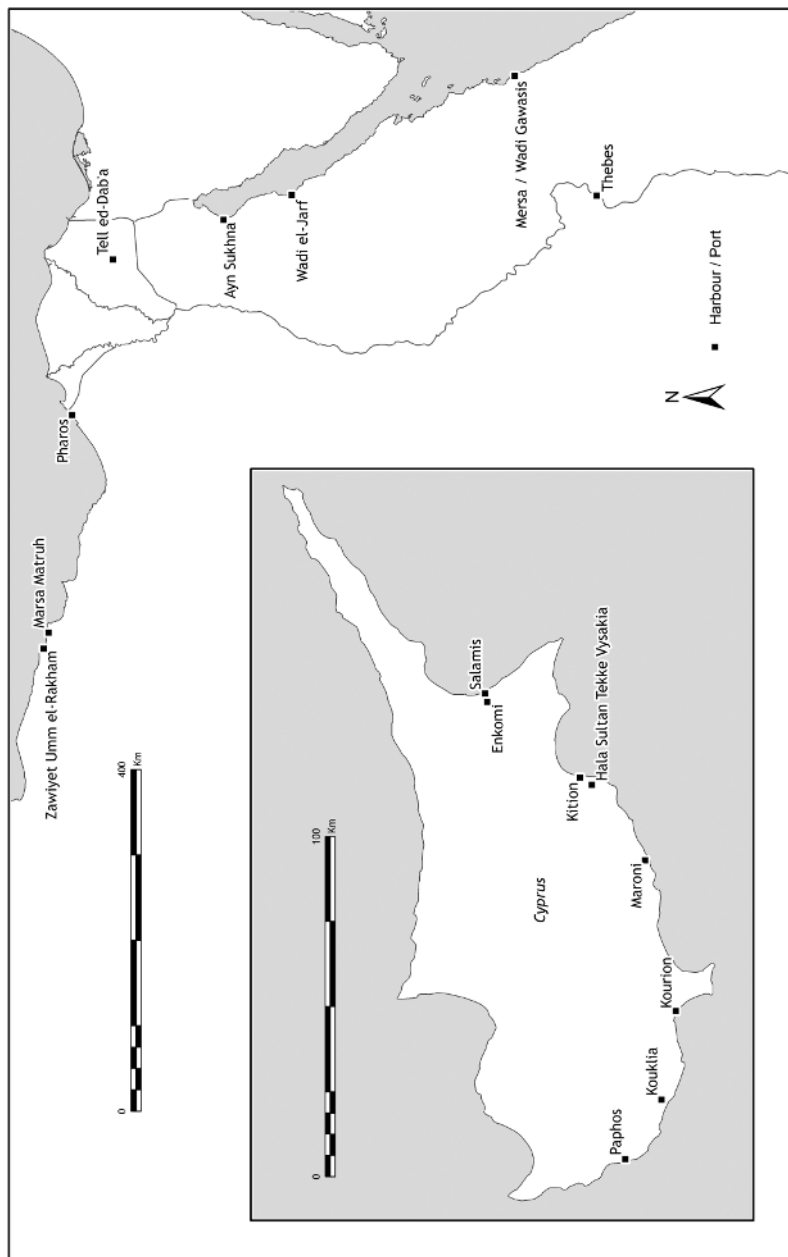
A. Bernard Knapp and Stella Demesticha  
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Since this volume went to press, we have published the following, co-edited volume, which contains several new papers on the Cycladic Collar-necked Jar, Canaanite Jars, Transport Stirrup Jars (from Tiryns) and Phoenician transport amphorae; with the exception of a paper by Day and Wilson (2016), we were unable to cite any of those papers in the present volume.

Demesticha, S., and A. B. Knapp (eds)  
2016 *Maritime Transport Containers in the Bronze Age Aegean and Eastern Mediterranean*. Studies in Mediterranean Archaeology and Literature PB 183. Uppsala: Åström's Förlag.

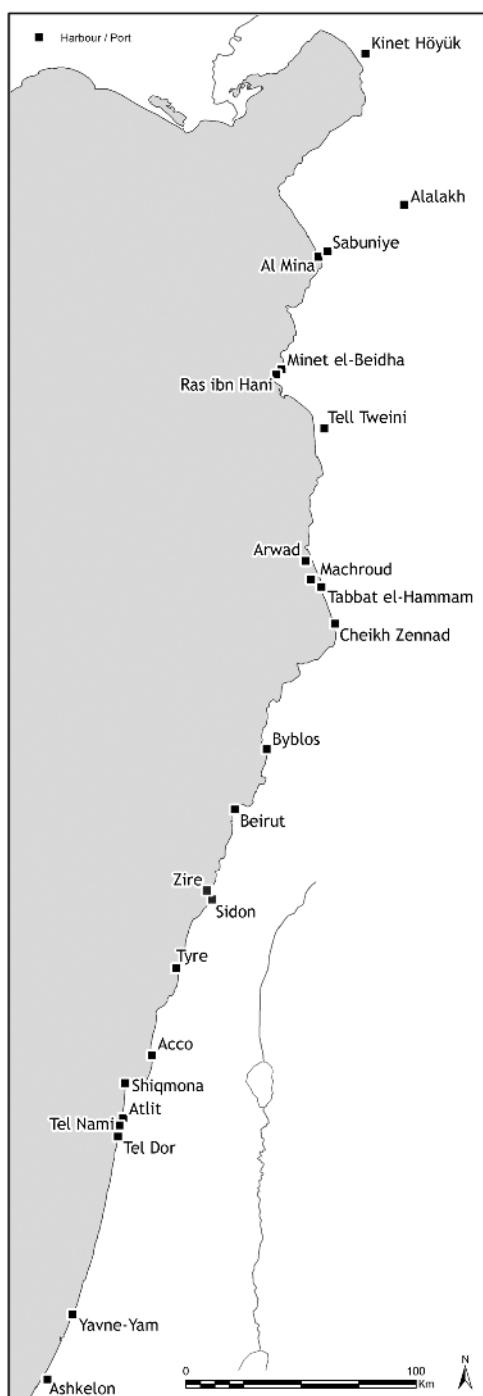


Map 1a Bronze-Iron Age harbours (Aegean).

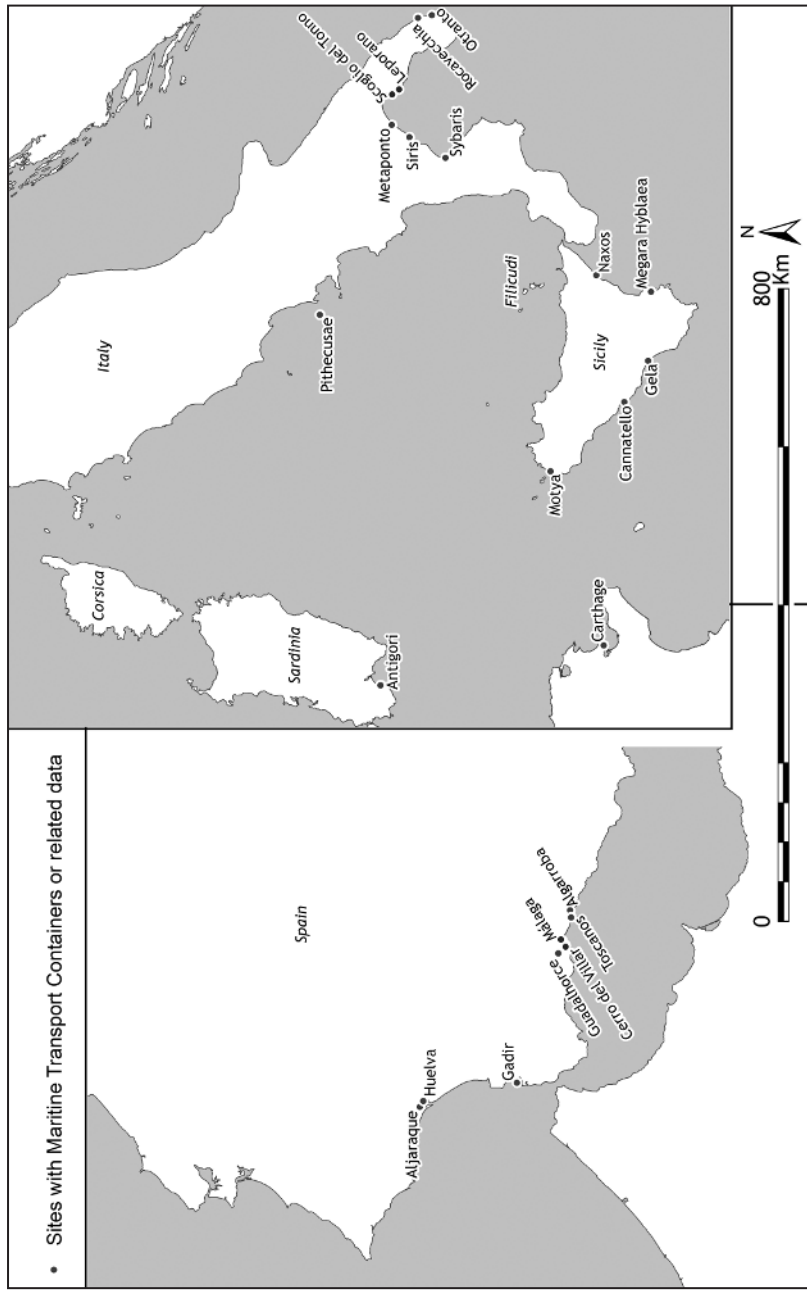


Map 1b Bronze-Iron Age harbours (Cyprus, Egypt).

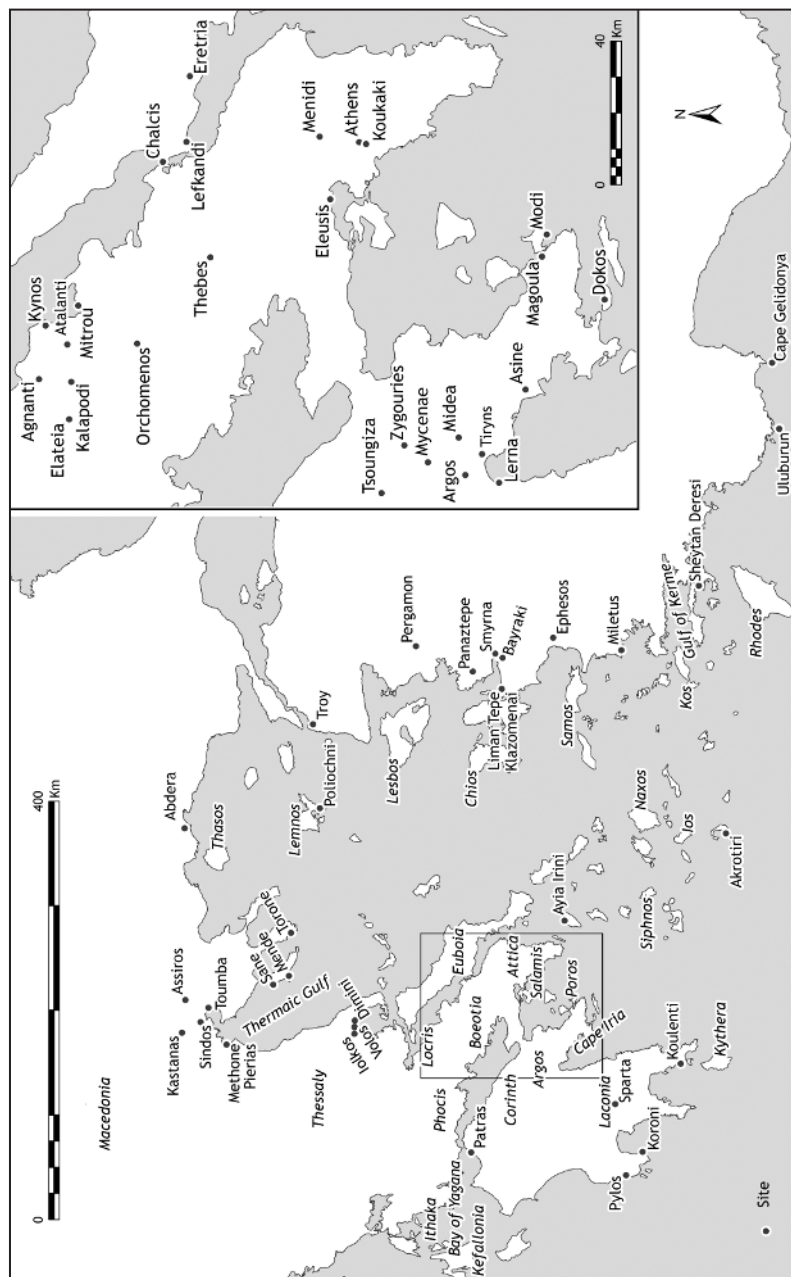




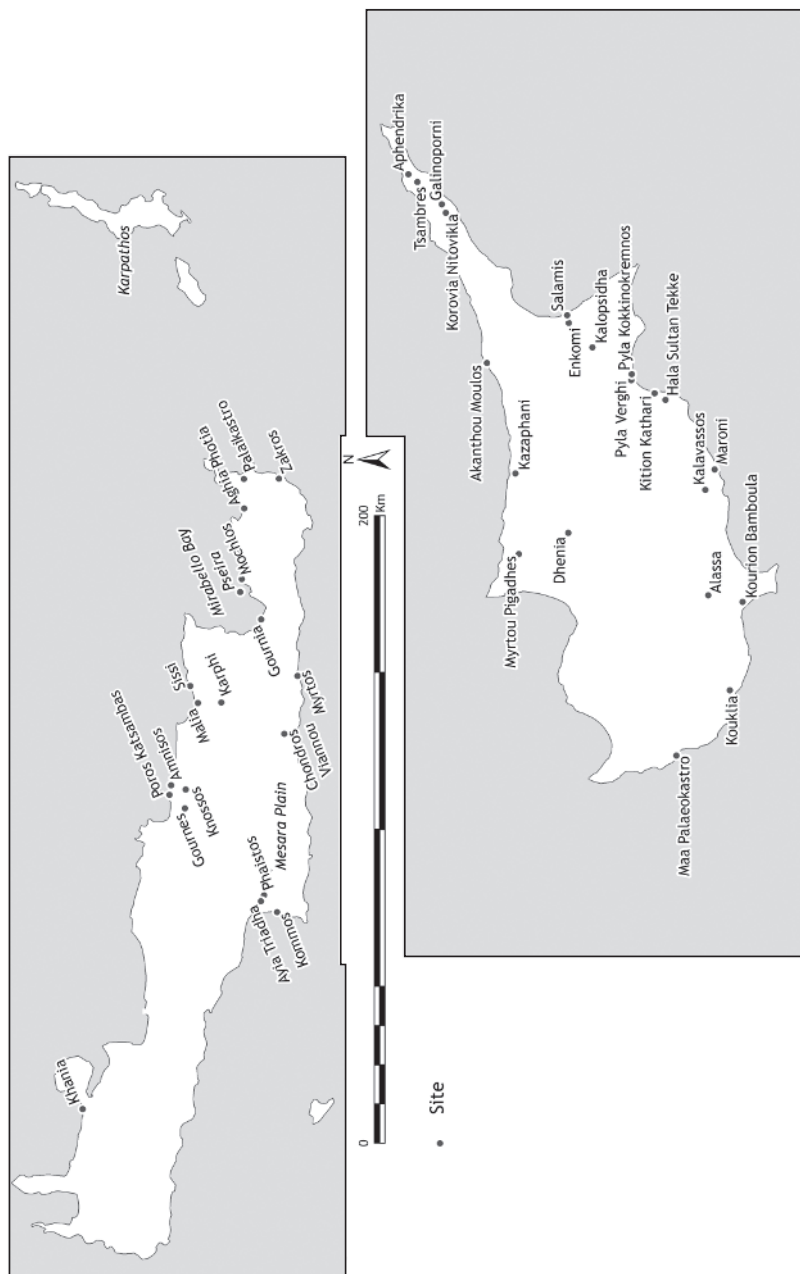
Map 1c Bronze–Iron Age harbours (Anatolia, Levant).



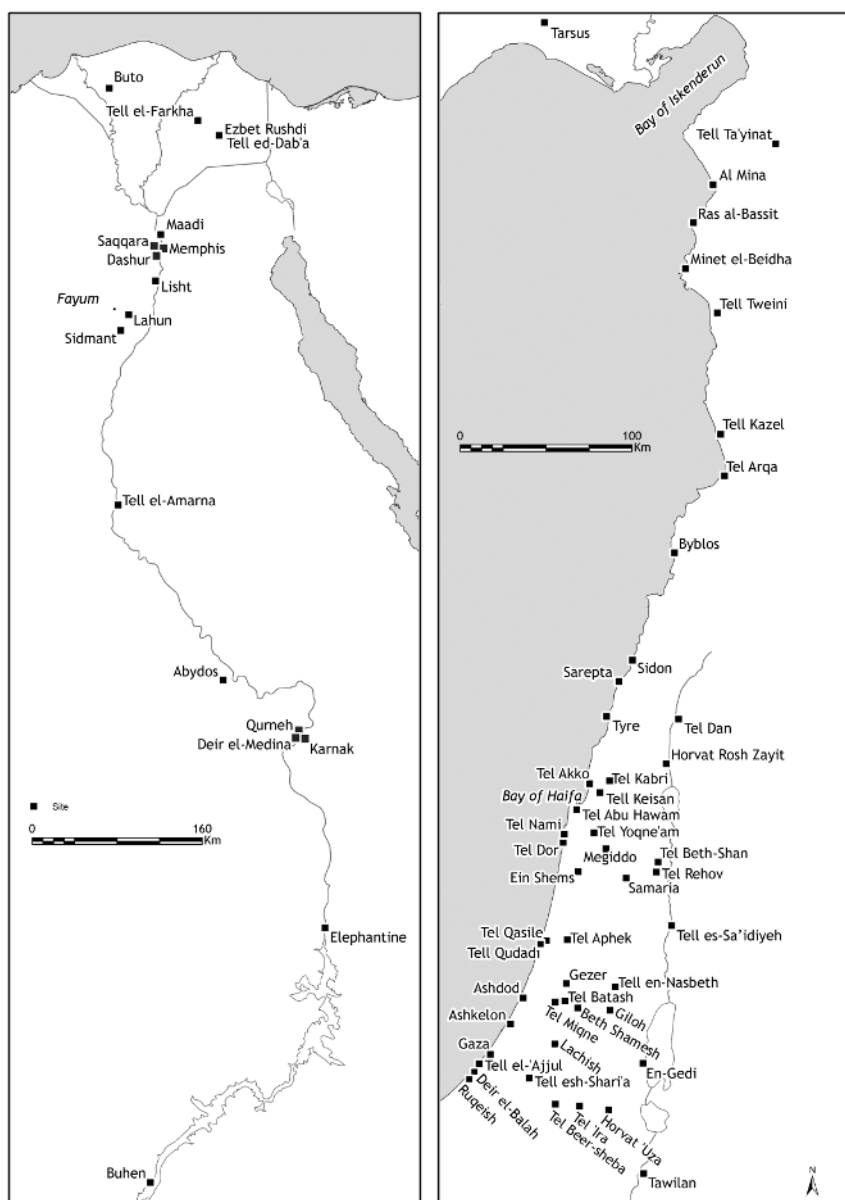
Map 2a Bronze-Iron Age sites with Maritime Transport Containers (west and central Mediterranean).



Map 2b Bronze-Iron Age sites with Maritime Transport Containers (Aegean, Anatolia).



*Map 2c* Bronze-Iron Age sites with Maritime Transport Containers (Crete, Cyprus).



Map 2d Bronze–Iron Age sites with Maritime Transport Containers (Egypt, Levant).

# 1 Introduction

... the ship is a floating piece of space, a place without a place, that exists by itself, self-contained and at the same time exposed to the endless sea, travelling from port to port, from cargo to cargo, from brothel to brothel, as far as the colonies, in search of the most precious treasures ...

(Foucault 1984; <http://foucault.info/doc/documents/heterotopia/foucault-heterotopia-en-html>; also cited by Panagiotopoulos 2011: 45)

In order to gain a deeper understanding of ancient Mediterranean connections, and of the roles of shipwrecks, seafaring and coastal communities in Bronze–early Iron Age interregional trading systems, a maritime perspective is essential (Broodbank 2000: 2). Even if we have moved beyond ‘the lame use of “trade” as a self-explanatory force’ (Morris 2006: 67) in analysing interconnections in the prehistoric and early historic Mediterranean, we still need to explore ways to assess the complexities of Mediterranean trade and trade mechanisms. In this study, we seek to do so by considering the origin, development and likely functions—from the Early Bronze through the early Iron Ages in the Aegean and eastern Mediterranean—of what we term the ‘maritime transport container’ (MTC) (after Marcus 2002: 409–411).

Within the field of Mediterranean archaeology, such vessels have a long and dynamic history of study. Because these containers have been studied by pottery specialists working in different regions over long periods of time, and because of the diverse functional, temporal or geographical contexts in which they have been found, they are referred to quite differently: e.g. Canaanite Jar (Grace 1956; Parr 1973; Raban 1980; Sugerman 2000; Killebrew 2007); Egyptian Amphora (Wood 1987; Bourriau 2004); Oval-mouthed Amphora (Betancourt 1990: 39–40; Poursat and Knappett 2006), Aegean Transport Stirrup Jar (Ben-Shlomo et al. 2011; Haskell et al. 2011); wine jars (Grace 1953). By the Iron Age, at least, most MTCs are simply termed amphorae (Grace 1961; Peacock and Williams 1986), albeit with multiple designators: e.g. Phoenician (transport) amphorae (Bettles 2003a; Regev 2004); SOS amphorae (Pratt 2015); Greek transport amphora (Whitbread 1995); and transport amphorae more generally (Koehler 1979; Beck et al. 1989; Eiring and

## 2 Introduction

Lund 2004). Within and beyond these terms, other, more specific definitions and classifications may be found, and no doubt will continue to be referred to as such in their respective chronological and culture–historical domains. In order to carry out this diachronic study covering the Aegean and eastern Mediterranean, however, it was crucial to adopt a single overarching term—the maritime transport container (MTC)—that would be readily understandable to anyone who conducts research on these transport (and/or storage) vessels designed to carry organic bulk cargoes long distances by sea. Nonetheless, we still retain the specific cultural nomenclature for each vessel type throughout the text.

Grace (1956: 80–81) first identified the Levantine Late Bronze Age form as the ‘Canaanite jar’, while Parr (1973: 173–174) deemed it to be the ‘direct ancestor of the Greek and Roman amphora’, a pottery type in use for over 2000 years. Stirrup jars appear in the earliest studies and catalogues of Minoan and Mycenaean pottery under various names: Bügelkanne (Furtwängler and Loeschcke 1886: xiii), stirrup-vase (Evans 1902/1903: 138), vase à étrier (Renaudin 1922: 122–123), false-spouted vase (Pendlebury 1939: 202) and false-necked jar (Furumark 1941: 85). The unique arrangement of the handles, the closed neck and the spout made these containers easily distinguishable in the archaeological record. Seldom, however, have these—or any of the vessels discussed here—been examined diachronically as a commercial commodity container (cf. Bevan 2014).

Here we consider the likely origins of these types of vessels, their development and spread throughout the Aegean and eastern Mediterranean as archetypal organic bulk cargo containers, and their wider impact on Mediterranean connections, transport and trade over the Bronze and early Iron Ages, a period of some 2500 years. Maritime transport containers facilitated the large-scale (‘bulk’) transportation of goods in ships. In attempting to reconstruct the early phases of their history, we also consider the early phases of ‘systematic’ seaborne trade—i.e. the transport of wine, olive oil, other organic goods, and other products in large quantities—as it may be traced archaeologically. To what extent had such trade developed by the Early Bronze Age? How did it change during the Middle–Late Bronze Ages? Did the early Iron Age bring further developments?

Other issues raised (even if not always resolved satisfactorily) are:

- To what extent can maritime transport containers inform us about patterns of seaborne trade in the Mediterranean over the nearly 2500 years covered in this study?
- Did social factors such as mobility, communications and maritime experience outweigh constraints such as the availability of resources, the (reputed) seasonality of seaborne trade (Beresford 2013), or the distance to specific ports or markets (Curtin 1984: 15–37; van Dommelen and Knapp 2010)?

- How are any culture's sociopolitical and economic institutions—together with sources of wealth and prestige—related to its maritime trading patterns?

In the attempt to answer such questions, we focus first on maritime matters (shipwrecks, harbours), as well as on general issues involving connectivity and seaborne trade (bulk transport of goods; types of goods exchanged; social aspects of exchange) and how they changed through time. We then define and consider at length the maritime transport container, its form and function(s), the many varieties and where they were likely manufactured, what they may have contained, and their development throughout the Bronze and early Iron Ages. At various points in the text, we also consider later, better-known patterns of maritime production and trade that may shed light on the situation in the Bronze and early Iron Ages. Finally, we discuss how this treatment of maritime transport containers enhances our understanding of ancient Mediterranean connections, transport and trade. The volumetric analyses in the appendix calculate the capacity of each type of MTC treated here through the use of a computer-aided modelling, which produces 3D images of the vessels. The aim is to consider whether there was any level of capacity standardisation throughout the use history of the MTCs presented here. Such standardisation, if it existed, would have been beneficial for both the sellers packaging their products in vessels of known capacity, and the merchants and mariners who had to estimate the extent and spatial arrangement of their cargoes.

Underlying the discussion of various aspects of the production, transport and consumption of what were likely bulk organic products is the unifying theme of the movement of goods and people throughout the Mediterranean maritime world, the routes they followed, and the social or economic relationships involved in such movements. If, as Febvre (*Annales*, 11 January 1940: 70) wrote, 'The Mediterranean is the sum of its routes', and if, as Braudel (1972: 277) subsequently observed, 'the whole Mediterranean consists of movement in space', then there are no land routes or sea-lanes in the Mediterranean without people moving and interacting, no people moving without making stopovers (e.g. at ports, anchorages, inns, markets) that give shape to the journey. Venturing onto the open sea was always risky, but for those long-distance maritime traders who did so, the advantages of cost and speed opened endless opportunities (Panagiotopoulos 2013: 155). As Broodbank (2013a: 394) recently quipped, the Mediterranean Sea 'remained an anarchic, free-for-all zone for anyone with the skill, daring and funds to set out upon it'.



## 2 Maritime Matters

### Shipwrecks and Harbours

... wait until the sailing season arrives, and then  
drag your swift boat down to the sea,  
arrange the cargo in it and get it ready  
so that you can bring the profit home.

(Hesiod, *Works and Days*: 630–632)

#### Shipwrecks

Despite the wealth of new information gained from studies of the Uluburun shipwreck and its cargo (most recently, Pulak 2008; 2009; Monroe 2007; 2009: 10–15; 2010), our understanding of the nature and forms of Bronze Age maritime transport remains limited, particularly in comparison with later periods. Moreover, some scholars are sceptical about whether wreck sites situated close to land and lacking wooden ship remains actually represent shipwrecks. Wachsmann (1998: 205; 2011: 17, n. 14), for example, questions whether the finds from Dokos (a small island in the Argo-Saronic Gulf) represent an Early Helladic wreck, or whether those from the Pseira islet (east Crete) indicate a Minoan shipwreck. Here it is worth emphasising that only the Bronze Age wrecks at Cape Gelidonya and Uluburun preserve any wooden remains of the actual ships. At Dokos, at least, the absence of an Early Helladic settlement on the promontory (Myti Kommeni) just above the wreck site, as well as the results of the geophysical survey (Yannis Lolos, pers. comm.), leave little doubt that the assemblage represents that of a shipwreck. Moreover, the area around the Saronic and Argolic Gulfs formed part of an important sea-lane of trading activity from the Early Bronze Age onward (Papageorgiou 2009: 214). At Pseira, the depth of the assemblage (at –45 m) points to a wreck rather than a dumping episode from the land site. In both cases, the excavators have suggested wreck deposits rather than dumping, which in our view means that these were assemblages of vessels transported on ships (see Figure 1 for all shipwreck sites mentioned in the text).

Beyond the best-known shipwrecks, at Uluburun and Cape Gelidonya in Turkey and Point Iria in Greece (Bass 1967; Karageorghis 1993: 584–587; Vichos and Lolos 1997; Phelps et al. 1999), the cargo of another late Middle or early Late Bronze Age (c. 1600 BC) wreck was excavated at Sheytan Deresi off

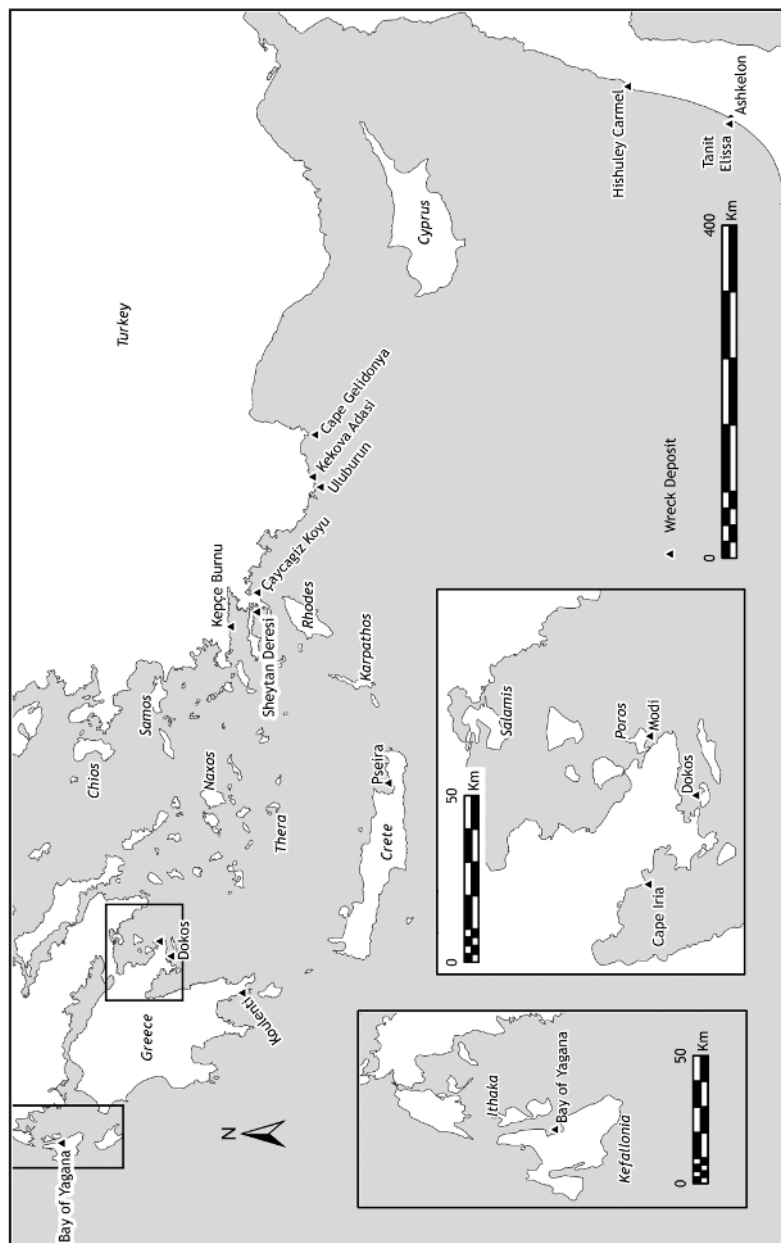


Figure 1 Bronze-Iron Age sites with shipwrecks mentioned in text. Drawing by Luke Sollars.

Turkey's southwest coast (Bass 1976; Margariti 1998; Catsambis 2008). Recent excavations have identified another Late Bronze Age wreck just off the islet of Modi, near Poros in the southern part of the Saronic Gulf, some 60 km south of Athens' Piraeus harbour (Agouridis 2008; 2011; 2012). Two further 'Minoan' wreck deposits are known: one (already excavated) near the Pseira islet in northeast Crete (Hadjidaki 2004a; 2004b; Hadjidaki and Betancourt 2005–2006), the other (only reported) at Koulenti along the Laconian coast of the Greek mainland (Spondylis 2012). Finally, a wreck deposit that most likely dates to the Late Bronze Age (thirteenth century BC) has been identified on the basis of finds—mainly copper and tin ingots—at Hishuley Carmel, about 1 km south of Haifa on the southern Levantine coast (Galili et al. 2013). The argument made by the same authors (Galili et al. 2011) for four Late Bronze Age shipwrecks along a 3-km stretch of beach south of Haifa seems more speculative—at least until it can be demonstrated that this is not the result of dumping, or taphonomic or other factors, or until some evidence of an actual ship is found (already noted by Wachsmann 1998: 208–209).

Other relevant instances of Bronze Age evidence, both iconographic as well as ships' remains or related finds, are simply noted at this point as examples of what is likely to be a larger corpus:

- 1 depictions or rough outlines of ships, or 'ships graffiti', from terminal Neolithic Strofilas on Andros in the Cyclades (Televenatou 2008: 47, fig. 6.8; Archibald 2013: 78, fig. 107), the Late Chalcolithic Levant (Marcus 2002: 406–407, fig. 24.1), predynastic Egypt (Braudel 2001: 92–93) and contemporary or slightly later Tarxien and Kordin on Malta (Cilia 2004: 73–75; Vella 2004: 28); Early Bronze Age Syros and Naxos in the Cyclades (Broodbank 1989: 327–329; 2000: 96–101; Televenatou 2008: 47), Mochlos off Crete (Wedde 2000) and in the southern Levant (Marcus 1998: 109–110); Middle Kingdom Egypt (Rod el 'Air, Sinai, in Wachsmann 1998: 32–37, figs. 2.45–2.60); Late Bronze Age Cyprus (Basch and Artzy 1985; Wachsmann 1998: 141–143), Crete (Soles 2012: 188–191, figs. 21.2, 6), Greece (Tragana, Messenia in Mountjoy 1999(1): 357–358, no. 132, fig. 123) and the southern Levant (Artzy 1997: 7).
- 2 ships' models (Westerberg 1983): Bronze Age clay and metal boat models from Byblos (Wachsmann 1998: 52–53); an Early Minoan model from Kephala Petras (Papadatos 2012), and one clay and one stone model from Mochlos on Crete (Soles 2012: 188–190, figs. 21.3–4); if authentic, the three lead models from Naxos in the Cyclades (Renfrew 1967: 5 pl. 3, 12–14; Broodbank 2000: 97–99, n. 4); at least seven Middle–Late Cypriot clay models of seagoing ships (Westerberg 1983: 9–16; Wachsmann 1998: 51, 62–67; Knapp 2014: 82); a wooden boat model from Gurob in Egypt, argued to be an Aegean or 'Sea Peoples' ritual vessel (Wachsmann 2013).
- 3 Early–Middle Minoan and later seal-stones (from Crete), and one on a golden signet ring (from Mochlos) depicting a variety of vessels—deep-hulled, masted, rigged, oared—in miniature, few of which show a sail

- (summarised in Broodbank 2010: 155–156, with further references; Soles 2012: 188–192, figs. 21.1, 5–6; see also Rahmstorf 2010).
- 4 wall-paintings of Cycladic or Aegean sailing ships, oared vessels and harbours (e.g. Doumas 1992; Sherratt 2000; Strasser 2010; Strasser and Chapin 2014).
  - 5 the plank-built boats from Early Bronze Age (First Dynasty) Abydos and the Fourth Dynasty funerary barge of Khufu (a riverine vessel) in Egypt (Lipke 1984; Ward 2006); the possible ‘Middle Bronze Age’ boat found at Mitrou on the Euobeian Gulf in central Greece (Van de Moortel 2012).
  - 6 stone anchors, widespread throughout the Bronze–Iron Age Aegean, Cyprus, the Levant and Egypt (e.g. Frost 1970a; 1979; McCaslin 1980; Galili et al. 1994; Shaw 1995; Toth 2002; Knapp 2014: 83–84).

Wachsmann (1998: 9–204) presents a comprehensive overview of all material and representational evidence of ships from the Bronze Age Levant and Aegean, while Broodbank (2010) offers a focused study of seagoing, sailing ships—including their representations—and ship-building technology, as well as their sociocultural impact in the Late Chalcolithic through early Iron Age Mediterranean (for a nautical analysis of the iconographic evidence, see Basch 1987).

In general, and depending on their state of preservation, shipwrecks provide the most crucial material resource, and often shed light on other factors such as traded goods (i.e. the cargo), sailing routes or the ports of origin and destination. Theoretical analyses and new finds in shipwreck archaeology (Adams 2001: 296–297) have refined the notion that a wreck is a single event phenomenon, whether a closed find (Westerdahl 1992: 7) or a case of ‘exchange frozen in time’ (Muckelroy 1980: 108). Even so, shipwrecks preserve their special synchronic value for dating and remain a unique source of information about nautical issues and seaborne activities. Nonetheless, the number of known shipwrecks from specific periods—in particular within the prehistoric Mediterranean—is typically low, and thus the existing archaeological record may not provide a sufficient sample from which we could derive definitive conclusions on ancient maritime trade mechanisms.

Six of the eight known shipwrecks of Bronze Age date—Sheytan Deresi (Bass 1976), Uluburun (Pulak 2008), Cape Gelidonya (Bass 1967), Point Iria (Lolos 1999), Modi (Agouridis 2011; 2012) and Laconia (Spondylis 2012)—were scattered on a sloping seabed or steep reef. A slightly different set of six—Sheytan Deresi, Point Iria, Modi, Koulenti (Laconia), Hishuley Carmel (Galili et al. 2013) and Pseira island (Hadjidaki and Betancourt 2005–2006)—should be considered open deposits rather than closed finds. Moreover, as already noted, only the Uluburun and Cape Gelidonya wreck deposits have revealed any elements of the original ships’ wooden hulls. For the early Iron Age, the picture is equally limited; only three certain shipwrecks are known, dated to the Late Geometric–Early Archaic periods (and thus at the limit of our time frame in this volume): the deepwater *Tanit* and *Elissa* wrecks off the coast from Ashkelon (Ballard et al. 2002; Stager 2003), and Kekova Adası off the

Mediterranean coast in southwestern Turkey (Greene et al. 2011). Greene et al. (2013: 28–32) also provide preliminary accounts of two further possible Iron Age shipwrecks, at Kepçe Burnu and Çaycağız Koyu, respectively about 200 and 150 km northwest of Kekova Adası. The cargo of both wrecks was badly broken, but contains many examples of the Cypriot Basket-handled Amphorae that dominated the assemblage of the Kekova Adası wreck (discussed further below, in Chapter 4, *Maritime Transport Containers: Into the Iron Age*). The *Tanit* and *Elissa* seem to be well preserved and coherent but too deep for excavation, while the wrecks at Kekova Adası, Kepçe Burnu and Çaycağız Koyu are widely scattered and dispersed on the rocky sea bottom. Nonetheless, and despite their fragmentary condition, which does not provide the best evidence about the type and size of ship, these wrecks still render specific information on ancient Mediterranean trade, especially concerning the composition and nature of their cargo.

As the Uluburun wreck deposit has demonstrated (Pulak 2008), a ship's cargo presents striking evidence for the material components of ancient trade—goods exchanged and/or carried from one port to another (also Parker 1992: 3). More typically, however, evidence of Bronze or Iron Age maritime trading patterns—shipping, sailing or shipwrecks—is quite limited compared to that for later periods, especially for the Hellenistic and Roman eras. An interesting point that emerges from these later periods, and one that may have some relevance for considering earlier forms of trade, is that shipping was not evenly balanced between bulk cargoes (made up largely of a single component, e.g. transport amphorae, or copper ingots) and compound (or mixed) cargoes. Only 5% of the ships included in Parker's (1992: 20–21) study could be considered 'tramps' or general cargo carriers. His more specific study on the distribution of wrecks with specific amphora types as cargo also indicates a directed trade in bulk commodities along well-travelled routes between major ports (Parker 1990). Even so, complex trading networks connecting primary with secondary harbours, via a combination of long-distance trade and coastal ventures, can result in compound cargoes redistributed by—or transhipped in—small carriers, or through distribution patterns difficult to trace in any detail (Nieto 1997; Hohlfelder and Vann 2000; Nantet 2010).

On the basis of the goods exchanged, as well as some limited examples of representational art, it seems clear that seagoing, sailing ships were operating between the Levant (if not Cyprus) and the Nile Delta by the middle if not the early third millennium BC (Marcus 2002: 407–409; Wengrow 2006: 148–150; Broodbank 2013a: 301–303; see further below), and throughout the Aegean world by the middle to end of that millennium (Broodbank 2010: 255–256, fig. 20.2). On present evidence, it seems to have taken another thousand years before this technology reached the central and western Mediterranean. The emergence and development of the relevant ship-building and sailing technologies seem to have gone hand in hand with more complex sociopolitical systems, if not increases in population (Anderson 2010: 7).

## Sailing

It has long been assumed that the technological limitations of ancient through medieval merchant ships, as well as prevailing meteorological conditions, forced ships under sail to travel along the coasts and island chains of the northern Mediterranean, and along the Levantine littoral. Furthermore, we know that Roman and medieval ports or naval bases scattered throughout the Mediterranean's sea-lanes formed the basis for maritime shipping, commerce and political power. Arnaud (2005: 117; 2011: 62), however, has expressed doubts about the reliability of using medieval seafaring patterns or mercantile ventures to study those of antiquity. For example, in interpreting cargoes during certain periods, a distinction must be made between merchants and ship owners: the former might have had several ships on their ledgers—none of which they owned—en route from one trading post to another. So, just how much can we assume for earlier periods, particularly when constrained by the lack of relevant historical records (especially relevant during the Bronze and early Iron Ages in the Mediterranean)?

Given the importance that maritime trade had assumed for several polities already during the Bronze Age in the Mediterranean (e.g. Muhly et al. 1988; Broodbank 1989; 1993; 2013a: 314–344; Knapp 1990; 1996; 2014; Bauer 1998; Stager 2001; Marcus 2002), we need to consider more carefully whether merchants, emissaries and mariners travelled only along certain routes or only during certain seasons, dependent on the prevailing winds. Sauvage (2012: 265–270) has recently reconsidered notions of enforced seasonal or coastal navigation with respect to variations in the direction and intensity of prevailing winds, and in light of natural hazards as well as a sailor's offshore navigational skills and techniques. She concludes that skilled Bronze Age sailors were able to determine their approximate position on the open sea, within and beyond the eastern Mediterranean. Georgiou (1991: 61–62) long ago argued that prehistoric maritime enterprises were neither haphazard nor limited by seasons and weather conditions, while Sherratt and Sherratt (1991: 358) suggested that smaller independent or entrepreneurial maritime ventures always existed, and presumably were undertaken on their own terms. Frost (1995: 1) observed that winds and currents never completely dictate where people go or how they get there. Finally, Papageorgiou (2009: 201–204) maintained that sea surface circulation—usually determined by the circulation of the surface currents, themselves created by wind blowing on the surface of the sea—may have favoured voyages on the open sea during all seasons of the year.

Seamanship and local knowledge compensate to some extent for navigational difficulties, whether being blown off course into the open sea, or sailing at night, or during the off-season (Arnaud 2011: 62, 70–71). Morton (2001: 255–265) argued that although wintertime and night time were commonly avoided in ancient seafaring, this depended on particular regional conditions or specific sea routes: for example, the route between Greece and Egypt would have been safe for winter sailing. Beresford (2013: 181–183), while agreeing that winter

navigation, especially across the open sea, was difficult, suggests that it was possible if the mariners were able to modify their seasonal sailing strategies accordingly. The question of the relation between seaworthiness during winter and the size of the ships, although important for the study of ancient trade mechanisms, remains unresolved, because of other, equally intractable issues—e.g. cargo weight, ability to shelter, or manoeuvrability of bigger vs smaller vessels (Morton 2001: 153; Beresford 2013: 125–134). In Arnaud's (2011: 75) view, winter sailing was commonplace but riskier than summer sailing: it generated different trading patterns on a different scale, used different (coastal) routes and sailing times, and probably involved the use of smaller ships, with increased losses, and thus a search for higher profits. The bottom line seems to be that there was no closed season as far as merchant shipping was concerned. Still, if we accept that regional or micro-regional economies were based on cabotage (Horden and Purcell 2000: 145, but see below), we must keep in mind that—throughout antiquity—most recorded open seas trips were never longer than three days (24 hrs) and were related to the prevailing winds, at least during summer (Arnaud 2005: 121).

We must also make a distinction between long-distance sailing and cabotage (not 'tramping' per se, but coastal sailing/trading between known ports), both of which seem to have occurred during the Bronze and early Iron Ages. Trading over certain long-distance routes—e.g. between Crete and the Levant, which required sailing in the open sea—may well have been restricted to certain months of the year (i.e. April–November) whereas short-distance, coastal contacts using smaller vessels (10–12 m in length) could have been conducted all year round. The Point Iria wreck deposit is estimated to have involved a ship 9–10 m in length, that of Cape Gelidonya about 10 m (Vichos and Lolos 1997: 334–335; Phelps et al. 1999: 118–119; Bass 1967: 49–50). Pulak (in Hirschfeld and Bass 2013: 102), however, now suggests the length of the Cape Gelidonya ship could have been up to 12.5 m, while Bass (2013: 67) suggests it may have been up to 16 m. The shipwreck at Uluburun is estimated to have been 16 m long, with a capacity of about 20 tons (Pulak 2005: 295; Monroe 2007: 2, and n. 2). Monroe (2007), moreover, cautions that reconstructions of Bronze Age trading networks should assume that ship capacities were not substantially larger than 20 tons, and should also consider the advantages of shallow-draft ships. He has also pointed out (pers. comm., 12 April 2015) that—regarding the issue of cabotage vs open sea sailing—one must recognise that Bronze Age ships lacked the deeply protruding keels that converted lateral or sideways forces of the wind into forward motion. Without such keels, these ships had considerable leeward drift, i.e. their round bottoms were pushed in the direction of the wind, which would have made cabotage quite dangerous whenever they were close to shore during higher winds. Open-sea sailing, while presenting navigational challenges owing to a lack of landmarks, was a safer way to sail ships suffering from leeward drift. While twin quarter rudders may have ameliorated drift to some degree, 'wine-shaped' hulls (with still only a modest keel protrusion) only appear in the archaeological record during the fifth century BC.



With respect to coastal vs open-sea sailing, assessment of the options was based on many factors: e.g. the season, the route, the type of ship, the crew's experience, cost effectiveness and more. When time or necessity dictated, it is likely that both kinds of routes might have been combined in one trip (Morton 2001: 143–162). The type of ship involved was also important: open-sea sailing is easier for merchantmen than for galleys. Moreover, the nature of the cargo had to be taken into consideration: heavy cargoes or those that could not be jettisoned in the face of danger were likely to have been unsuitable for travel on the open sea. And, once again, experience with the particular routes concerned could also be a decisive factor in choosing between the two sailing options. Finally, it is clear that throughout antiquity sailing patterns underwent changes that were directly dependent on various administrative, cultural, geopolitical or economic factors (Arnaud 2011: 62).

Sailing ships like the one that wrecked at Uluburun, for example, must have required major investments of labour, materials and wealth, yet the decrease in transport time afforded by winds and water currents would have offset some of these costs (Monroe 2007: 13–15). Cuneiform records from Ugarit (north Syria) demonstrate that wealthy Bronze Age merchants invested independently in ships like these, as well as their cargoes; they also invested on the king's behalf (Monroe 2009: 181–189). Indeed the royal role in maritime trade at Ugarit seems to have been indirect—taxing merchants rather than maintaining a fleet of commercial vessels—and a complex administrative structure involving merchants, overseers, a harbour master and an overseeing governor smoothed the working of the system (Monroe 2007: 14; 2009: 164–173, 171 fig. 5.1). In one often-discussed document (RS [Ras Shamra excavations, inventory no.] 16.238+254), the Ugaritic king exempted from any claim the grain, beer and oil that the merchant Sinaranu had brought from Crete on his ship (Monroe 2009: 165–166). Of related interest is an Ugaritic text (RS 17.133) mentioning that a ship had wrecked into a quay in the harbour at Ugarit, and that the ship's captain was obliged to reimburse the ship's owner the cost of the vessel and its cargo (Monroe 2009: 76, 90). This brings us, then, to a discussion of ancient harbours in the Mediterranean, and their role in maritime connections.

## **Harbours**

If shipwrecks form one primary context (some would say a skewed and biased context—Marriner and Morhange 2007: 137) for investigating the mechanisms of Mediterranean trade, harbours provide another: they were founded and endured largely because of the ships, goods and people involved in maritime exchange (Gates 2011: 381). The harbours of Rome, to take a later example, supported a huge range of different people, jobs and guilds (Mattingly and Aldrete 2001). In Purcell's (2014: 67) view, classical harbours were first and foremost the points where sea travel was subject to surveillance and taxation, as the polities that received such revenues from duties on travellers and trade were dependent on them for their own access to the world of the sea.



The term ‘harbour’ generally refers to a protected and sometimes enclosed space used to shelter vessels, while ‘port’ is used to distinguish a location where goods or people pass between sea and land (Leidwanger 2013: 221 n. 1). In this study, however, we use the terms port and harbour interchangeably, in the broader sense of an ‘emporion’, i.e. a place oriented around the traditional functions of maritime trade (*emporía*) and the activity of maritime traders (*emporoi*) (Arnaud 2011: 65), but not necessarily in the sense of a ‘port of trade’. The latter was a politically neutral institution that sponsored secure and reliable trading relations between strangers (Polanyi 1963; Luke 2003: 2–10, with refs. and analysis of the terms).

Most ports were fundamentally commercial entities, although they may also have provided shelter or a place for repairing, watering or virtualising ships. In the end, they prospered or failed along with the volume and level of commercial exchange they handled. In general, coastal settlements typically were established at the safest anchorage and on crucial junctures in the sea-lanes of any given area; this suggests they were founded intentionally to be used as harbours (Papageorgiou 2009: 216). On quite another level, a harbour might be seen as a liminal ‘threshold’, a meeting point between different maritime people or societies designed to convey people, ideas, goods or resources unavailable elsewhere (Monroe 2011: 90, 96), or even as a geographic point of contention between an ordered land and the chaotic sea (Westerdahl 2005: 3).

To some extent, the study of ports and harbours in the Bronze–Iron Age Mediterranean has been one-dimensional, treating remains on land but not underwater (although it must be noted that relatively few of the latter are known) (for all harbour sites mentioned in what follows, see Maps 1a–c at the front of this volume). There are several general treatments (e.g. Blackman 1982; Raban 1985; Shaw 1990; Blue 1997; Gates 2011; Tartaron 2013: 139–181), and many studies of individual sites (e.g. Artzy 1995 and Monroe 2009: 15–19 [Tell Nami]; Stager 2001 [Ashkelon]; Hayden et al. 2007 [Pyrgos, Crete]; Van de Moortel 2007 [Kommos, Crete]; Marcus 2006 and Bietak 2008 [Tell ed-Dab’a, *passim* Egypt]; Watrous 2012 [Gournia, Crete]; Tartaron et al. 2011 and Pullen 2013 [Kalamianos, Greece]), but rather fewer studies on the wider sociopolitical, cultural or ideological phenomena associated with harbours or maritime landscapes (e.g. Westerdahl 1992; 2010; Knapp and Cherry 1994: 135–146; Knapp 1997; Morgan 2007; Rogers 2013). Archaeologists, moreover, tend to view harbours as physical entities (quays, piers, moles, ship-sheds) and the infrastructure that gravitates to them; earth scientists, by contrast, see them in terms of their sedimentary contents and hydrological aspects, especially with respect to understanding aggradation of the harbour bottom, or coastal progradation and deformation (Marriner and Morhange 2007: 145–146).

As Tartaron (2013: 141, 163) points out for Bronze Age Aegean harbours, regional or local tectonic activity (including erosional and depositional processes) can make the detection of ancient harbours relatively easy or difficult. Along the west coast of Asia Minor, for example, the estuary and delta

systems that once hosted major Bronze Age harbours at Troy, Ephesos or Miletos are now silted in, leaving the ancient harbours stranded many kilometres inland (Marriner and Morhange 2007: 154). On the southern shore of the Gulf of Izmir, the gradual infill of a (former) coastal bay led to the formation of a peninsula on which the Bronze Age harbour site of Liman Tepe was situated (Erkanal 2008). Farther southeast, in Cilicia, geomorphological fieldwork around Kinet Höyük—today situated a half-kilometre from the sea—indicates significant aggradation after the Hellenistic era, which would have buried those parts of the Late Bronze and Iron Age settlement/port that lay closer to the sea (Beach and Luzzadder-Beach 2008).

Despite such complicating factors, several key ports or harbours that were instrumental in the movement of maritime transport containers have been identified. Some of the best-known harbours that have divulged various aspects of their underwater components are (in Syria) Minet el-Beidha and Ras ibn Hani—both ports of Ugarit; (in Lebanon) Byblos, Beirut, Sidon and Tyre; (in Israel) Tell Abu Hawam, Tel Nami, Tel Dor and Atlit; (on Cyprus) Hala Sultan Tekke *Vyzakia*, Maroni *Tsaroukkas*, Enkomi and Kition; (on Crete) Kommos; and (in Egypt) Marsa Matruh (Frost 1973; 1985; 1995; Raban 1985; 1987; 1998; Manning 1998: 53–54; Artzy 2005: 356; 2006a; 2013; Haggi 2006; Haggi and Artzy 2007; Marcus 2007: 165–170; Carayon et al. 2011; Devillers et al. 2015).

On a general level, what we know is based on various pictorial representations, documentary evidence, stone anchors, limited underwater explorations, and of course land excavations carried out at ports or anchorages. The ‘miniature’ or ‘flotilla’ fresco from the West House at Akrotiri on Thera, for example, offers an informative (and probably realistic) representation of double harbours, particularly in their setting on peninsulas or headlands, and their association with shore-side structures, like ship-sheds (Shaw 1985: 22–25; Shaw 1990: 429–433; Morgan 2007: 120–121; Blackman 2011). Whether the West House fresco represents an attempt to depict the actual harbour of Akrotiri (or, Strongyle, before the eruption) continues to be a matter of debate (most recently Strasser 2010, and fig. 6—reconstruction of the harbour; see also Friedrich and Sørensen 2010; Strasser and Chapin 2014).

The earliest Bronze Age harbours seem to be preferentially concentrated around small coves, pocket beaches, estuaries and wadis, in other words around natural anchorages that required little if any modification by the people who used them (Marriner and Morhange 2007: 175). Many early seafaring communities originated in the eastern Mediterranean; for example, many of the rocky and recessed coasts of the Cyclades and other Aegean islands were well-suited to sheltering early mariners and their vessels. Other Bronze Age harbours were frequently situated on the open shore, typically in combination with a small offshore islet (Frost 1995; Shaw and Shaw 2006: 854). One example on the north coast of Crete is Amnisos (a harbour town of Knossos), but the best known (Late) Bronze Age harbour on the island—the result of its long, exemplary history of excavation (Shaw and Shaw 2006)—is Kommos, situated

directly on the coast of the western Mesara plain and fronting the Mediterranean Sea. Here lay an impressive harbour-side complex with two monumental ashlar structures that seem to have served, at differing times, various maritime and/or commercial functions associated with a gateway community (Shaw and Shaw 2006: 848–853).

At Kommos, Building T, Middle Minoan (MM) III–Late Minoan (LM) I in date (c.1750–1470 BC, Manning 2010: 23, table 2.2), is a monumental structure that likely served some storage functions (Room 25, where many *pithos* fragments were found), and that had several long, narrow rooms (C–J) that may have served as ship-sheds (Blackman 2011). This building would have functioned as a distribution centre for goods to be transhipped overseas or along the coast to other sites, or alternatively transferred inland (M. Shaw 1985; Knapp and Cherry 1994: 139). There is little doubt that the six long, broad ‘galleries’ (5.5 × 38.5 m) of Building P, LM IIIA2–IIIB in date (c.1390–1200 BC), were ship-sheds (Shaw and Shaw 2006: 580–582; Blackman 2013: 10); this structure may also have been used for the storage of Short-necked Amphorae (discussed below). A third ashlar structure, Building N (also LM IIIA2 in date), which partly covered Building T, may also have served some of the latter’s administrative functions, or perhaps housed those who supervised all the maritime activity in Building P. Three fragments of imported copper ingots found in Building N also point to trading activity there (Shaw and Shaw 2006: 726). Two large, heavy, three-holed anchors quarried in Cyprus or Syria indicate that large ships came to Kommos (Shaw 1995), while pottery imports (and their contents in some cases) from the Greek mainland, the Cyclades, Cyprus, Anatolia, the Levant and Sardinia (summarised by Rutter and Van de Moortel, in Shaw and Shaw 2006: 856–863) leave little doubt that at least some people at this site were intimately involved in Mediterranean connections during the Late Bronze Age.

Blackman (1982: 93) once maintained there was little likelihood that large-scale built harbour works existed in the Aegean area during the Bronze Age, and nothing beyond Crete. With the discovery of the ship-sheds at Kommos and other recent work, however, that view has proved wanting (Shaw 1999; Blackman 2011: 4–5). Recent fieldwork at Poros-Katsambas on Crete, for example, has revealed a row of six long chambers that might equally be interpreted as ‘Minoan storage shipsheds’ (Blackman 2011: 5–7, figs. 7–8; 2013: 12). Evans (1928: 229–230) had already identified Poros-Katsambas as the harbour town of Knossos, and further recent studies have demonstrated that the site was occupied from Prepalatial through Neopalatial times, i.e. from Early Minoan (EM) I–LM III A (Dimopoulou-Rethemiotaki 1993; Dimopoulou-Rethemiotaki et al. 2007; Blackman 2013: 12). Farther east along the north coast, submerged buildings can be seen along the shore and offshore island at Amnisos, but their proposed date (Late Minoan I—Schäfer 1991) remains uncertain. There are also cuttings in the bedrock at Nirou Chani but neither their earlier interpretation as Minoan ship-sheds (Marinatos 1926: 146) nor their Bronze Age date can be demonstrated (Shaw 1990: 425–426; but cf.

Chryssoulaki 2005: 83 and n. 39; Blackman 2013: 12). Farther east yet, at Malia, there are (undatable) cuttings as well as the remains of a submerged building with what are likely to be storage chambers, not ship-sheds (Shaw 1990: 427–428; Blackman 2011: 8, fig. 13; cf. Hue and Pelon 1991; Raban 1991: 139–140 and pl. 35).

Based on finds of Minoan structures, Early–Middle Minoan pottery and a possible mole or breakwater at Plaka on the south coast of Crete (about 40 km southeast of Phaistos), Hadjidaki (2004a) suggests the site may have been a Minoan harbour. The small islet of Mochlos in east Crete was likely joined to the mainland by a narrow isthmus, with protected anchorages on either side, a rare phenomenon on this coast. With its natural harbour facilities (no built works underwater are yet known), Mochlos was ideally situated to serve as an entrepôt not only for local communities around the Bay of Mirabello, but also for goods coming from as far distant as the Levant (Branigan 1991; Soles 2005). Finally, and most recently, Watrous (2012) has identified what he believes to be a harbour complex—with a monumental ship-shed ('Shore Building' with galleries similar to those of Building T at Kommos), fortification walls with towers, *pithoi* and anchors, and a cobbled street running from the harbour toward the town—about 360 m north of the Neopalatial Minoan site of Gournia, on Mirabello Bay (see also Lobell 2015: 35). Overall, and in addition to Kommos, then, it is likely that Poros-Katsambas, Amnisos, Nirou Chani, Mochlos, Gournia and possibly Malia and Pseira served as Aegean Bronze Age ports (Shaw 1990: 425–428; Chryssoulaki 2005: 82–83; Blackman 2011; Watrous 2012: 536), but further underwater work is desirable in almost every case.

On the Greek mainland, Lolos (1995: 65–72, fig. 1) listed several potential harbour sites in the Argolic and Saronic Gulfs, most convincingly at Peristeria on Salamis and Ayios Nikolaos on Hydra. More recently, Pullen (2013) and Tartaron (2013: 243–270; Tartaron et al. 2011) have presented the striking remains of what is almost certainly a Mycenaean (and perhaps also Early Helladic I–II) port at Kalamianos on the Saronic Gulf. The town itself—with extremely well preserved architecture—seems to have been a short-lived maritime outpost (LH IIIA2/IIIB). Two submerged beachrock platforms incorporating large quantities of both Early Helladic and Late Helladic pottery (found during marine geophysical and underwater survey), along with the site's configuration (a promontory forming two harbour basins), confirm its status as a port, perhaps the only one in the Saronic Gulf with direct access to Mycenae (Pullen 2013: 258–259; Tartaron 2013: 248–251, 258–265). Far to the west, near the Late Bronze Age site of Pylos, a detailed geomorphological study (Zangger 2008) suggests the existence of an artificial harbour at the locality Romanou; if correct, this would be the only known built port of Mycenaean Greece. Other likely Bronze Age port sites in the Aegean include Tiryns, Ayios Stephanos, Kolonna on Aegina and Kastri on Kythera. For the sake of completeness, we also mention here the 17 copper ingots found just outside the modern harbour of Kyme on Euboea (Buchholz 1958; 1959); in their extensive

survey of the island, however, Sackett et al. (1966: 75–76) found no evidence for the existence of a major Mycenaean harbour here.

In Egypt, the massively fortified citadel and palaces at the site of Tell ed-Dab'a (ancient Avaris), were fronted—at the location 'Ezbet Helmy—by what Bietak (2008: 112 n. 2; 2010: 18; 2013: 188–189, figs. 1–2) describes as a large, 450 x 400 m harbour basin linked by canals to the main river channel (the Nile's Pelusiac branch). Beyond the reputed two million 'Canaanite amphorae' buried at Tell ed-Dab'a (Bietak 1996: 20), a broad selection of wares from Cyprus (early Late Cypriot) was also found at the site (Maguire 2009). In Kamose's later victory over the Hyksos (i.e. Canaanite) rulers of Avaris, the pharaoh claimed to have plundered from ships docked at this site such goods as gold, lapis lazuli, silver, turquoise, and a range of organic goods (olive oil, incense, fat, honey and fine woods): 'all the fine products of *Retenu*', i.e. the southern Levant (Redford 1997: 14). Thus this river port—glowingly described as 'Venice on the Nile' (Marcus 2006)—no doubt served as a gateway for any further trade up the Nile (Bietak 2010: 20–21), and as a key nexus in eastern Mediterranean trade.

On the Red Sea coast, over 400 km to the southeast of Tell ed-Dab'a and about 150 km northwest of Thebes, recent excavations have identified a Middle Kingdom harbour facility at Mersa/Wadi Gawasis (Bard and Fattovich 2010; 2011; 2015; see also Frost 1996). The mouth of the Wadi Gawasis—which in the late third to early second millennium BC was a deep lagoon within a large embayment—provided an optimal Red Sea location for an ancient harbour. Above this ancient lagoon, which extended considerably farther inland from the present-day shoreline, and cut about 20 m deep into the western wall of the fossil coral terrace at Wadi Gawasis, were two isolated rock-cut chambers (Caves 1, 8) and six long galleries (Caves 2, 3, 4a/4b, 5, 6, 7). Amongst the seagoing paraphernalia found in these caves were an estimated 26–30 coils of rope from ships (Cave 5), and over 40 wooden cargo boxes stacked in the area outside Cave 6. Both within and outside the rock-cut galleries, excavations produced some 90 ship's timbers from the hull, deck and rudders of ships, along with tenons, dovetails and copper strips used as fastenings (Ward and Zazzaro 2010). Seventeen ostraca, including one with the name of Amenemhet III (c.1831–1786 BC), recorded references to quantities of food and ships. Alongside this tentative time marker, the pottery typology together with nine radiocarbon dates demonstrate that this harbour was used primarily during the Middle Kingdom (c.2055–1650 BC) (Bard and Fattovich 2011: 109, table 1; 2015: 5). The authors argue that the harbour served for seafaring expeditions to the lands of Punt and Bia-Punt (Fattovich 2012), located somewhere along the African coast and hinterland in what is today southern Sudan and Eritrea, with possible extension to Yemen on the opposite coast (Bard and Fattovich 2010: 11–12; 2011: 127–128; 2015: 9–10).

Farther north, along the Suez Gulf, even earlier harbours are reported (Tallet 2012). The first is at Ayn Sukhna, some 120 km east of Cairo; this port was used throughout the Middle Kingdom, if not earlier, and excavations in ten

galleries similar to those at Wadi Gawasis produced two large limestone anchors, the cedar planks of at least two ships and related Old Kingdom hieratic inscriptions (one of which mentions *kbnt*-ships, which may be earliest mention of the well-known 'Byblos ships'). The second harbour is at Wadi el-Jarf, some 100 km south of Ayn Sukhna; it is dated to the beginning of the Old Kingdom's Dynasty IV (c.2600 BC). On the shoreline is a set of harbour facilities (including an L-shaped pier), while underwater explorations turned up at least 22 limestone anchors and some large storage jars that may have been used to ship water across some 50 kms of water that separate the site from the Sinai peninsula, with its copper and turquoise mines (Tallet and Marouard 2014: 4–7, figs. 1–2, 5–8). Another 99 'boat anchors' were excavated some 200 m from the pier area, between two structures that may have been storage buildings (Tallet and Marouard 2014: 11–12, figs. 17–18). Farther inland, excavations in some of the 30 identified storage galleries revealed wooden parts of ships (long hull pieces, fragments of oars, tenons), ropes and pieces of sail (Tallet and Marouard 2014: 7–8, fig. 10).

Along Egypt's Mediterranean coast and in a seemingly remote location over 300 kms west of the (western) Nile Delta lay another intriguing port, Marsa Matruh (White 2002a; 2002b). Excavations in Late Bronze Age levels at this site divulged numerous examples of imported wares, including MTCs such as Canaanite Jars, Aegean Transport Stirrup Jars and Cypriot *pithoi* (Russell, Hulin, in White 2002b: 8–15, 28–38). One of the pottery specialists felt that the numerous imports at the site should be related to an 'informal' type of tramping, barter or sailor's trade in 'relatively value-less' items (Hulin, in White 2002b: 174). The excavator (White 1986: 83–84; 2003: 75), however, more reasonably felt that Marsa Matruh served as an essential way station for merchants or sea traffic travelling between the Aegean, Egypt, the Levant and Cyprus (also Broodbank 2013a: 403). Numerous ostrich eggshell fragments found at the site—perhaps one object of the merchants' eyes—suggest the same (White 1999: 933–934; see also Conwell 1987). Metallurgical debris (slags, a crucible) and the metal products, however, seem more in keeping with small-scale local production for local use (White 2003: 74).

Twenty-five km farther west lay the massive fortified site of Zawiyet Umm el-Rakham, dated to the thirteenth century BC (Snape 2003). Imported pottery found at this site includes 15 whole Canaanite Jars (and several fragmentary ones), at least five, tall, coarse-ware Aegean Transport Stirrup Jars (two with Cypro-Minoan marks on their handles), some Mycenaean fine wares and Late Minoan jugs, and a range of Cypriot wares (Snape 2003: 67–69, figs. 3–6). The excavator suggested that these materials could have come to the site via seaborne traders en route to/from Egypt, who re-fitted or restocked their ships at Umm el-Rakham. White (2003: 77), however, reasonably felt that the lack of any suitable anchorage along the coast north of Umm el-Rakham (which today lies about one km inland) counts against its role as a trading post; he suggested instead that the transport and storage containers found at Umm el-Rakham represent provisions offloaded at Marsa Matruh and carried overland to that



site. Despite its limited size and the restricted number of imports, the significance of Marsa Matruh as a port—combined with its possible role vis-à-vis Zawiyet Umm el-Rakham—lies in its unique location and its extensive links within broader Mediterranean exchange systems. The MTCs found at both Marsa Matruh and Zawiyet Umm el-Rakham are discussed in more detail below.

Georgiou (1997: 121) suggested that Cyprus's most prominent anchorages or harbours were always situated in bays or inlets on the south and southeast coasts, between modern day Famagusta and Larnaca in the east and around to Limassol in the south central part of the island (for a more recent discussion of Cypriot harbours, see Knapp 2014: 84–85). Bronze Age harbours or anchorages likely existed at Enkomi, Kition, Hala Sultan Tekke and perhaps Kourion/Episkopi. Recent underwater survey at a coastal site below *Palaipaphos*—Kouklia *Achni*—recorded 120 stone anchors (Howitt-Marshall 2012), perhaps pointing to a 'proto-harbour' during the Bronze Age (cf. Iacovou 2008: 271, who suggests the main harbour of *Palaipaphos* may have been at the locality *Loures*). Other Late Bronze Age coastal sites have divulged numerous stone anchors, on land and in the sea: Hala Sultan Tekke *Vyzakia*, Kition and Maroni *Tsaroukkas* (Frost 1970b; 1985; McCaslin 1980: 21–22; Manning et al. 2002: 111–118, 123–143).

The site of Enkomi certainly served as an *emporion* from the outset of the Late Bronze Age, receiving and handling imported prestige goods and other specialised products: ivory, metal goods and precious metals, cylinder seals, jewellery, Levantine and Egyptian pottery, and much more (Courtois et al. 1986; Keswani 1989a; Crewe 2007: 16–25). A least 20 Canaanite Jars were found in the 'Sanctuary of the Ingot god' at this site (summarised in Crewe 2012: 232–234; see Table 1 on page 57 for detailed references.). Enkomi lay only a day's sail from Levantine or Anatolian markets in Syria and Cilicia, and to judge from its richly endowed tombs, archaeometallurgical facilities and evidence of early literacy (Knapp 2013: 427–432), its harbour certainly must have served as a crucial nexus in the island's overseas trade with both the eastern Mediterranean and the Aegean. Although Enkomi today lies some 4 km inland (on the common estuary of the Yialias and Pedhaios rivers), during the Bronze Age it must have had an estuarine port accessible to watercraft via a navigable channel from the Bay of Salamis (Sawicky 2007: 19–20; Howitt-Marshall 2012: 114).

Although there are no material remains of formal 'built' harbours on Bronze Age Cyprus, there are several indicators of suitable ports or anchorages on the island. At Hala Sultan Tekke *Vyzakia* in the southeast, for example, harbour facilities would have been situated in the shelter of a coastal lagoon (today a salt lake filled with water from the sea in winter), with a navigable outlet to the sea (Gifford 1985). Recent coring work and geomorphological mapping by Devillers et al. (2015) confirm the formation of such a lagoon; they have also identified two possible natural channels between gaps in the Pliocene limestone outcrops along the eastern and southern edges of the lagoon, through which Middle–Late Bronze Age maritime traffic could have passed. In the hinterland west of Hala Sultan Tekke, survey work has indicated that ancient ports may

have existed at the mouth of the Tremithos and Pouzis rivers (just west of Cape Kiti, along the easternmost point of the south coast) (Leonard 2000: 135–137).

Located on a long, exposed stretch of the east coast, the area around Kition *Kathari* (the Late Bronze Age site)—with no obvious natural bay or offshore ridge—may have been situated directly on a marine embayment (protected from the sea by a *Posidonia* bed) that would have had access, via an inlet, to the sea (Morhange et al. 2000; Devillers et al. 2015: 78; see also Collombier 1988: 43–44). Even if Kition lacked a well-protected harbour during the Late Bronze Age (LBA), its role as a major maritime centre has never been in doubt. In the west of the island, survey and geophysical work by the Palaipaphos Urban Landscape Project has prompted the suggestion that *Loures*—directly east of the natural terrace where the *Palaipaphos* sanctuary is situated—may have been the inlet of the site's original harbour (Iacovou 2008: 271; 2012a: 62 fig. 7.4, 64). In the south, based on the imported pottery and stone anchors recovered during underwater survey just off the coast at Maroni *Tsaroukkas*, Manning et al. (2002: 113 fig. 6, 121–123) argue that this site served as a Late Bronze Age anchorage.

Cyprus's closest Levantine neighbour, Ugarit, together with its ports Ras ibn-Hani and Minet el-Beidha (ancient *Mahadu*), was already established as an international player in the Middle Bronze Age, if not earlier (Bordreuil et al. 1984; Yon 2006: 16). Al-Maqdassi (2013: 78–79) argues that Syrian port cities like Ugarit and Tell Tweini (port for Tell Sianu?), as well as Byblos farther south, were in 'full development' by this time, and played a decisive role in eastern Mediterranean exchange systems. Gates (2013) makes a similar case for the 'Hittite port' at Kinet Höyük, which is located in a well-protected corner deep in the Bay of Iskenderun; two types of Canaanite Jars (Middle Bronze [MB] III, LB II) and an array of Middle Cypriot [MC] III–Late Cypriot [LC] II Cypriot imports (Bichrome, Base-ring, White Slip, Monochrome, Red-on-Black) tend to confirm its role as a key port (Gates 2013: 227, figs. 7–8, 229–232 figs. 15–16, 234 n. 2). At Ugarit itself, the site functioned as an important LBA gateway where merchants and mariners met and exchanged all manner of raw materials, organic products and finished goods with their Levantine counterparts, as well as with representatives from inland centres (Courtois 1979; Knapp 1991: 35–41; Yon 2003; 2006: 136–171). Situated at the intersection of overland and maritime trading routes, and within a day's sail of Cilicia and Cyprus, as well as several Levantine ports, Ugarit served as a key intermediary between the Levant, ancient western Asia and Egypt, Anatolia, Cyprus and the Aegean. The site also enjoyed easy access to the main overland passage to central Anatolia, through the Amanus and Taurus passes.

In maritime terms, Schaeffer (1937: 140–141, fig. 7) reported a seawall of ashlar headers at Minet el-Beidha, one of Ugarit's harbours. Eighty Canaanite Jars were also uncovered, standing in ordered stacks, within a storehouse excavated at the site (Schaeffer 1932: 3, pl. III.3). Stone anchors deposited in and around the so-called Temple of Baal, which crowned the highest point in the town itself, perhaps gives some credence to the suggestion that it served as a landmark for ships and sailors (Akkermans and Schwartz 2003: 338–339;



Frost 1991). In terms of documentary evidence, cuneiform texts from Ugarit reveal that ships from several Levantine sites (Beirut, Byblos, Tyre, Sidon), Cyprus (*Alashiya*), Crete (*Kabduri*) and Egypt docked at its ports, and that seafaring merchants from Crete, Cyprus, Egypt and Cilicia dealt there, typically through local merchants and officials, or with the king in special cases (Heltzer 1989: 12–13; Monroe 2009: 171–189). Ugarit's own stock of ships was substantial, and its shipwrights probably produced most of them, whether galleys or merchantmen (Linder 1981: 38, 40; Artzy 2003). Ugarit's vibrant commercial activities with the Mediterranean world, and the wealth that derived from such commerce, are as evident materially as they are textually. While Ugarit at times seems to have allied itself to more powerful states such as New Kingdom Egypt or Hittite Anatolia, documentary evidence indicates that many surrounding towns and villages were dependent on this mainly independent town and its port, whose position and wealth were based on trade, and in large part on maritime trade.

### ***Early Iron Age Harbours***

The original, 'proto-harbours' at Levantine sites such as Byblos, Arwad, Beirut, Akko, Tyre and Sidon are, arguably, of Bronze Age date (Raban 1998: 429–430; Carayon et al. 2011; Carayon et al. 2011–12: 442–447; Doumet-Serhal 2013). The earliest known, *built* harbour works in the Levant, however, only appear early in the first millennium BC. It is likely that the growing importance of trade to these coastal city-states—or the growing size of ships, with keeled bottoms that couldn't be beached safely—led merchants, mariners or rulers to develop their maritime knowledge and skills, and so to build artificial harbour works. This development may be likened to the ways that some ports in the contemporary Mediterranean have enlarged their capacity for containerisation to serve the needs of transshipment traffic in expanding global transport networks (Ridolfi 1999).

Of the Bronze Age Levantine harbour towns, Byblos was probably the most important (already in the third millennium BC), but is the least well-known today. Sauvage (2012: 234–235) has suggested that the 'Byblos ships' recorded in Old Kingdom Egyptian texts may refer to the technological origins of this type of vessel. In any case, the spatial layout of Byblos is thought to be typical of the Bronze Age, i.e. a series of simple, juxtaposed anchorages or sheltered coves (see Carayon 2012–13: 19 fig. 25). The spatial configuration of Middle–Late Bronze Age Beirut is similar and typical of other Canaanite harbours, i.e. a promontory (Ras Beirut) where the town centre was located, overlooking two natural harbours (Carayon et al. 2011: 51–53; Carayon 2012–13: 25–34 for detailed discussion). Marriner's (2007: 380–422) geomorphological reconstruction suggests that an anchorage was situated between the Nahr ('river') Beirut (to the east of Ras Beirut), two rocky promontories and an offshore island. At Yavne-Yam, a Middle Bronze Age site on today's Israeli coast, submerged boulder piles may reflect an attempt by local mariners to

improve the nature of the natural anchorage there (Marriner and Morhange 2007: 175).

The later, artificial constructions used for Iron Age harbours in the Levant's reputedly shallow and largely shelterless shoreline (albeit one with multiple reefs, offshore islands and lagoons that would afford adequate protection for smaller ships) are typically described as 'Phoenician', whether in reference to the original builders or to those who improved the works at this time—e.g. by adding a built quay or free-standing, often ashlar-built, vertical moles (Blackman 1982: 92; Frost 1995: 2–6). Historically, 'colonial' activities in many parts of the world led to the creation of new harbour installations, which often adapted existing natural harbours and landing places (Rogers 2013: 188). The pre-existing harbours at Arwad, Tyre and Sidon were likely renovated and modified at this time (Frost 1972; Raban 1995a: 154). Carayon (2012–13) offers an extensive discussion of 15 sites along the Lebanese coast—from Cheikh Zennad in the north to Tyre in the south—that show evidence of Phoenician maritime activities; that study is an indispensable addition to the presentation of these sites here. The level of detail presented in this section (as compared to that for Bronze Age harbours) reflects the already vast amount of information published on these sites.

The earliest, securely dated example of a newly built 'Phoenician' harbour is that at Tabbat el-Hammam, which may have served as the port for Tell Kazel, situated a few kms inland and to the east. Tabbat el-Hamman lies on the coast almost opposite the small islet of Machroud, which itself lies at the southern end of 8-km-long reef terminating at Arwad. Submerged foundation trenches and a scatter of building blocks on the sheltered side of Machroud suggest that it may once have been a landing place for small ships, but had become unstable, at which point an alternative was constructed at Tabbat el-Hamman (Frost 1995: 12). Dated to the ninth–eighth centuries BC, Tabbat el-Hamman was excavated in the 1930s (Braidwood 1940: 207–208). An L-shaped mole (protruding jetty) was identified, partly on land, but with its longer leg projecting into the sea, thus creating a small harbour (Braidwood 1940: 204). Although the mole was never excavated, the construction consists of one header-built wall (facing the waves) backed by a mixture of ashlar blocks and rubble fill, all executed in a typical Phoenician manner (Frost 1972: 106, fig. 59; Nouredine 2010: 179).

The earlier, Bronze Age harbour at Tel Dor on Israel's Carmel coast, some 30 km south of Haifa, is thought to have had two 'natural' anchorages—a bay to the north and a large lagoon protected by islets to the south. Such anchorages were of crucial importance for ships and seafarers prior to the construction of artificial harbours (Gilboa and Sharon 2008: 148). Those at Dor may have served as a stopping point for ships travelling between Egypt or the southernmost Levantine coast and the Canaanite towns farther north. The port at Dor was important for local if not long-distance trade, providing easy access to the Jezreel valley and its agricultural products; copper from Feinan in Jordan may have been traded through its gates (Artzy 2006b: 78). Dor is mentioned in the

eleventh century BC Egyptian papyrus known as the Tale of Wenamun (Goedicke 1975), a merchant who set sail by ship from Egypt en route to Byblos; his first stopover was the harbour at Dor, where his goods were stolen (the nature of trade in which Wenamun was involved is discussed further in Chapter 5, under *The Political Setting of Late Bronze–Early Iron Age Trade in MTCs*).

Dor seems to offer a good example of a natural (Bronze Age) harbour that could have served as a stopping point for Egyptian maritime commerce; it may well have functioned as an international harbour. By the early Iron Age, the prevalence of Egyptian Jar fragments recovered from almost every locus at Dor is unparalleled at other Levantine sites (Gilboa and Sharon 2008: 159). In Raban's view (1987: 124; 1991: 142–143; 1995b), the southern bay at Dor was used as a harbour from at least the late thirteenth to the late tenth centuries BC. Renovations carried out during those centuries, he argued, were undertaken to cope with localised geomorphological changes and fluctuations in sea level (Raban 1987: 125–126; 1998: 429; cf. discussion in Sharon and Gilboa 2013: 399–401). At some point during the tenth century BC, a large ashlar wall was constructed on top of an earlier (twelfth–eleventh century BC) quay, projecting southwards from the shoreline (Raban 1998: 429). Excavations at Dor in 1994–1995 uncovered the continuation of this wall (Stern et al. 1997: 38). Others have argued that these harbour works should be dated to the eleventh century BC at the very earliest (Artzy 2006b: 78–79; Haggi and Artzy 2007: 82; Sharon and Gilboa 2013: 402). Whatever the specific dates prove to be, the harbour construction technique found at Dor accords well with other, later, Phoenician constructions (e.g. at Sidon, Tyre, Atlit). The quay in Dor's southern bay, which had been in use up to the tenth century BC, evidently became blocked at that time, and a new, alternative quay was only constructed there during the Persian period (Haggi 2006).

The harbour at Atlit was most likely built in the late ninth or early eighth century BC, and may eventually have replaced Dor as a harbour during the Iron Age II and following periods (Haggi 2006: 51–52). The date of the harbour at Atlit is based on radiocarbon analyses of wooden wedges from long-lived *Cedrus libani* and *Olea europaea* trees, found between stone courses of the artificial mole (Marriner and Morhange 2007: 175). The harbour works are divided into two almost symmetrical sectors and include a mole perpendicular to a quay. The southeastern quay, some 38 m in length, was constructed on the shore in typical Phoenician fashion, with the narrow side of the ashlar (headers) facing the sea. The mole, attached to the eastern end of the quay (Raban 1985: 31), was also built in Phoenician style, with two parallel walls of ashlar headers enclosing a fill of fieldstones (Haggi 2006: 49).

The Atlit harbour most likely served ships involved in local commerce between (Phoenician) ports to the north (e.g. Tyre, Sidon) and those of the southern Levant, including Atlit (Haggi 2006: 55). Aubet (2001: 76–77) argues—largely from biblical references—that Israel was one of Tyre's main sources of oil, grain and wine. Indeed, excavations at Shiqmona, just north of

Atlit, have revealed industrial olive presses, warehouses, storage jars, crushed murex shells and other aspects of the purple-dye industry, all dated to the beginning of the eighth century BC (Haggi 2006: 55). Shiqmona itself was on the sea, but exposed to the winds and waves to such an extent that it was unsuitable as a port. Thus Atlit was likely the most suitable point along Israel's northern coast for constructing an artificial harbour in line with new, tenth–ninth century BC standards of construction.

Several major Levantine ports were established in areas where the rock formation of a coastal reef was sufficiently large to be termed an island (Frost 1995: 6). These include such sites as Pharos at Alexandria in Egypt, Sidon and Tyre in Lebanon, and Arwad in Syria. At Arwad, the island in question is about 700 m in length and lies at the northern end of 8-km-long reef (Frost 1995: 7–8). The 'ships of *Arwada*' are already mentioned in four of the Late Bronze Age Amarna Letters (EA 98, 101, 105, 149), suggesting the town's maritime importance even then. A bay on the landward side of the island would have provided good natural shelter. Stone quarried from the entire perimeter of the island (to make an esplanade) was used to strengthen the rock-cut sea-defences, one part of which is preserved in five courses of blocks that reach 9 m in height.

The Phoenician port of Sidon is situated on a rocky promontory that forms part of a partially submerged sandstone ridge running along the Levantine coast. According to Frost (1973; see also Doumet-Serhal 2013: 132), the Bronze Age 'proto-harbour' consisted of two parts: one on land where the sandstone reef runs tangential to the shore, the other on a part of the reef that forms the islet of Zire (see also Marriner et al. 2006: 1–2; Carayon et al. 2011–12: 442–447, on Bronze Age harbours and anchorages generally). Poidebard and Lauffray (1962: 72, 88) suggested that a closed harbour ('cothon') might lie beneath modern Sidon, a possibility that has received some confirmation from recent geomorphological work (Marriner and Morhange 2005). The 'northern harbour' even seems to have undergone some artificial modification during the Middle Bronze Age (Carayon et al. 2011: 49).

Sidon enjoyed an ideal location, with two natural marine embayments at the northern and southern sides of the promontory, and a third anchorage on the small island of Zire, some 600 m north of the northern harbour (Marriner et al. 2006: 1516–17, and fig. 3). Although the southern bay was not entirely suitable as an anchorage, its wide sandy beach could have accommodated smaller craft (Marriner et al. 2006: 1525; Carayon et al. 2011: 50). The northern bay was protected from the open sea by a prominent sandstone ridge and would have provided the best natural shelter for larger, merchant boats; it became the town's main port. This northern harbour, to be distinguished from the northern bay (see map in Carayon et al. 2011–12: 433 fig. 1), was divided into two sectors, both of which rest on the northern reef, which was reinforced with ashlar to provide protection from the open sea. A mole built on its lee side extended for about 230 m (Haggi and Artzy 2007: 81). The 540-m-long offshore island of Zire also served as a deepwater anchorage, or outer harbour, a typical Phoenician tactic. A veritable suite of harbour works—a seawall, quay and

mooring bits—made Zire an integral part of Sidon's port system (Marriner et al. 2006: 1526; Carayon et al. 2011–12: 447–449). A double seawall on its western side offered general protection (Carayon 2003: 96–97), and several scattered masonry blocks have been identified on the seabed around the island (Frost 1973: 79–80). In all but the worst weather, large merchant vessels would have been able to load or unload goods onto smaller vessels, to be ferried to the main shore.

The site of Tyre was established during the Bronze Age. Its golden age, however, spanned the centuries between *c.*900–600 BC, when it wielded wide influence throughout the Mediterranean basin (founding, for example, the city of Carthage) and became, along with Sidon, one of the most renowned of Phoenician city-states. During the Bronze Age, merchants and mariners probably made use of Tyre's 'proto-harbour', a semi-open marine cove. Shallow draught boats could have been hauled up onto the beach, while larger, merchant vessels would have anchored in the bay (Marriner et al. 2005: 1319).

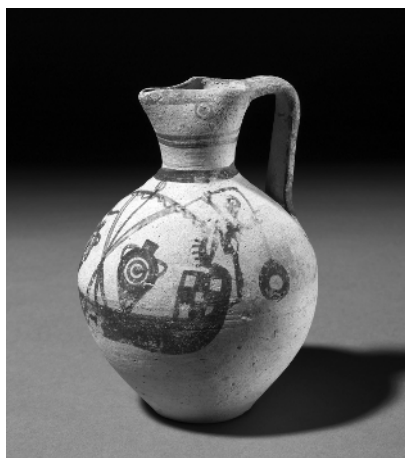
At some point in the first millennium BC, as a result of rising sea levels and perhaps because of intensifying international trade, an early, semi-artificial harbour was built at Tyre (Marriner et al. 2005: 1325). This ancient port was situated on an island, part of a sandstone reef running parallel to the coast. To the north was the 'Sidonian harbour' and to the south the 'Egyptian harbour' (Haggi and Artzy 2007: 81–82; Nouredine 2010: 176–177). The dating and even the position of the southern harbour remain uncertain (Frost 1971: 105–106). Instead of a harbour complex, the presence there of numerous walls and quarries in a late phase of the site has led to the suggestion that it may have been an urban quarter, protected from the sea by a mole that is now submerged (Carayon et al. 2011: 47). By contrast, the contemporary northern harbour appears to correspond to its ancient counterpart, which is estimated to have been approximately twice the size of the present one, encompassing parts of the modern-day town centre as well (Marriner et al. 2005: 1302). Nouredine (2010: 177–179, figs. 2–3) has identified what he believes to be the submerged Phoenician jetty—likely of seventh century BC date—at Tyre's northern harbour, with two parallel header walls connected at their eastern end by a long wall that closed the structure. The harbour faces north and is protected from the dominant southwesterly winds by a row of Quaternary sandstone reefs.

Numerous land reclamation projects undertaken around Tyre, not the least of which was Alexander the Great's construction of a causeway linking the island to the mainland, have made it difficult to define Tyre's ancient physiography, especially during the early Iron Age. Even so, Carayon et al. (2011: 49) suggest that: 'Tyre's port system during Phoenician times comprised a vast outer harbor that exploited the long aeolianite ridge exposed during this period and upon which the ancient city lay'. Such an outer harbour would have operated in association with the semi-protected, natural northern harbour and the beaches and sheltered lagoon of the ancient town (Carayon et al. 2011: 48 fig. 4). Alexander's causeway seriously altered the amount of sediment deposited in the coastal zone between the island and mainland

(Marriner and Morhange 2007: 152–153), today characterised by a tombolo (spit), some 1500 m in length and 3000 m wide. The lack of any relevant strata during the first millennium BC probably resulted at least in part from constant dredging during the Roman and Byzantine periods (Marriner et al. 2005: 1325–1326).

In north Syria, at the mouth of the River Orontes, stands the site of Al Mina—with substantial quantities of Middle–Late Geometric Greek pottery as well as contemporary Cypriot wares. While this was clearly a trading centre, its role as a port or harbour is contentious (Luke 2003: 1–2), even if ‘al-Mina’ means ‘the port’. Woolley (1937: 2–3, 12–13; 1938) felt that the Orontes river mouth would have provided a safe, sheltered anchorage: he believed that the waterfront and earliest occupation at Al Mina itself had been washed away by the Orontes. Boardman (1990: 183), however, felt that the site had no natural harbour and possibly little more than a beaching area at the river mouth (see also Boardman 1999: 154–155). Although Al Mina might also have served as the port for Tell Ta’yinat, some 50 km inland (Osborne 2013: 782–783, 786–787), there is no physical evidence of harbour facilities at the site. It is equally likely that the site of Sabuniye, some 6 km inland from the present coast, served as the port for Tell Ta’yinat and Tell Atchana (Alalakh) during the Late Bronze and early Iron Ages; recent palaeogeographical work suggests that Al Mina (closer to the sea than Sabuniye) was beneath the sea when Sabuniye became the main port on the Orontes, but only took over that role in the mid-eighth century BC (Pamir 2013: 182–183, 188 fig. 2).

On Cyprus, port-towns like Kition, Salamis and Amathus received goods from far and wide (including ‘commercial amphorae’ from both the Aegean and the Levant—Yon 1995: 121–122) (Figure 2), and exported a range of



*Figure 2* Bichrome ware jug (Cypro-Archaic, c.750 BC) showing merchant ship loaded with amphorae; a crewman lowers an anchor from the bow. ©Trustees of the British Museum, Reg. no. 1926,0628.9.



Cypriot pottery vessels found from the Aegean to Cilicia and all along the Levantine coast (e.g. Gilboa 1998; Iacovou 1998; 2007). The most conspicuous (built) harbour works on the island, however, fall beyond our period of concern. They are represented by the fifth–fourth century BC ship-sheds at Kition (Yon 1995; 2001), the (Hellenistic) underwater harbour constructions at Amathus (Empereur 1995), and various submerged structures, including a breakwater, at Roman Paphos (Hohlfelder 1995).

Iron Age ports in the Aegean are not so well known, nor have they been so intimately studied as those in the Levant. One must have existed at Kommos on Crete, the successor to the Bronze Age facilities there. Morris (1992: 154–155, and n. 24) suggested Kommos might have been a port of call in the early Iron Age metals' trade; finds of Phoenician bulk-transport amphorae, however, point to other rubrics of exchange (Shaw 2006: 43, 57). Indeed the site has yielded numerous eastern imports including a substantial quantity of Phoenician pottery (tenth–eighth centuries BC). Moreover, what appears to be a Phoenician-type sanctuary (the 'Tripillar Shrine') was incorporated within a Cretan structure ('Temple B') (Shaw 1989). No actual harbour facilities, however, are attested. Other, less direct indicators of maritime activity during Kommos's Iron Age (into the Archaic period) include the following: some fishhooks, a possible bronze 'net mender', some bones from deepwater fish, and the many transport amphorae recovered in Building Q, which may have functioned as a storage area for wine during the Archaic period (Johnston 1993; Shaw 2006: 56–57). The elaborate anchor with a partially preserved (60 cm) marble stock from 'Temple C' dates to the later, classical period.

In the cemeteries at Knossos, the wide variety of Cypriot and Levantine ceramic and metal imports, as well as 'orientalising' faience beads and jewellery, found in Geometric tombs indicate that an important 'port of call' must have existed nearby (e.g. Coldstream and Catling 1996: 716). Here it may be recalled that Bronze Age ports are likely to have existed at the nearby sites of Amnisos, Nirou Chani and Poros-Katsambas (Shaw 1990: 425–428; Dimopoulou-Rethimiotaki 1993).

Based on rich imports—gold jewellery, Cypro-Levantine bronzework, perfume flasks and Egyptianising faience—found in the tombs at Lefkandi in Euboea, Sherratt and Sherratt (1993: 365) suggested that this site may have been a natural anchorage for ships travelling toward the northern Aegean, and that its inhabitants were apparently reaping the benefits of this 'passing traffic' (see also Papageorgiou 2009: 213). The presence of ninth century BC Cypro-Levantine balance weights in Tomb 79 of the Toumba cemetery at Lefkandi also supports this idea (Kroll 2008). Although there are no harbour facilities known at this site, geoarchaeological investigations around the hill of Xeropolis indicate that the sea formed more extensive lagoons on either side of the settlement; these lagoons may have formed an isthmus between two harbours (Davidson et al. 2010).

Farther north along the Euboean Gulf there is evidence for harbours at Kynos and Mitrou. Both sites are located on the coast of east Lokris and were

continually inhabited from the Late Bronze Age through the late Protogeometric period. In the *Iliad* (531–533), Kynos was identified as the main port of the region. Although the extant remains of the port do not date to the Bronze or Iron Age, there can be little doubt that harbour facilities once existed there. The hill upon which the settlement sits is itself located on the coast and substantial numbers of fish bones, fishhooks, lead net weights and shells have been recovered from all habitation contexts (Dakoronia 2002: 287). In addition, the Late Helladic (LH) IIIC occupations have produced a wealth of iconographic evidence including detailed scenes of seafaring and ships on pottery, as well as a number of clay models representing war and merchant ships (Dakoronia 1996: 161; 1999). The site's continued habitation into the tenth century BC also suggests a continued use of the harbour into the early Iron Age (Kounouklas 2009).

A similar situation exists at the nearby site of Mitrou, located on a small tidal islet within a larger bay. The position of the island within the bay creates a particularly favourable anchorage area to its north, including a sandy beach. As with Xeropolis and Kynos, there are no remains of a port structure, but boats could have been dragged ashore when necessary. There are extensive Middle to (early) Late Helladic imports from Kea and Aegina at Mitrou, and several Transport Stirrup Jar fragments were noted in a surface survey of the site (Kramer-Hajos and O'Neill 2008). The settlement at Mitrou was intensively occupied in the LH IIIC period and continued to be so into the Protogeometric period. The construction of a large apsidal building associated with drinking equipment and wealthy graves with imports suggest that the site remained well connected (Van de Moortel and Zahou 2011). Presumably, the strategic location of Mitrou, with its natural harbour along the Euboean Gulf, provided another stopping point for any ships travelling northward.

According to Blackman (1982: 93), the first attempts to improve upon the natural harbours in Aegean coastal towns with purpose-built construction took place in the eighth–seventh centuries BC, notably a quay and breakwater on Delos, precariously dated to the late eighth century BC. According to Herodotos (*Histories* 3: 60), the harbour works at Samos, dated to the classical era, were a major engineering feat, but few remains survive (Mitchell 1975: 82–84). All these areas eventually came to prosper along with the newly configured Iron Age exchange networks involving new mercantile city-states ('city kingdoms' on Cyprus), more enterprising merchants and larger sailing ships (especially galleys) than those used during the Bronze Age.

*Summary* In other parts of the world, a positive correlation has been demonstrated between strategic location, specialised production and complex systems of coastal-oriented exchange (Knapp 1989: 181–188). Gillis (2012) suggests that similar coastal ecologies combined with long-term maritime interconnections result in coastal communities sharing more in common with each other than with their immediate hinterlands. In the Mediterranean, the material remains found at most Bronze and early Iron Age coastal sites



demonstrate that they functioned as maritime junctions, stations or ports in wider systems of connectivity and social exchange (e.g. Artzy 1995; 2005). In many of them, a wide variety of goods was available for trade, transshipment or local consumption. Maritime centres in the Late Bronze–early Iron Age eastern Mediterranean certainly owed much of their commercial success to a location along commonly used sea-lanes, or their proximity to various resources in demand. Nonetheless, it is also possible that regional control over certain aspects of Late Bronze Age trade dictated the location and heightened the significance of ports in areas where mineral or agricultural resources were marginal, for example at Marsa Matruh. However, in none of the coastal ports known from the Late Bronze or early Iron Age eastern Mediterranean, nor in any of the diverse trading systems that operated during those times, is there any evidence of overall domination of the sea (i.e. ‘thalassocracies’) (Knapp 1993).

Not every coastal or near-coastal site with imports had a usable harbour, and nor did each one necessarily serve as a port or gateway community. With the exception of documentary-rich sites like Ugarit, we are seldom certain of the social makeup or politico-economic configuration of such coastal communities. For example, based on one interpretation of the scene in the tomb of Kenamun (mayor of Egyptian Thebes in the early fourteenth century BC) (Figure 3), beyond the gift exchange (earmarked for palace or temple) that included Canaanite Jars, prestigious metal vases and the like, Levantine merchants and sailors engaged directly in smaller scale, freelance trade with Egyptian shopkeepers touting local goods in the port of Thebes (see Panagiotopoulos 2012: 54–55, who questions the extent to which merchants were the ultimate arbiters of trade or cultural interaction). Ports like these, including Ugarit, were not only multi-ethnic but also provided merchants and mariners with the wherewithal to conduct their business (Monroe 2009: 280), short haul or long-distance, varying in time and no doubt with market demand. One burning question that remains is the extent to which we can extrapolate from Ugarit’s rich documentary record to other, contemporary ports in the Aegean or eastern Mediterranean.



Figure 3 Scene from Tomb of Kenamun, Thebes (after Amiran 1970: fig. 43.1).

We close this chapter with some further questions. To what extent were harbours, ‘proto-harbours’ or anchorages important for the transport of maritime transport containers? Whereas small vessels may operate as tramps or *caboteurs*, loading and unloading discrete amounts of cargo in protected bays without any structures, heavier ships and their cargoes—including bulk goods such as timber or metals—usually needed some kind of mooring construction in order to be efficiently loaded or offloaded. Even so, how are all these factors—harbours, shipwrecks, merchants and traded goods—related to interconnections and the movement of MTCs in the Bronze–Iron Age Aegean and eastern Mediterranean? What was the role of seaborne trade in such connections, and what sort of goods was shipped by sea in MTCs?

### 3 Connectivity, Seaborne Trade and Maritime Transport Containers

Within the Mediterranean at least, ‘connectivity’ refers generally to the mobility of people and goods, the means of travel and communication, and any related social exchanges. Maritime mobility and maritime interconnections have formed key features of coastal dwellers and islanders in the Mediterranean from its earliest prehistory (e.g. Broodbank 2006; Knapp 2010; Leppard 2014). Even so, it was only during the third millennium BC (the Early Bronze Age), when seagoing, sailing ships developed alongside other social and cultural factors, that we can see evidence of what Broodbank (2010: 250–254) terms purposive *voyaging*, and the pursuit of exotic goods, gain or glory. Indeed, the very practice of maritime mobility, and not least the sleek new craft that made it possible, may have been ideologically charged and imbued with sociopolitical power (Broodbank 1993: 323; 2013: 329), with respect not only to specific ports and their associated polities, but also within wider maritime land-, sea- and islandscapes.

Merchants, mariners and local traders ‘connected’ people and things from different islands and mainlands. Coastal and island communities situated in large ports or harbours were not only oriented toward the sea but also relied on its connecting role to meet the demands of a wider system defined by maritime contacts. Horden and Purcell (2000: 224–230) note that, at least in historic times, many aspects of Aegean island production resulted from ‘all around connectivity’. Connectivity and maritime trade determine the amount of mobility that coastal and island communities enjoy, and condition the level and intensity of their contacts.

But who conducted this trade, under whose aegis, and involving what sort of social or economic mechanisms? During the Bronze and early Iron Ages, if not for all periods prior to the age of steam, it has been argued that one main form of (local or regional) Mediterranean seaborne trade was ‘cabotage’, defined by Horden and Purcell (2000: 365, 368–369) as small-scale, coastal oriented trade sailing from cape to cape or port to port, in search of markets (see also Panagiotopoulos 2011: 38; but cf. Arnaud 2011: 62–63, discussed further below). Only a substantial private enterprise, however, namely a rich merchant or state organisation, could have engaged in the level of (elite) connectivity (‘grand cabotage’) that financed the kind of cargo that filled the Uluburun ship

(e.g. Pulak 2008; Monroe 2010). This wreck deposit provides by far our best material witness of Late Bronze Age trade in the Mediterranean.

Nonetheless, a wide array of Bronze Age material and documentary evidence, together with an impressive corpus of analytical data, shows that seaborne trade within and beyond the Mediterranean was diverse and complex, multidimensional, always changing: it involved local as well as 'state' control, entrepreneurial ventures (tramping and cabotage), and gift exchange on the royal level (Sherratt and Sherratt 1991; Knapp and Cherry 1994: 126–151; Panagiotopoulos 2012). Multiple webs of communication and exchange linked many regions of the central and eastern Mediterranean during this time. From their wide survey of studies on 'trade' and exchange over the millennia and throughout world archaeology, Oka and Kusimba (2008) conclude that:

Trade forms the material component of a larger exchange network in which even strictly 'social' or 'political' actions and decisions might be commodified on the one hand, while economic decisions are made taking noncommercial factors into account on the other'.

In other words, the vectors of trade combine commercial, sociopolitical and ideological interests, regardless of the exchange mechanism involved.

Tartaron (2013: 185–203, 186 table 6.1)—building upon earlier work by Horden and Purcell (2000: 365), Constantakopoulou (2007), Malkin (2011) and others—has developed a framework for examining the maritime landscape of Mycenaean Greece, detailing four different 'spheres of interaction' and the geographical, temporal and material scales that characterise each: (1) coastscape, (2) maritime small world, (3) regional/intracultural and (4) interregional/intercultural. Although he emphasises that his framework was developed in the attempt to understand better Late Bronze Age Aegean spheres of interaction, his detailed analysis makes it possible to consider its application on a broader basis.

According to Tartaron (2013: 186, 212–284), the entire Aegean was a 'regional' sphere, comprising many small worlds, such as the Saronic Gulf or the southeastern Aegean. No such study exists for the eastern Mediterranean basin, and it is beyond the scope of this book to attempt one. Nonetheless, various factors may help us to consider the extent to which coastscapes or small worlds might be relevant in that region. According to Horden and Purcell (2000: 125–127), for example, visibility is an important factor in the connectivity of micro-regions. In this respect, a considerable area of the Mediterranean, north of Egypt, lies beyond the sight of land, and might have acted as a barrier between Egypt and Cyprus or the Aegean. Nonetheless, we can be fairly certain that crossings of this open sea had become common by the LBA, both to/from as well as between Cyprus and the Aegean (amongst many others, see Portugali and Knapp 1985; Cline 1987; Wachsmann 1998: 295–296).

Another factor that may impact on maritime spheres of interaction is travel time, which is largely dependent on weather conditions as well as on the type

and size of ships, so any proxies should be used with caution (on the complexity of sea routes in the Late Medieval Levant, see Gluzman 2010). In the absence of any contemporary evidence, the calculations of Hellenistic or Roman geographers are useful, because they determined distance on the basis of sailing time (Arnaud 2005: 61–96). For example, according to the *Stadiasmus (Sive Periplus Maris Magni, 316)*, the distance between the Akrotiri peninsula on the south coast of Cyprus and Pelusion in Egypt was 2300 stadia or 2.5 days (2.5 x 24 hours) of travel. In this case, however, unfavourable winds might make the return trip much longer: up to six or seven days (Casson 1951: 145). As the only large island in the eastern Mediterranean, Cyprus seems to have played a central role in sailing patterns within the region (Arnaud 2005: 217–230).

In terms of travel time, there are very few accounts that treat sailing along the Levantine coast to Egypt and back. Even so, since the difference in speed performance between the square sail (used in the Bronze Age) and the lateen sail (used from the Late Roman period onward) was minimal (Whiteright 2011), we might consider information from the eleventh century AD Geniza manuscripts (Goitein 1967: 316–326). According to these letters, it could take four days (under unfavourable conditions) to travel from Acre (Akko) to the Egyptian port of Tinnis (near modern Port Said); eight days from Alexandria to Tripoli in Lebanon; and seven days from Tinnis to Ascalon (Ashkelon) (Whiteright 2011: 13). If the southern Levant (arguably, Akko to Ashkelon) could be considered as one small world and the Egyptian coast as another, then contacts between the two constitute a sphere of interaction that had been in operation since at least the Early Bronze Age (Stager 2001: 625). The port cities of the central-northern Levant may have formed another small world that had several major harbours, all involved with local as well as long-distance trade. This extended maritime world was closely connected with the southeastern coast of Cyprus: according to Strabo (*Geography* 14.6.3), the distance from Kition to Beirut was only 1500 stadia, or two days and one night of navigation, i.e. a travel time similar to that from Ephesos in Anatolia to Delos in the Aegean (Arnaud 2005: 227). Farther north, the coasts of Cilicia, Lycia and Pamphylia may have comprised small worlds of their own, possibly linked to the (intervisible) north coast of Cyprus. Round-trip travel time between many ports or capes along the southern coast of Anatolia was approximately one day (Arnaud 2005: 220–221).

Based on these various aspects of time, travel, visibility and interconnectivity, we might propose that Cyprus belonged to two if not three eastern Mediterranean subregions: Egypt and the southern Levant, the central-northern Levant, and the southern coast of Anatolia. If this proposal holds true, then perhaps we could begin to consider the extent of local mariners' mental maps, which helped them direct their ships in familiar waters, under predictable weather conditions, to known ports and anchorage.

We return to examine further Tartaron's views on the maritime cultural landscape in the *Discussion* section below (Chapter 5), but now turn to consider the role(s) of MTCs in seaborne Mediterranean trade.

Beyond what are usually termed ‘exotica’ (see, for example, Vianello 2011), what sort of goods were transported or transhipped during the Bronze Age? How much can we say about what was shipped in maritime transport containers? To address the latter point first, but briefly (to preface further discussion below), Leonard (1996: 250–251) suggested that Canaanite Jars of the Middle and Late Bronze Ages were used to transport wine, olives, oils and fats, beer, milk, honey, fruits and vegetables, fish and meat, as well as incense, resins, dyes and unguents. With regard to the more general shipment of goods, the list quickly becomes unmanageable, and can only be treated in summary form here (but see, for example, Knapp 1991; Haldane 1993; Palmer 2003; Tzedakis and Martlew 1999; Martlew 2004). From the Egyptian Tale of Wenamun, we learn that Egypt sent to Byblos—in a compelled exchange for cedar wood—such goods as ‘royal’ and ‘Upper Egyptian’ linen, papyrus, cowhides, ropes, sacks of lentils, baskets of fish, and precious metals (four jars of gold, five jars of silver) (Pritchard 1969: 25, 28). Once goods such as these reached their destinations, typically by maritime transport, they are likely to have been distributed, consumed or transformed quickly; it’s unlikely that many, if any, of them would turn up in the archaeological record.

When the ships that carried such goods were wrecked, however, the outcome may be different. While underwater excavations have seldom recovered the types of specific goods mentioned in Wenamun’s report (i.e. linens, cowhides, ropes, sacks or baskets), the organic remains from the Uluburun shipwreck demonstrate just what might be preserved, and at the same time provide a glimpse into the range of products actually transported by sea during the Late Bronze Age: almonds, acorns, pine nuts, pine cones, wild pistachio, olives and olive stones, pomegranate and fig seeds, caper seeds, other fruit fragments, two types of grape seeds; the remnants of coriander, black cumin and sumac seeds; charred barley and charred wheat; at least three types of pulses; and seeds from more than forty different weeds and other plants (Haldane 1993: 352; Monroe 2009: 10–12).

Examining a wide range of Near Eastern and Aegean documentary evidence and the results of analytical work on organic products, an earlier study (Knapp 1991) showed the exchange of such goods as wood and timbers (e.g. ebony, cedar, pine), reeds, purple and other dyes, cosmetics, soap, linens and cloth, wool, textiles and clothing (e.g. shirts, gloves, shoes, greaves, girdles, scarves), basketry items, rugs, leather and other animal products, perfumes, perfumed oil, olive oil, beer, wine, honey, wax, salt, cheese, curds, various fats, beans and lentils, grains and cereals (wheat, barley), juniper berries, ostrich eggs, spices (e.g. cinnamon, cassia, cumin, saffron, sesame, cardamom, fenugreek, fennel, sage, citron, rose), frankincense, myrrh, resins (pine, *pistacia* and *terebinthus*), fish, possibly opium and henna, as well as a range of inorganic goods (copper, bronze, precious metals, ivory, stone, faience, etc.). One study has proposed that Cretan Transport Stirrup Jars as well as Canaanite Jars might have contained resinated wine (Tzedakis and Martlew 1999: 157, 173), while some inscribed stirrup jars are said to have contained olive oil, perfumed oil and wine (Day

1999: 69; Palmer 2003: 131–132; Haskell et al. 2011: 5)—all these are discussed in more detail below, under the relevant MTCs.

The circulation of goods across spatial and cultural boundaries represents not just an economic exchange or a physical movement but also a social transaction (Bauer and Agbe-Davies 2010), entangling providers and recipients in wider relations of alliance and dependence, of prestige and debt (Thomas 1991: 123–124). At the same time it reflects the desire of people to consume different cultures as well as diverse types of material culture. Sailing ships connected not only new and different places, in particular ports, but new people, at times effacing local senses of identity and creating new ones (Malkin 2003; Broodbank 2010: 259). By definition, long-distance maritime trade involved complex physical movements (circular routes, frequent stopovers) and encounters between people from diverse cultures, whose home ports typically were distant and unknown (Sherratt 2010: 119), sources of exotic things or at least of goods otherwise difficult to acquire.

Within and beyond the Bronze and early Iron Ages, the richness and diversity of Mediterranean trading systems, the motivations of the merchants, emissaries and mariners involved, and the expectations and perceptions of those who received imported goods, all tend to obscure the differences amongst producers, traders, consumers and the actual mechanisms of trade (Skeates 2009: 565–566). Even when we know the presumed origins (provenance) of objects and materials, it is deemed important to distinguish between ‘prime-value’ materials (e.g. copper, tin, other raw materials), ‘value-added’ production (e.g. finished metalwork, pottery, faience) and ‘added value’ products (e.g. textiles, perfumed oils) (Sherratt 1998: 294–295).

Furthermore, we need to frame more precisely the questions we ask: for example, it may be wise to reassess critically the value of provenance work (chemical or petrographic) which indicates that a specific type of MTC was produced on Crete, or in the southern Levant, or on Cyprus, when it may have been shipped and/or transhipped several times to/from different lands, in various directions, with different contents, or none at all (Sherratt 2011: 22). In terms of the contents of MTCs, including those discussed in this study, another cautionary note must be raised. In reviewing 21 journal articles published between 1946 and 2011, which in total made reference to 5549 Greek amphorae dating from the fifth to the third centuries BC, Foley et al. (2012: 91) found that in 95% of these cases the authors *assumed* the commonly held belief that these vessels contained wine; virtually none, however, could demonstrate that suggestion in light of scientific analysis.

Moreover, given the extensive evidence for re-use of transport amphorae attested in classical Greece (Lawall 2011a) and throughout the Roman world (Peña 2007), Abdelhamid (2013: 92–99) argues that empty amphorae could be discarded or collected, repaired or modified, refilled with a diversity of other products, or used as a ‘commodity’ for different purposes entirely (e.g. storage, scuttlebutts [ship’s water barrels], infant burials). In our case, Leonard (1996: 251–252) already had noted:

Further obscuring the identification of the commodity (or commodities) traded to the Aegean world in Canaanite jars is the fact that we are dealing with societies in which the use of these jars in a one-way or one-time capacity would have been unlikely, except under special circumstances (e.g., as burial goods or royal gifts).

He cited further evidence on the recycling (Amarna) or relabelling (Malkata, Amenhotep III's palace) of Canaanite Jars in Late Bronze Age Egypt. In her discussion of the trade in wine amphorae in the Greek-speaking sectors of the classical era, Koehler (1996: 327, nn. 13–14, 330, n. 29) mentions the frequent re-use of such amphorae, at least on a local scale, but cautions that this practice cannot be quantified in any meaningful way. Even classical authors were aware of this practice: Pliny (*Natural History* 14.25.128) states—counterintuitively to most modern tastes—that it's better to put wine into containers previously used for vinegar, rather than in those used for mead or sweet wine. Although the re-use of MTCs is much better studied for later periods (e.g. Lawall 2011a—Classical; Peña 2007: 61–118—Roman; van Doorninck 1989—Byzantine), the issue remains controversial and unresolved.

This study reassesses or addresses anew many of these questions, and ultimately aims to unravel at least some of the tangled issues related to connectivity and seaborne trade, through a diachronic study of maritime transport containers, of the ships, or shipwrecks, on which they travelled, and of their find-spots in multiple kinds of terrestrial contexts throughout the Aegean and eastern Mediterranean.



## 4 Maritime Transport Containers

### Amphora

The Greek word amphora (*αμφορεύς*) is composite (*αμφί* + *φέρω*) and describes (albeit partly) both the form and function of a multi-purpose vessel (Daremberg and Saglio 1877: 248–250, s.v. amphora), one that could be carried or moved by two handles positioned opposite each other. The first reference to the word in written sources comes from the Knossos Linear B tablets: A-PI-PO-RE-WE (Evans 1935: 731, fig. 714). The relevant ideogram resembles the vessel in question but there is also another word (KA-RA-RE-WE) that describes the Cretan Transport Stirrup Jar (TSJ, see further below). Strictly speaking, then, the word ‘amphora’ was not a generic synonym for an MTC, at least not during the Late Bronze Age. Several references to *αμφορεύς* in their sense as MTCs are found in Homeric poems (*Iliad* 23: 92, *Odyssey* 2: 290, 349, 379) and in later classical sources (Herodotus, *Histories* 4: 163; Aristophanes, *Plutus* 807; Xenophon, *Anabasis* 5.4.28; Thucydides *Historiae* 4.115.2; see also Grace 1961: 9). In Latin literary sources, MTCs have several names, including amphora (Peña 2007: 369), whereas in Greek texts of Late Roman Egypt the terms *κούφον* and *μαγαρικόν* appear (Bees 1944; Cockle 1981: 87; Bakirtzis 1989: 70–71). Nonetheless, most works that treat the period of time from the Iron Age to the Roman era refer to the vessels we call MTCs as amphorae or transport amphorae, perhaps because most Iron Age versions *were* amphorae, i.e. closed vessels with two handles, positioned opposite one another, with which the vessels could be carried. A key group of MTCs discussed in this study, however, were not amphorae in the strict sense of the term: the ‘Torpedo Jars’ of the early Iron Age, for example, have two vertical loop handles, but they are too small for the purpose of carrying the jar, even when empty.

The distinctive characteristics of the Canaanite Jar, as summarised by Marcus (2002: 410, after Raban 1980: 1–8; see also Parr 1973: 177; Grace 1956; Marcus 1995: 601), emphasised functional attributes like the simple design, the strong construction and the standard shape and dimensions, as well as morphological features including the narrow neck that could be sealed, the increasingly elongated body shape with base serving as a third handle, the two handles (loop- or ledge-shaped, in this case) and the narrow thick base.

According to Grace's (1979: 1–2) definition, the commercial containers found in the Athenian agora:

have in common a mouth narrow enough to be corked, two opposite vertical handles and at the bottom usually a tip or knob, which serves as a third handle below the weight, needed when one inverts a heavy vessel to pour from it.

Peacock and Williams (1986: 5), writing about MTCs during Roman times, modified this description in order not to exclude amphorae with flat bases, and suggested that we should consider as amphorae 'all vessels that were used for the transportation of liquids, regardless of their shape, if they could be easily moved when full, and, stowed in ships'. Later, Whitbread (1995: 1), discussing Greek Transport Amphorae, adopted Grace's description and responded to Peacock and Williams's remark, noting that 'the majority of jars classed as transport amphorae have pointed toes', which is true, at least, for the Archaic period and later in the Aegean (pre-Classical MTCs did not regularly conform to this criterion; see further discussion on flat bases in the following section, *Shape and Function*). Given all this, before we add yet another definition, it is necessary to examine the shape and the function of vessels that we classify as MTCs.

## **Shape and Function**

The relationship between shape and function in pottery is often inexplicit, even though several works have discussed it at length (e.g. Shepard 1954: 224–225; Rice 1987: 211–212; 237–243; Orton et al. 1993: 217–228). According to Franken and Kalsbeek (1969: 73), the shape of a vessel is related to a combination of different factors, mainly the raw materials available, the manufacturing techniques and the tradition inherited by the potter (see also Schuring 1984: 146–147). In this study, however, we focus on one particular class of pottery characterised not by its form but by its primary and very specific function: i.e. a transport container. Several different shapes (or forms) of MTCs are discussed below. In order to distinguish the common morphological and functional features shared by these differently shaped vessels, it is necessary first to put them into their 'ceramological' context.

Among the three essential components of a vessel form (orifice, body and base), the orifice, or mouth, is the most specifically modified or adapted to distinctive uses (Rice 1987: 212–241). Both storage and transport vessels have this restricted orifice, which keeps the contents, especially liquids, inside the container and allows for stoppering when the vessel is transferred, transported or stored. Smaller orifices suggest infrequent access or longer periods of time before the vessel's contents are needed. A neck is a special adaptation of a restricted orifice suitable for holding liquids or for particular storage or transport functions. The rim also has a functional significance, as its extensions or ridges may facilitate stoppering.

The body of closed vessels may be cylindrical, spherical, conical, ovoid or ellipsoid, depending on the manufacturing techniques. The size in this case is also a decisive factor for the final shape. Because vessels taller than 35–40 cm must be thrown in several sections on the potter's wheel (Schreiber 1999: 20–22), the final shape of such vessels is the result of this procedure. The exact sequence of successive manipulations carried out by a given potter depends on local traditions and the available tools. Thus, the use of the fast or the slow wheel and the manufacturing technique chosen by a potter in order to increase the size of a particular vessel are crucial factors in determining the shape of the body and base (Orton et al. 1993: 164; Schuring 1984). Another interesting point concerning the link between the shape and the function of storage and transport vessels is that, according to ethnographic studies, liquid storage vessels may be more variable in shape than dry storage vessels and relatively taller as an aid to pouring; long-term dry storage vessels are relatively short and squat without necessarily restricted orifices (Henrickson and McDonald 1983: 632–633).

Rice (1987: 240) maintains that table vessels or domestic transport vessels for liquids shouldn't be heavier than 15 kg (33 pounds) when full. When such vessels are used for long-distance movement of goods, thus serving for storage as well as transfer, both tight closure and easy handling are important. In this case, thick walls may be a disadvantage because of their extra weight, even if they add stability and strength. The weight of an MTC when full is difficult to calculate today, because of the various contents it may have held. Liquids have different specific gravities: e.g. olive oil is lighter than wine, and resin is lighter than honey. In most cases, the commercial use of MTCs seems to have placed more value on capacity rather than weight. For example, based upon calculations of Iron Age II Levantine torpedo-shaped vessels recovered from the *Tanit* and *Elissa* shipwrecks (Stager 2003: 239), the weight of each vessel shipped represented 30–35% of the jar's weight when full. Because each of these ships carried some 400 jars, it seems logical to assume that any increase in capacity meant an increase in efficiency or profit, and that the modified shape of these torpedo-shaped jars was not motivated by a need to reduce vessel weight (discussed further below in the section *Iron Age II Phoenician Shipwrecks: The Tanit and Elissa*).

Some key work done in this field (Wallace 1986; Koehler and Wallace Matheson 1987; van Alfen 1996; Monakhov 2005) has revealed significant differences in volume amongst MTCs of the same period, and also amongst the different sizes of the same type of MTC. For example, the largest examples of Canaanite Jars amongst the Uluburun ship's cargo held about 26.7 litres while the smallest ones, representing about 75% of the total, held an average of only 6.7 litres (Serpico 2003: 225; more recent work on the largest examples reveals no standardisation in volume—Cemal Pulak, pers. comm., 5 September 2014). Zamora's (2000) examination of MTCs at Ugarit also calls into question precise standardisation. To take a final example, the average capacity of a Greek amphora is considered to be 20–25 litres (Garlan 2000: 68), but the larger SOS

amphorae could hold nearly 64 litres (Johnston and Jones 1978: 134). In fact the manufacture of different, often standard, sizes of the same transport container seems to be indicative of its commercial use.

Apart from the two handles, the narrow flat, thick or pointed base is a distinctive morphological feature of MTCs. According to several scholars, their narrow, unstable bases—non-functional on land but very convenient for stowage in a ship's hold, or as a third handle during stowing or emptying the contents—represented major technological improvements, applied first to Canaanite Jars, thus facilitating lifting, manoeuvring and storage (Parr 1973: 176–177; Wood 1987: 76; Leonard 1996: 239). MTCs with a flat base could be problematic when stowage in multiple layers was necessary. According to Grace (1979: 3–4), flat bases only added an unnecessary additional weight that (1) still would not offer a firm basis for pouring out liquids; (2) would add to difficulties in storing the containers as cargo; and (3) would increase the costs of production. Moreover, during strength analysis experiments on MTCs with pointed, round and flat bases, Radić Rossi (2006: 164–168) demonstrated that containers with flat bases were the most vulnerable to exertion by vertical forces, which were significant in cases of storage in multiple layers. We should bear in mind, however, that stowing large numbers of vessels in multiple layers does not seem to have been standard practice during the Bronze or Early Iron Age. Moreover, containers with a flat base *were* used as MTCs in antiquity, during different periods. Some are discussed in this book (e.g. the Cretan Transport Stirrup Jar and the Attic SOS Amphora), but others, dated to later periods, are not (e.g. the Roman amphorae from Forlimpopoli—Aldini 1978; Peacock and Williams 1986: type 42). The flat base therefore should not be regarded as a decisive factor in characterising a vessel as a maritime transport container.

The function of domestic ceramic containers involves three broad realms: storage, processing and transfer or transport. Multiple uses, like storage and transport in particular, are also very common (Rice 1979: 208–209; Orton et al. 1993: 217). Certain factors involved in the relation of design to function may be very helpful in characterising pottery classes: these include the frequency of transactions, the duration of episodes of use (especially for storage) and distance (for transport or transfer). Of course, MTCs in their primary use are not domestic containers, because their most significant attribute is that they were *designed* for maritime transport, not just used for it; in the early phases of their history, however, this wasn't necessarily the case. Given their multifunctional character, domestic storage and transport containers would have been used for transport, maritime or terrestrial, when restricted quantities of (liquid) goods had to be transported on a ship or on an animal's back. This is in accordance with Raban's (1980: 1–8) suggestion that the Canaanite Jar, the distinctive MTC of the Middle–Late Bronze Age Levant, developed from storage jars that were modified to meet the needs of maritime trade (also Marcus 2002: 411).

In fact, MTCs might serve for storage as well as preservation either during their primary use (i.e. until they were opened and emptied of their contents, the time depending on the vessel's shelf life), or during their re-use (Peña 2007:

61–118; Abdelhamid 2013). In this respect, Peña (2007: 20) suggested that amphorae, as a ‘functional’ category of Roman pottery, are ‘portable jars/jugs employed for the packaging, distribution and post-distribution storage of foodstuffs, chiefly wine, olive oil, processed fish products and fruit’. The fact that as late as the Roman period jurists needed to explain the difference between transport containers and storage vessels (e.g. ‘amphorae are regarded as incidental packaging rather than as containers for ongoing use’—Peña 2007: 47–51) is indicative of the close association between these two trade-related functions, and hence the two kinds of vessels connected with them. This association may explain a certain degree of confusion in Bronze Age pottery studies, especially when terminology is involved: see, for example, the frequent reference to Canaanite Jars or Phoenician ‘commercial’ amphorae as ‘storage jars’ (e.g. Killebrew 2007; Sagona 1982), or the introduction to a chapter on a large group of closed vessels from Protopalatial Phaistos on Crete (Levi and Carinci 1988: 39), where the authors feel ‘uncomfortable’ using a classical term (i.e. amphora) to describe Bronze Age vessels, which they specifically associate with transport or household use, beyond storage.

Since storage was one of the constituent attributes of MTCs, especially during the earliest stages of their use and development, morphology or function alone cannot provide adequate evidence for characterising a vessel as an MTC. Their archaeological context may be more elucidating, especially when it can be associated with their systemic context, i.e. the specific phase of their life at the time of deposition. The extensive re-use of transport containers, however, documented in many different periods and contexts (Peña 2007: 62–71; Lawall 2011a: 43–47; Abdelhamid 2013), may obscure our understanding. For this reason, arguments might be developed more fully when statistically significant numbers of similar vessels are found in association with key stages in an MTC’s life: manufacture; distribution over short distances, by land or sea; temporary storage; and transportation on ships. In this respect, the typical contexts in which transport or storage vessels might be excavated in quantities sufficient to determine their use as MTCs are:

- Kiln sites: pottery-manufacturing sites tend to be rare in the archaeological record. Kiln sites like that reported at Iron Age Sarepta in Lebanon (Anderson 1989) are among the earliest examples where production of MTCs has been attested. Although the output of pottery workshops was seldom limited to one type, the manufacture of storage or transport vessels destined for bulk transport would have been on a large scale, and thus easily distinguishable from the production of similar vessels for domestic use.
- Distribution stations (for filling vessels transported over short distances by land or sea): this phase would only be evident in cases where the ‘stations’ for filling the vessels were not in the immediate vicinity of the workshops (Lawall 2011a: 38–40). Such contexts are difficult to detect in the archaeological record because the likelihood of accidents was small, both

during land transport (small numbers of empty vessels loaded on animals), and sea transport (short trips in shallow waters of the coastal zone).

- Temporary storage points: temporary or short-term storage took place in several stages of an MTC's primary use life, before and after both their transport in ships and their distribution to points of consumption. Thus this phase may be associated with several types of storage installations: e.g. production points (wineries and olive presses); structures devoted to private trade; administration or distribution centres; port facilities, and so on. Such archaeological contexts may be complex, involving several kinds of vessels and merchandise in diverse phases of primary or secondary usage. There are conditions, however, that may be enlightening as far as the characterisation of MTCs is concerned, such as when large numbers of stored vessels of the same type are found together—e.g. the 80 examples of Canaanite Jars found in a storeroom at the Ugaritic port of Minet al-Beidha (Schaeffer 1932: 3, pl. III.3), or when the mouths of the vessels are still sealed, either because they were ready to be loaded for export or because they were temporarily stored before consumption—e.g. the House of the Oil Merchant at Mycenae, originally called the House of the Stirrup Jars (Wace 1953: 9, 13, pl. 7).
- Ships' cargoes: the presence of transport containers in ships' cargoes provides direct evidence of their maritime function. Given the multiple purposes that transport containers served as well as their extensive re-use, however, this is not always straightforward, especially in the early stages of their history. For example, although Cycladic Collar-necked Jars are predominant on the EH II Dokos shipwreck (Papathanasopoulos et al. 1995: 20–21), it remains difficult to determine if they were shipped as MTCs—i.e. full with their contents—or just empty, as pottery cargo. Moreover, not all MTCs found in shipwrecks are necessarily cargo: e.g. the four (or five?) Cretan Transport Stirrup Jars found on the Cape Gelidonya wreck (fragments of two or three [Hennessy and Du Plat Taylor 1967: 123–124] and two almost intact [Haskell et al. 2011: 135]). Even if they belonged to the crew or were not being used to transport liquids, the fact that they were re-used on board is indicative of their maritime value.

Another archaeological indicator that typifies MTCs is their distribution at some distance—near or far—from their place of manufacture. Their character as MTCs presupposes the need for a large number of low-cost packaging containers for export; thus the exported or traded quantities are also important markers of their use. Generally speaking, wherever there is a strong similarity in form, we may also assume a similar function (McGovern et al. 2013). In a study of commercial amphorae, Twede (2002) argued that three nearly universal demands of commercial packaging have dictated the design of transport jars: (1) protection of the contents; (2) utility for transport and distribution/consumption; and (3) 'market communication' (i.e. packaging) (noted in Bevan 2010: 63; see also Bevan 2014). All these factors may be said fairly to characterise MTCs.

Given all these issues, the clarification of the term is important before we proceed to discuss the relevant types. Focusing first on their use, we suggest that the term ‘maritime transport container’ should be applied to any pottery vessel that was *designed* or used repeatedly (not occasionally) to move bulk organic cargo over long distances by sea. Of necessity they had to be airtight, capable of being sealed, and made from materials that would not react with their contents or let them be spoiled by bilge water or sea spray (Marcus 1995: 601). Thus, such vessels were usually sealed either on the interior (with pitch, pine sap, etc.) or exterior (by an applied slip or burnish). Their basic morphological features ought to include a narrow or restricted orifice (mouth, neck), durable walls, (at least) two handles and, ideally, a narrow base. Four–five litres may be considered as a minimum threshold capacity, but the production of the same container in different sizes (e.g. the Canaanite Jars on the Uluburun shipwreck) clearly underscores the variability involved when these vessels were used for bulk transport. Because there are several types of ceramic vessel with such attributes in the archaeological record—some used for the occasional transport of goods, others exported empty and then used for domestic storage or transport, in order to distinguish an MTC we should be able to demonstrate its primary use in maritime transport by its presence (a) on shipwrecks and/or in storage installations, and (b) outside its production centres, in considerable numbers.

When do such *maritime* transport containers, which we can at least assume were usually shipped full with their contents, first enter the archaeological record, and how do they change through time? The latter part of the question is easy enough to outline, but the first presents various problems as we lack secure evidence for certain elements such as kiln sites, temporary storage or ship transportation (i.e. shipwrecks).

### **Maritime Transport Containers: The Bronze Age**

Although there is no clear evidence of MTCs prior to the Bronze Age, it is perhaps worth noting that excavations at the Chalcolithic ‘sanctuary’ site of Gilat in Israel revealed the common occurrence of a torpedo-shaped jar that in many respects anticipates later amphora forms (Commenge et al. 2006: 423–424, 445–446). Organic residues analysis carried out on eight of these jars indicates that they contained olive oil (Burton and Levy 2006). Another late fourth millennium BC marker of possible maritime connections involves the export of freshwater, Nile River valley molluscs (*Aspatharia rubens*) to the southern Levant in a (storage?) jar (36 cm tall and 27 cm wide at most); petrographic analysis of this jar indicates production from a non-calcareous alluvial Nile clay (Sharvit et al. 2002: 159–161, fig. 3a–b). The jar was found on the seabed at depth of 11–12 m, some 700 m offshore at north Atlit bay in Israel, about 20 km south of Haifa. Eighteen of these shells were found in and around the jar; they have also been found at several other Chalcolithic and Early Bronze I sites in Israel (Bar Yosef Mayer 2002), and thus may have been common imports to the southern Levant.



By the onset of the Early Bronze Age (EB) (c.3600–3500 BC; see Braun et al. 2013), when developments in horticulture (especially olives and vines) were well underway in the southern Levant (Stager 1985; Zohary and Hopf 2000: 142–159; Fall et al. 2002: 472–473; Cavalieri et al. 2003; McGovern et al. 2009), potters in the same area had begun to adapt certain attributes of the common storage jar that would have made it more suitable for purposes of transport (Marcus 2002: 410; on the wider contacts between Egypt and the southern Levant throughout the Chalcolithic–EB era, see de Miroschedji 2002; Wengrow 2006: 148–150; Hartung 2013). For example, southern Levantine EB IB ledge- and loop-handled jars travelled to Egypt along with their contents (see the Appendix, Table A1: nos. 4–5). These are found, for example, at Maadi (EB IA?) near the apex of the Nile Delta (Rizkana and Seeher 1987: 31–32, 52–54, 108–111, pls. 72–77, IX–X), and at Tell el-Farkha in the eastern Nile Delta, along with local imitations of lug- and ledge-handled jars (Czarnowicz 2011: 122–123, 126, fig. 3). From Tomb U-j in the near-contemporary royal cemetery at Abydos, over 200 wine jars were found stacked in chambers 7 and 10, and impressions of another 150 wine jars were recorded in the floor of chamber 12 (Hartung 2002: 437–443, figs. 27.2–27.6; Watrin 2002: 453–455, figs. 28.3–28.4). Forty-seven of these jars contained grape pips, while other jars held completely preserved grapes and sliced figs. Organic residues analysis (ORA) suggested that some of these jars could have held terebinth-infused and fig-flavoured wine at one time or another (McGovern et al. 1997; McGovern 1998: 29–30; Stager 2001: 630–631). More recent re-analysis of one of the Abydos jars indicates that ‘herbal additives’ may have enhanced the wine, medicinally or otherwise; wine and other alcoholic beverages provided an ideal means to dissolve and administer botanical medicants (McGovern et al. 2009; 2013).

An early Neutron Activation Analysis (NAA) study of 11 of these Abydos wine jars suggested an origin in the southern Levant (McGovern 1998: 31). Goren (2003), however, argued that the database used (Brookhaven National Laboratory) was not comprehensive enough to make such an assignment. Moreover, based on petrographic analyses of 130 randomly selected vessels from the same chambers in the Abydos U-j cemetery, including 17 samples also analysed by NAA, Porat and Goren (2002) maintained that the majority of these vessels were manufactured locally, even if some show indicators of a pottery-producing technology associated with the southern Levant.

In Egypt itself, it seems clear that some local potters eventually adapted these shapes, perhaps to store or transport ‘Delta wine’ (Watrin 2002: 459). In time, and with the development of local vineyards, imports from the southern Levant declined. Hence it is interesting to note that amongst several Egyptian vessels imported into the southern Levant during the latest phases of EB I, at least one ‘wine jar fragment’ from Lod (Israel) has a potter’s mark that may represent the determinative for wine (*irp*) (Braun 2011: 114–115, fig. 12.17). Wengrow (2006: 266) is probably correct in a general sense that many of the technologies associated with EB modes of agrarian production in Egypt, including plough



agriculture and viticulture, were of foreign origin; however, it remains uncertain whether the loop- and ledge-handled jars found in Tomb U-j in the Abydos royal cemetery were actually Levantine imports used for the bulk transport of wine, rather than local products made principally for internal (land-based) storage and/or transport and exchange (also Braun 2011: 112). One interesting footnote to this question is provided by an ivory handle from Abydos, showing people in what is regarded as Levantine-style dress carrying what seem to be ledge- or loop-handled jars (Shaw 2000: 314). Broodbank (2013a: 278, 287 fig. 7.16) highlights this object, and suggests that local production of these jars may represent an attempt to allude to more exotic origins for the vintages than was actually the case.

Whatever the origin(s) of these EB I wares, it is clear that by the EB II–III periods (c.3050–2400/2200 BC) other pottery vessels from the southern and central Levant were being imported into Egypt (e.g. Knoblauch 2010; Wodzińska and Ownby 2011). Most of these were loop-handled jars and, like the later MTCs, increasingly were produced with thickened walls and bases, an elongated body, a shaped rim, and so on. Such features may have emerged to meet the growing demands of seaborne trade (Marcus 2002: 410; see also Stager 1985: 179–180). For example, the size and capacity of combed (‘Metallic Ware’) jars, as well as the level of standardisation seen in their production, may well be associated with the increased carrying capacity of some ships, now also powered by the sail (Esse 1991: 115–116, fig. 21; Marcus 2002: 410; Broodbank 2010). Sowada (2009: 248–255) suggests these containers may have held imported commodities such as olive oil, wine and resins. Moreover, the ‘Metallic Ware’ jars of EB II–III (Figure 4a–b; see also Appendix, Table A1: no. 5) manufactured in northern inland and coastal centres in the Levant (i.e. the highlands and coast of southern Lebanon and southern Beq’a, upper Jordan valley, Golan plateau, Galilee, Jezreel valley) may have been mass-produced in workshops centred first in the upper Jordan valley (Greenberg and Porat 1996; Marcus 2002: 410), and later along the central Levantine coast (Thalmann and Sowada 2014). Greenberg (2011: 239) suggests they may represent ‘incipient commoditization’, at least in part related to storage and trade in wine and/or olive oil. Such ‘commercial’ jars were depicted on wooden labels and ivory inlays of the Egyptian First Dynasty (Amiran 1969); the scene from a later, Old Kingdom tomb at Giza shows an Egyptian storage jar next to a Levantine two-handled jar, while an inscribed label found nearby indicates that it may be full of ‘sweet oil’ (Kantor 1992: vol. 1: 20, vol. 2: fig. 6.3). Other near-contemporary examples of olive oil production include a large olive oil processing installation at (final) EB Ugarit (Courtois 1962: 418 fig. 3, 420–429) and olive oil storage jars in Building P4 at EB IV Ebla (Matthiae and Marchetti 2013: 391).

Ownby (2012: 24; see also Wodzińska and Ownby 2011: 287–293; Köhler and Ownby 2011: 43) reports on petrographic analyses of five (EB II–III) Red Polished and ‘Metallic Ware’ vessels found in tombs at Helwan (near Memphis, at the apex of the Nile Delta), and on 18 (EB III) ‘combed jar’ sherds from the Giza necropolis. The results indicate a provenance along the northern Levantine

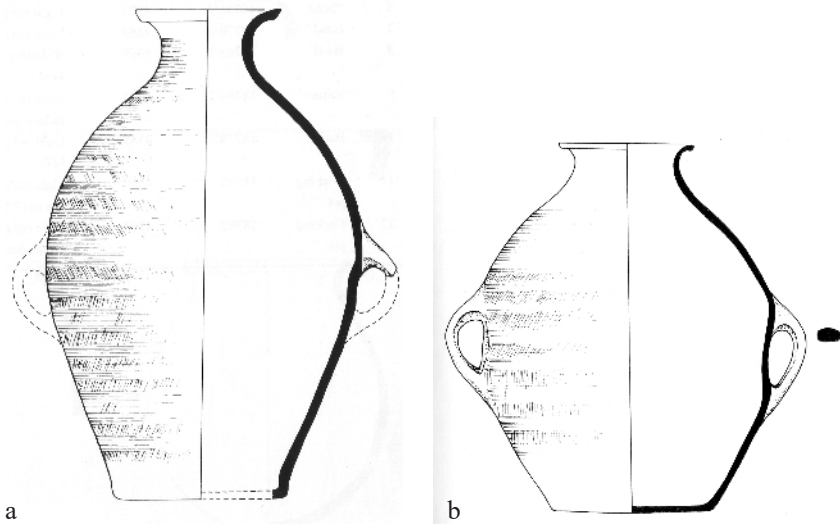


Figure 4 EB II–III Metallic Ware jars from Tel Dan: (a) fig. 2:3, tall; (b) fig. 2:5, short (after Greenberg and Porat 1996: 8). Courtesy of Raphael Greenberg.

coast, in the Akkar Plain (near Tell Arqa and Byblos) for the Red Polished and ‘Metallic Ware’ vessels, and in Lebanon more generally for the combed jar sherds. These Levantine wares had specific characteristics—highly fired, less permeable, strong but lightweight, loop handles—that would have rendered them suitable for easy packing and transport (Greenberg and Porat 1996: 10–11). Once this Lebanese coastal industry refined the design of the combed (‘Metallic Ware’) jars, making them relatively taller and with streamlined handles (Greenberg, commentary to Bevan 2014: 406), they became the iconic vessels of the trade with Old Kingdom Egypt (Thalmann and Sowada 2014: 369–372), displacing the more globular ‘Metallic Ware’ containers, whose production quickly declined within the southern Levant.

Concerning these early stages in the development of the maritime transport container, Marcus (2002: 410) has rightly concluded that the emergence of specialised workshops for production of vessels designed for commercial purposes indicates the reorientation of pottery production toward the necessities of trade. Furthermore, the manufacture of vessels so well adapted to maritime purposes may suggest that certain people—merchants, mariners, pottery producers, perhaps even winemakers—in the southern Levant had reoriented their economic outlook to long-distance seaborne (as opposed to overland) trade in the eastern Mediterranean. Thus, the combed ‘Metallic Ware’ jars and jugs produced in northern Canaan and (most likely) shipped to Egypt during the EB II–III periods may bear witness to a much broader economic system of production and exchange, only hinted at by the examples found in Egypt (on the complexities and constant shifts in the intensity of ‘cash crop’ trade between

Egypt and the Levant during the Early Bronze Age, see Genz 2003: 69–71). With the instability and regionalism that marked the First Intermediate Period (c.2180–2055 BC), Egyptian maritime activity seems to have declined, which perhaps also affected imports.

By the EB III period, on current evidence, the paucity of Egyptian material in the southern Levant, and the increased number of Egyptian objects found around Byblos in the central Levant, may indicate that Egyptian trade, when it resumed, had shifted farther north (Marfoe 1978: 274), not least in search of high-quality timber for ship-building (de Miroschedji 2002: 45–46). Marfoe (1987: 27) went so far as to suggest that there was a ‘spiralling interdependence between timber procurement, ship construction and carrying capacity’, which together greatly expanded the scope and extent of maritime trade. Two brief passages (of the pharaoh Sneferu) on the Palermo Stone mention ships ‘of 100 cubits’ (50 m) made of ‘meru’ wood (Strudwick 2005: 66). Based on the hieroglyphic of the Palermo Stone and Strudwick’s reading, Monroe (2007: 5) felt that the boats ‘of 100 cubits’ must refer to royal Nilotic craft that were to be built from the wood imported in the seafaring ships, whose size is unstated. By contrast, Esse (1991: 116; based on Wilson, in Pritchard 1969: 257 and n. 2) suggested that such ships, on the open sea, were fully adequate for transporting heavy cedar timbers, and could easily have accommodated the Red Polished or larger combed ware jars noted above.

To summarise: on the basis of certain technological and typological characteristics of EB II–III vessels from the southern Levant, we may assume they were produced to transport (liquid?) goods to Egypt in newer and perhaps larger sailing vessels. Material or pictorial evidence of seagoing ships at this time, however, is very limited: there are a few incised representations of (riverine?) boats on pottery sherds from Megiddo and a miniature clay boat model from Tel Erani (Marcus 2002: 406–407, fig. 24.1). From Egypt, some ships are depicted in the temple of Sahure at Abusir and in the causeway of Unas at Saqqara, both of Fifth Dynasty date (c.2500 to 2350 BC) (Marcus 2002: 408; see also Kantor 1992: 20–21). But there are no shipwrecks in the eastern or southern Mediterranean, only the documentary mention of ‘Byblos ships’, and the suggestive stone anchors that formed the first step leading up to a towering structure (a lighthouse?) on the shore at Byblos (Frost 2004: 320–321, fig. 5). Thus we cannot determine unequivocally if such goods were transported in bulk, or if the vessels themselves served equally for transport and storage purposes.

## **The Levant: Canaanite Jars**

Earthen jars full of wine are brought into Egypt twice a year from all Greece and Phoenicia besides: yet one might safely say there is not a single empty wine jar anywhere in the country. What then (one may ask) becomes of them? I shall explain this too. Each governor of a district must gather in all the earthen pots from his own township and take them to Memphis, and the people of Memphis

must fill them with water and carry them to those arid lands of Syria; so the earthen pottery that is brought to Egypt and unloaded or emptied there is carried to Syria to join the stock that has already been taken there.

(Herodotos, *Histories* 3: 6–7)

In Leonard's (1996: 237, figs. 15.2–15.3) view, the 'classic' Canaanite Jar (see Figure 5, below) was about 50 cm tall, with an ovoid body that in time developed a more conical lower body profile and a more pointed or stump base. Based on our work and that of others, however, it seems clear that there is no 'classic' or standard-sized maritime transport container: they tend to appear in diverse forms and sizes. Pedrazzi (2007), for example, undertook a morphological study that included MTCs as well as storage jars. She defines 30 different 'forms' in the Levant between c. 1400–900 BC, each of which has distinctive types, or variants. The two basic types of interest here are those with an angular or carinated shoulder and more slender, tapering body (her Type 5.4), and those with a rounded or sloping shoulder and globular body (her Type 6) (Pedrazzi 2007: 75–77, 87–90; 2010: 53–54). She has identified two main volumes of capacity, one of 10–14 litres (the most common) and another of 18–22 litres (Pedrazzi 2005: 61–62; 2007: 238, fig. 4.15; 2010: 53–54) (see also the Appendix to this volume). As already noted, Cemal Pulak (pers. comm., 5 September 2014) now feels there is no clear volumetric standardisation in the larger Canaanite Jars from the Uluburun shipwreck (see also Zamora 2000). Our own volumetric analyses of two Canaanite Jars found on the Uluburun shipwreck (which may thus be considered as 'cargo') indicated a height of 54 cm, but with capacities of 7.5 and 12.3 litres (see Appendix, Table A1: nos. 12–13).

The typology of these vessels is complex (see further below), but the most common *commercial* containers have a tapered body, angular shoulder and pointed base. Just below the shoulder of these vessels were attached two opposing, vertical loop handles; the neck remained wide enough to extract the contents but narrow enough for sealing or stoppering. This distinctive, practical form not only provided structural strength but also ensured ease of handling. Because these jars could be stacked against each other if necessary, they were easy to transport by ship or to store in a room (recall the 80 examples, noted above, found stacked in a warehouse at Minet al-Beidha in Syria—Schaeffer 1932: 3, pl. III.3). For more formal occasions, or for convenience when opened, they might be placed in a ring stand (Leonard 1996: 237 fig. 15.2).

By the beginning of the Middle Bronze Age (MB IIA, c. 1950–1750 BC), there was a shift in the design of MTCs, from a flat to a more rounded base: examples from Tell el-'Ajjul and Byblos are commonly cited (Tufnell 1962; 1969: 15–16, 25–26, 32 fig. 6). Thalmann (2007: 434) calculated the average capacity of jars from the Royal Tombs at Byblos to be 40–45 litres; he also presents a two-handled, flat-based MB I jar from Tell Arqa (Phase N) with a capacity of 20–30 litres that he believes was 'more specifically designed for transport' (Thalmann 2007: 435–436, fig. 5:3). Ownby (2010: 65–70) provides a much fuller discussion, especially with respect to rim types. In any case, the

change to a more rounded base served to reduce the stress on the vessel, particularly severe at the junction between the base and the walls, caused by the sheer weight of its contents (Parr 1973: 176–177; Leonard 1996: 239). It might be debated, as Tufnell (1958: 220) suggested, whether this change from a flat to more rounded base reflected the arrival in the (southern) Levant of a new, wine-drinking community; however, the remains of a ‘palatial’ storage complex from Middle Bronze II levels Tel Kabri in Israel suggest that wine was readily available to certain people at the site (Koh et al. 2014; see also Yasur-Landau et al. 2012) and, by extension, to Tufnell’s ‘wine-drinking community’. Forty large (50-litre capacity), mostly handleless jars, with rounded bases, as well as a few smaller vessels, made from the most common type of ceramic fabric known from Tel Kabri, indicate a ‘wine cellar’ of approximately 2000 litres of (mostly red) wine (Assaf Yasur-Landau, pers. comm. 28 August 2014).

As Parr (1973: 176) noted, with the further development of the pointed base during the course of the Late Bronze Age, this vessel became much more suitable as a ‘means of conveyance’ as distinct from stationary storage. Certainly it represents a key technological innovation, and perhaps indicates yet another economic reorientation to long-distance seaborne trade, like that which had begun in the Early Bronze Age. With the possible exception of Sheytan Deresi, tentatively dated to the very end of the Middle Bronze Age (Bass 1976; Catsambis 2008), there are no other Middle Bronze shipwrecks known from the eastern Mediterranean (only scattered anchor deposits—Wachsmann 1998: 209–211, 265–266). Even so, we are now on firmer ground in assuming that at least some of these vessels had a specific transport function, and evidence from Egypt—both documentary and material—helps to strengthen that assumption.

Documentary evidence comes from inscribed granite blocks found at Mit Rahina (Memphis), which are court records of the Twelfth Dynasty pharaoh Amenemhet II (c.1911–1877 BC) treating building activities, endowments and Egyptian foreign relations—both military and commercial in nature. The record of this seaborne, commercial expedition has been described as the earliest known ‘cargo manifest’ in the ancient Mediterranean (Marcus 2007: 154, along with full refs. to original inscription and previous interpretations). Two ‘transport ships’, which had been sent to *Hnty-s* (central-northern Levant), returned home with all manner of goods for redistribution: precious metals, minerals, stones and seals, aromatics, oils and resins, wine, medicinal plants, trees (fig, olive, sycamore, cedar), spices (coriander, and possibly cinnamon), and finished goods both mundane and exotic (e.g. bronze daggers decorated with gold, silver and ivory). Marcus (2007: 149–150), moreover, suggests that the organic materials listed in this inscription—incense, oils, wine, aromatics, figs—may well have been stored in vessels that could withstand seaborne transport, i.e. Levantine jugs or jars, both of which were suitable MTCs.

The archaeological evidence is more impressive. Excavations in Middle Bronze (MB) IIA–IIB levels (c.2000–1650 BC) at Dab’a in the Egyptian delta produced a wealth of Canaanite Jars, even if the estimate of two million

examples at the site stretches credibility (Bietak 1996: 20; McGovern and Harbottle 1997: 145). These MTCs formed the largest group of imported pottery at Tell ed-Dab'a, between 15–20% of the estimated vessels in the total assemblage (Bader 2011: 139, fig. 1). Although they are reportedly quite similar in size, overall shape and rim/base profiles, the same cannot be said for their capacities. Thalmann (2007: 437, and fig. 7) analysed 20 of these Canaanite Jars from Tell ed-Dab'a, and argued that—once again—they showed no standardised capacity, ranging between about 14–25 litres. Complete vessels tend to be rare but rim, base and handle fragments were found in the majority of recorded contexts. Most stemmed from residential or palace contexts, but some were recovered from a refuse pit and a storage area, while a few were found beneath the floors of residences, where they had been used to bury infants (McGovern 2000: 37). At least one vessel had a seal impression with a hieroglyphic inscription reading 'ruler of *Shimu*', perhaps a Levantine place name or personal name, and possibly associated with Byblos (Cohen-Weinberger and Goren 2004: 84), itself suggested to be the 'mother city' of Tell ed-Dab'a (Holladay 1997: 209).

Neutron Activation Analysis (NAA) was carried out on 290 of these vessels from Tell ed-Dab'a (McGovern 2000: 31–33; McGovern and Harbottle 1997). Nearly 75% of them, and all those that had seal or scarab impressions, were made from clays argued to be consistent with production in the southern Levant (e.g., Tell el-'Ajjul, Ashkelon); less than 1% of the imports were thought to come from coastal and inland Lebanon and Syria. The only other region consistently represented—but by relatively few examples—was that around Tell ed-Dab'a itself (McGovern 2000: 34–37); such examples did not differ stylistically or technologically from the Levantine imports. Once again, the standards for the comparative database (Brookhaven National Laboratory) used to assign provenance through NAA contained little material from the northern Levant; thus the origins of the Tell ed-Dab'a Canaanite Jars were only assigned very generally to 'southern Palestine'. In a later, petrographic analysis that included 70 of the same vessels analysed by McGovern and Harbottle using NAA, Cohen-Weinberger and Goren (2004) identified 11 different fabric groups stretching from the north Syrian coast to the coastal and inland regions of the southern Levant; Griffiths (2011–12: 160) now maintains that the 'Group B' jars were exported to Egypt from the coastal plain of Lebanon. Thus over 70% of these vessels seem to have originated in the northern Levant, just the opposite of McGovern's reading of the NAA results (see also Goren 2003).

From Kom Rabia (Memphis), some 100 km south of Tell ed-Dab'a at the apex of the Egyptian delta, came many more examples (mainly sherds) of Canaanite Jars, dated to the MB IIB/C periods (c.1750–1550 BC). Bourriau (1990: 19\*–20\*) reports that 'levels contemporary with the Middle Bronze Age as well as the Late Bronze Age all produce sherds of Canaanite jars', although the numbers increased dramatically during the Nineteenth Dynasty (thirteenth century BC) (Bourriau 2010: 229). Ownby (2010: 99) states that 1565 Canaanite Jar sherds are known from late Middle Kingdom and Second Intermediate



period contexts at Kom Rabia (Bourriau 2010: 30, adds that some 600 sherds came from closed deposits at the site). Petrographic and chemical analyses (ICP-AES and ICP-MS—inductively coupled plasma-atomic emission and plasma-mass spectroscopy) of 56 sherds from the Memphite (Kom Rabia) Canaanite Jars identified four distinctive compositional groups, extending from the coastal plain in the north-central Levant (around Tell ‘Arqa and Tell Kazel), through inland Lebanon (and possibly near Byblos) and the coastal area between Sidon and Akko, to the region around the Carmel coast and Tel Dor (Ownby 2010: 178; Ownby and Bourriau 2009: 177–181; Ownby and Smith 2011).

The presence of Canaanite imports in Egypt during MB IIB/C is also demonstrated at Dashur (noted by Bourriau 1990: 19\*, n. 7) and by excavations at Lisht (capital of Middle Kingdom Egypt). The latter have produced significant numbers of Canaanite pottery imports, mainly ‘large storage jars or amphorae’ from both funerary and settlement contexts (Arnold et al. 1995: 14, 27). Over 3% of the potsherds from ‘houses’ at Lisht Village were of Canaanite origin, and the excavators speculated that, even if they were in secondary (i.e. storage) usage, ‘each household in the area of Egypt’s capital Itj-tawy possessed at any given time during the Thirteenth Dynasty [c.1780–1650 BC], at least one Canaanite jar’ (Arnold et al. 1995: 30). Ownby (2010: 88–90, fig. 3.39) lists eight sites—from Tell ed-Dab’a in the north to far-distant Buhen in Nubia (Second Cataract)—that contained MBA Canaanite Jar fragments. Finally, Ownby (2012: 26) mentions further petrographic analyses of 22 Canaanite Jars from Khom el-Khigan, a northeastern Delta site near Tell ed-Dab’a; the results indicate production in coastal centres stretching from the central to northern (Syrian) coast of the Levant, with a few possible examples from farther south.

On the basis of present evidence, therefore, Canaanite Jars produced along the Syrian coast only turn up at the northeastern Delta sites, not in the Memphis area (Ownby 2012: 26). This is borne out by comparison of the Memphite (Kom Rabia) jars with the Canaanite Jars from Tell ed-Dab’a, which showed both similarities and differences (Ownby 2010: 179–207). While certain fabrics are seen at both sites, some of those used at Tell ed-Dab’a were not present in the material from Memphis. Unique fabrics from Tell ed-Dab’a, for example ‘Group A’ (thought to originate in northern coastal Syria—Cohen-Weinberger and Goren 2004: 71–73) and ‘Group F’ (thought to originate in the Mount Carmel region), were completely absent from the Memphis samples (Ownby and Bourriau 2009: 182). Some Tell ed-Dab’a fabrics unattested in the Memphite material were used exclusively to manufacture Canaanite Jars, e.g. the fabrics of ‘Group C’ (coastal area around Byblos) and ‘Group H’ (inland southern Levant) (Cohen-Weinberger and Goren 2004: 74–75, 78).

Taken together, all these analyses indicate that the majority of the Canaanite Jars found in Egypt during the MB II period stemmed from a network of sites stretching all along the Levantine coast, but perhaps primarily from the north-central Levant (Ownby and Bourriau 2009: 183–184). For the first half of the second millennium BC, therefore, we are on firm ground in asserting that these vessels were imports, but we cannot demonstrate unequivocally that they were

used for the bulk transport by sea of whatever goods may have filled them (wine and olive oil, if not resin, are certainly possibilities).

In an attempt to determine what the Canaanite Jars from Tell ed-Dab'a contained, McGovern (2000: 75–77) carried out a suite of ORA on a selection of 12 examples. Although he cautioned that the preservation of organic remains at the site was poor because of the humidity and high water table, five of the 12 jars showed the presence of tartaric acid (or calcium tartrate), a key chemical marker of grapes or wine, while one showed traces of terebinth resin (see also McGovern and Michel 1996: 58; McGovern 1998: 30).

Based on hieratic inscriptions painted on the sides of some Egyptian jars or amphorae (see below), Leonard (1996: 250–251; see also Lecuyot 1997) noted that (MB or LB) Canaanite Jars were used to transport not only wine, but also other edibles/potables (e.g. olives, oils and fats, beer, milk, honey, fruits and vegetables, fish and meat) and non-edibles (incense, resins, dyes and unguents). Callender (1965: 37–41) lists over 30 different items carried in transport amphorae. In the New Kingdom tomb of Khaemweset at Thebes (Tomb 261), the complete sequence of wine production is depicted, from picking and crushing the grapes, through their 'bottling' into Canaanite (or Egyptian?) jars, to their transport by ship and subsequent unloading (James 1985: 14–15, fig. 11; Leonard 1996: 244). From other New Kingdom reliefs and tomb paintings (e.g. the tombs of Rekhmire—Davies 1935: pl. 15, and Kenamun—Davies and Faulkner 1947: pl. 8), it also seems likely that wine was transported in Canaanite Jars (Panagiotopoulos 2012: 54) (see Figure 3, above). Most importantly for the present study, these examples of New Kingdom paintings provide good pictorial evidence, at least from the Late Bronze Age, for the sea transport of organic goods in vessels specifically designed for that purpose (see Ownby 2010: 77–81, for complete discussion of relevant New Kingdom tomb paintings). Before the latter half of the second millennium BC, however, we cannot demonstrate via shipwrecks that Canaanite Jars were used for bulk transport and nor are we certain of all the type(s) of products that may have filled them (based on the materials listed in the Mit Rahina inscription of the early second millennium BC, discussed above, Marcus [2007: 149–150] suggested that organic goods such as incense, oils, wine, aromatics and figs could have been stored and shipped in MTCs).

Turning to the broader picture of (Early–Middle) Bronze Age maritime transport containers, the Aegean world must also be brought into the picture. Reviewing Old Palace Period pottery at Knossos, MacGillivray (1998: 90) describes the fragmentary remains of Canaanite Jars, with 'incisions near the handles... reminiscent of those on similar jars found at the Royal tombs of Byblos'. The Knossian context led him to suggest that these MTCs were imported in either late Middle Minoan (MM) IIB or early in MM IIIA, approximately the same time that Minoan pottery turns up in some quantity in the Levant. Moreover, Minoan (as well as Egyptian) pottery found in a late MB tomb at Byblos is thought to corroborate links between Knossos and Byblos no later than the end of the Old Palace Period (MacGillivray 1998: 106). When we



return below to consider other early MTCs in the Aegean (Cycladic Narrow-necked Jars, Cretan Oval-mouthed Amphorae), it becomes fully clear that the Aegean world had become involved in the long-distance maritime transport of organic goods or other, related products long before the Late Bronze Age.

Turning to Late Bronze Age examples of Canaanite Jars, Furumark (1941) was the first to attempt to classify them. Although he recognised that the form of the Canaanite Jar was not Mycenaean, he nonetheless included it in his classification of Mycenaean pottery: as Form 6/Shape 13a (*pithos* with pointed base), and as Form 13/Shape 73 (jar with vertical handles on body) (Furumark 1972: 74–76, fig. 21: 13a, 587, 596). Because of their (foreign) fabric and unique shape, Furumark (1972: 74, 76) suggested that the former (the *pithos*), at least, may have originated in Egypt or the southern Levant. The Aegean Transport Stirrup Jar, discussed further below, is Furumark shape FS 164 (large domestic) (Haskell et al. 2011: 3).

Grace (1956: 86), who first designated these maritime transport containers as ‘Canaanite jars’, identified two variants: one with rounded shoulders and made of coarse brown clay, the other with a flattened and angular shoulder made of a finer clay with a greenish-buff surface. She suggested that the rounded coarse jar was produced in the southern Levant, while the finer jar with the angular shoulder originated farther north, in ‘Phoenicia’ or Syria (Grace 1956: 87). Amiran (1970: 140–142) updated Grace’s work and summarised the evolution in the shape of what she termed the ‘Canaanite commercial jar’ (found in the Levant) during three Late Bronze Age phases (Figure 5): the body changed from oval to ‘vigorously shouldered’; the base evolved from being narrow and rounded to being thick, heavy and ‘button-like’; and the handles moved from the middle of the body up to the more prominent, nearly horizontal shoulder, while the rim became plainer but thicker. Amiran related these developments to the function of the jars in the context of expanding commercial contacts in the eastern Mediterranean during and following the fourteenth century BC. She cited examples found in Egypt and the Aegean, which showed features associated with the later phases of the jar’s evolution: increasingly narrow vessels with flattened shoulders, the placement of handles on the shoulders, and thickened bases and rims (Amiran 1970: 141–142; 139 fig. 43:6–7, and especially 11–13).

Others attempted to develop further the typology of the Canaanite Jar. Raban (1980: 5–6), for example, divided the jar into five variants: oval, biconical, ‘Byblus’ type, angular and small conical jar. Most specialists, however, have found it difficult to develop a specific typology that combines rim, base and vessel profile (Killebrew 2007: 167; Serpico 2005; cf. Anderson 1988: 189–199). More recently, Pedrazzi’s (2007) morphological analyses (mentioned above) singled out two basic types of interest for the present study: her Type 5.4 with a carinated shoulder and Type 6 with a more rounded shoulder and globular body (Pedrazzi 2007: 75–77, 87–90; 2010: 53–54). She maintains that Type 5.4 is widely distributed in coastal Syria and Lebanon, and throughout the southern Levant, while Type 6 is most common in the (coastal) southern Levant, along the Lebanese coast and on Cyprus.

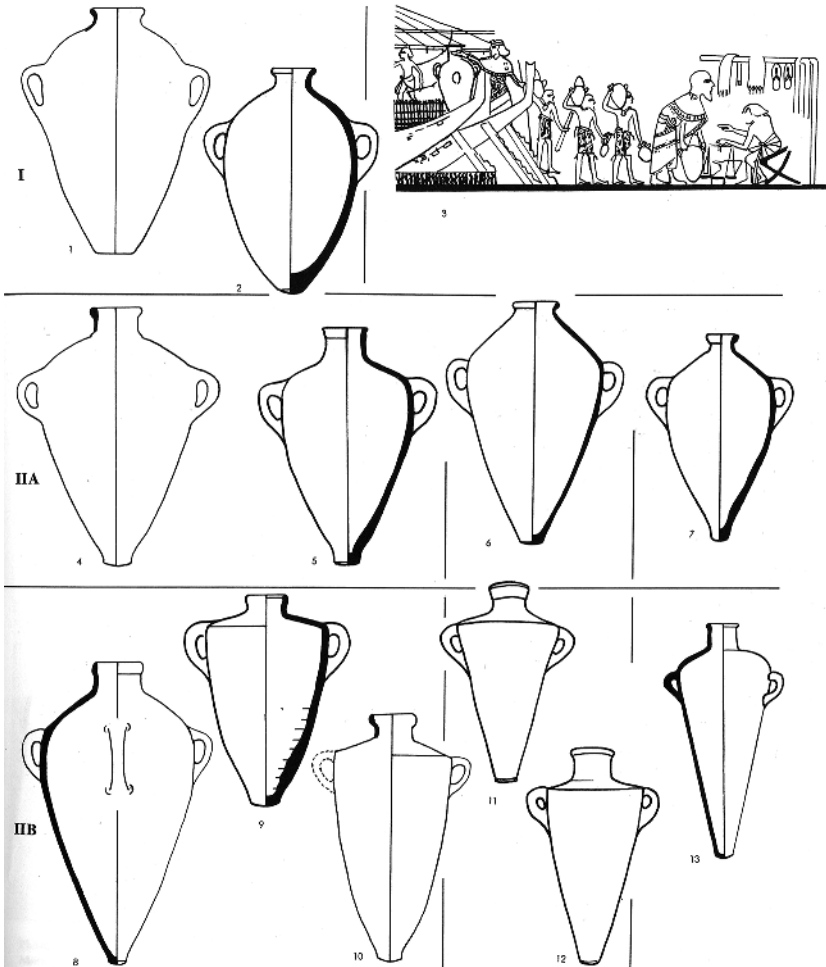


Figure 5 Canaanite Jars. Fig. 43.1, from Ruth Amiran, *Ancient Pottery of the Holy Land: From Its Beginning in the Neolithic Period to the End of the Iron Age*. Copyright ©1970 by Ruth Amiran. Reprinted by permission of Rutgers University Press.

Killebrew (2007: 167–168, fig. 1: 1–3), whose work we follow here, has re-defined the two basic types—one with rounded shoulders (her CA 21: two sub-types, CA 21a with two handles, CA 21b with four handles), and one with carinated shoulders (CA 22) (Figure 6), all with a variety of rim profiles (simple, folded or thickened, flaring) and bases (rounded, button-shaped or thickened stump, and ‘cup-like’—Killebrew 2007: 170, fig. 3: 1–9 [rims], fig. 3: 10–17 [bases]). There are a few examples of type CA 21a with painted decoration on the shoulders, either in a simple horizontal band or a metope-like frieze (e.g. Killebrew 2007: 171–172, fig. 4: 3–4; see Figure 6.3–4 here). Even with such

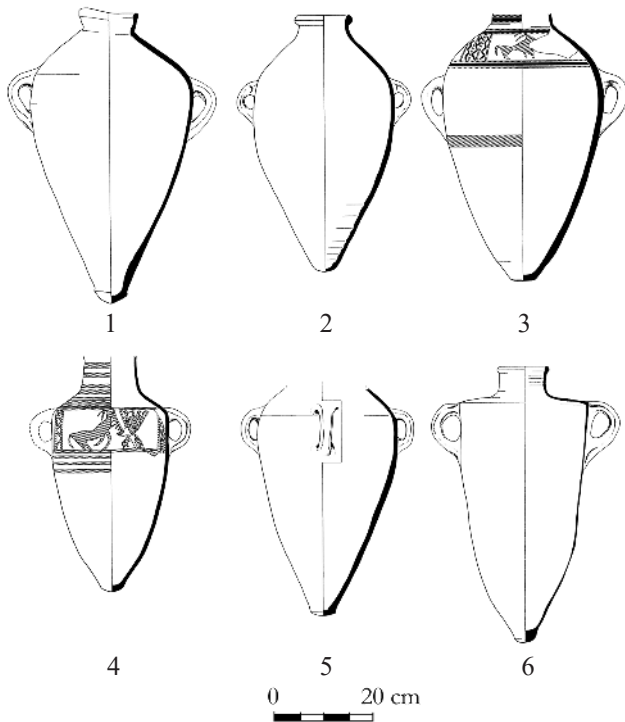


Figure 6 Canaanite Jar types (after Killebrew 2007: fig. 4). Courtesy of Ann Killebrew.

relatively specific criteria, however, it is difficult to assign precise chronological parameters to minor variations in the shapes of these vessels.

Killebrew's form CA 21a (rounded shoulders, two handles—Raban 1980: 5, Type I, oval) is found at many Late Bronze II sites in the southern Levant, Egypt, Cyprus and the Aegean. While most jars of this type are recognised as having been produced in the southern Levant, they were also manufactured farther north (Raban 1980: 5; Jones 1986: 572–573; Serpico 2005). Some of the examples from Maa *Palaeokastro* and Pyla *Kokkinokremos* on Cyprus may have been produced on the island (Jones and Vaughan 1988: 393; Georgiou 2014: 179–186; see further below). Killebrew's form CA 21b (rounded shoulder, four handles) is found at multiple Late Bronze II–Iron Age 1 sites in the southern Levant, while at least two examples were exported to Maa on Cyprus (Hadjicosti 1988: 349).

Killebrew's form CA 22 (angular shoulders, two handles—Raban 1980: 6, Type III, angular) is the most common type of maritime transport container found in the Bronze Age eastern Mediterranean; it is the type shown being offloaded from ships on the Egyptian New Kingdom reliefs mentioned above (e.g. Davies and Faulkner 1947: 43, 45, pl. VIII) (see Figure 3, above). Numerous examples are known from Egypt, the Aegean, Cyprus and Cilicia

(Bourriau 1990; Serpico 2005; Killebrew 2007: 173, nn. 29–31). The 80 examples found stacked neatly in rows in a storeroom at Ugarit's port Minet al-Beidha were also of this type (Schaeffer 1932: 3, pl. III.3). From the Uluburun shipwreck, some 150 Canaanite Jars of 'a single morphological type' (conical bodies, pointed bases, angular shoulders with two loop handles, narrow neck), but of multiple size groups, were recovered; those illustrated clearly belong to Killebrew's form CA 22 (Pulak 2008: 317–320, nos. 190a–b) (Figure 7). The five pieces of 'water jars' from the Cape Gelidonya shipwreck appear to include both Killebrew form CA 22 and CA 21a (Hennessy and Taylor, in Bass 1967: 122–123, fig. 132). Form CA 22 is also the dominant type along the northern Levantine coast, and is regularly found at Late Bronze II–early Iron Age coastal sites in the southern Levant, e.g. Deir el-Balah, Tell Abu Hawam and Tel Qasile (Killebrew 2007: 173, notes 34–35). While this angular-shouldered Canaanite Jar (Form CA 22) evidently ceased production at some point during the twelfth century BC, perhaps in the wake of destructions that affected major Levantine trading centres like Ugarit, the Phoenicians would continue to refine the form into the Iron Age (see discussion below, in the section *Levantine MTCs: LB/Iron Age Transition and Iron Age I*), and the Philistines seem to have used it exclusively for bulk transport or storage (Rutter 2013: 561 n.22). The round-shoulder examples (Form CA 21) also continued to be made into the first millennium BC.

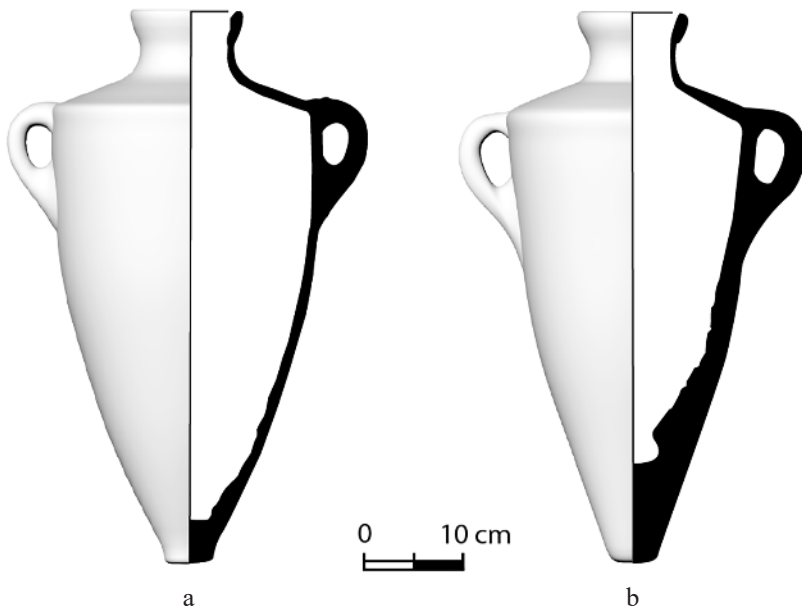


Figure 7 Canaanite Jars from the Uluburun shipwreck. a) after Pulak 1998: 201, no. KW214; b) after Pulak 1997: 241, no. KW612. Drawing by Irini Katsouri.

As noted, both vessel types (CA 21 and 22) have been found at Late Bronze Age sites throughout the Aegean and eastern Mediterranean. On the Greek mainland, they have been recovered at both coastal and inland sites, and mainly in tombs: Menidi, Mycenae, Tsoungiza, Argos and Asine, Koukaki, Magoula Galatas, Athens, Pylos, Tiryns, Dimini and Thebes (Rutter 2014). On Crete they appear mainly in coastal sites, usually in settlement contexts: Kommos (68 examples, see further below), Pseira, Mochlos, Palaikastro, Khania, Zakros and Poros-Katsambas; in the Cyclades at Akrotiri on Thera; and on the Cape Gelidonya and Uluburn shipwrecks (Åkerström 1975; Cline 1994: 95–96; Dimopoulou-Rethemiotaki 1993: 459; Leonard 1996: 240–244, 247–249; Rutter 1999: 153 n. 34). Rutter's (2014) recent study tabulates their contextual occurrences through time in the Late Bronze Age Aegean, remarks on the differences between Minoan and Mycenaean contexts and patterns of usage, and speculates that their contents may have changed (from oil and resins, to resins only) with the passage of time, even though no ORA have been conducted on these vessels.

In Egypt, Late Bronze Age Canaanite Jars are known from at least 14 sites, spread from the Nile Delta and the western desert in the north to Elephantine in the south (Ownby 2010: 90–92, fig. 3.40) and to Wadi Gawasis on the Red Sea in the east (Bard and Fattovich 2010: 9). To mention only a few examples, these jars have been recovered from excavations at the thirteenth century BC 'fortress' of Zawiyet Umm el-Rakham along western Egypt's coast, mainly in 'temples' and 'chapels', not storage magazines (Snape 2003: 67; Snape and Wilson 2007: 58–68). The bulk of the imported pottery identified thus far at Umm el-Rakham comes from 15 whole and several other, fragmentary Canaanite Jars, together with a number of 'plaster lumps' that may have fitted over their mouths. There are also a few coarse ware Transport Stirrup Jars, two with what might be Cypro-Minoan marks on their handles (Snape 2003: 68, fig. 4; see also Snape and Wilson 2007: 58, C2.5 and 59, C2.14, fig. 322), and a Canaanite Jar with a large black dipinto on its body (Snape and Wilson 2007: 60, C3.4, fig. 3.22). From nearby Marsa Matruh, mainly in the 'Northern Cluster' storage areas, came rim, base, shoulder, body and handle fragments of 20 Canaanite Jars, and 3 further handle fragments with what appear to be incised pot marks (Hulin, in White 2002: 19–20, fig. 8.2, 39–42, figs. 8.12–8.14). Of these pot marks, one occurs commonly on Cypriot or Mycenaean pottery as well as on a Canaanite Jar from Tel Nami in Israel, while another is typically seen on Canaanite Jars (note that Canaanite Jars marked with Cypro-Minoan signs are rare in the Levantine archaeological record—Hirschfeld 2000: 182; Yaser-Landau and Goren 2004: 24–25; Ben-Shlomo 2014: 27). Finally, examples of Late Bronze Age Canaanite Jars have been found at sites in northern Sinai, along the ancient road from Egypt to the southernmost Levant, the so-called Ways of Horus (Oren 1987: 83–84, 95, 103).

On Cyprus, Canaanite Jars have been found at 20 different sites (Table 1), and at least some of them—e.g. from Maa *Palaeokastro*, Enkomi, Hala Sultan Tekke *Vyzakia*, Kition, Kouklia *Palaipaphos* and Pyla *Kokkinokremos*—had Cypro-Minoan or other, similar signs incised on their handles (Masson, in Karageorghis

Table 1 Canaanite Jars from Cyprus

Enkomi [at least 20 from the 'Sanctuary of the Ingot god']	Dikaios 1971, Volume IIIa: pls. 65:10, 77:22–23; 120:11–12; 125:4; Courtois 1971: 248 fig. 89, 249, 251 fig. 91, 256 fig. 96; 1981: 37–38, fig. 15.3; Gunneweg et al. 1987; Mazar 1988; Åström 1991a; Crewe 2012: 232–234 (minimum count 31)
Arpera <i>Mosphilos</i>	Merrillees 1974: 54 fig. 35, 59; Crewe 2012: 229
Hala Sultan Tekke [at least 10,000 sherds-50 vessels?]	Åström et al. 1976: 15–16, pl. XVd; Åström 1991b; Fischer 1991a; 2011: 79; Åström 1989: 118 lists all refs. to Canaanite jars at Hala Sultan Tekke
Alassa <i>Pano Mandilares</i>	Hadjisavvas 1986: 67
Kalopsidha 'C', 'Gjerstad's house' [at least 26]	Åström 1966: 9; Crewe 2010: 68, 2012: 232
Pyla <i>Verghi</i>	Grace 1956: 92 n. 22; Åström 1972: 261
Korovia <i>Nitovikla</i>	Crewe 2012: 232 ('significant quantities')
Galinoporni Tomb 1(?)	Crewe 2012: 230–231, fig. 2.5
Pyla <i>Kokkinokremos</i> [at least 68 vessels]	Karageorghis and Demas 1984: 51, pls. 37–38; Georgiou 2014
Kition	Karageorghis and Demas 1985 (Part 1): 279
Kouklia <i>Palaipaphos</i>	Maier and Karageorghis 1984: 54
Maroni <i>Vournes, Tsaroukkas</i> [at least 4, and 1 in Tomb 15]	Cadogan et al. 2001: 77; Manning et al. 2002: 137–140; Manning et al. 2006: 478, table 2
Kouklia <i>Kaminia</i> [Tomb VII: 1]	Jones 1986: 572, pl. 7.16
Maa <i>Palaeokastro</i> [at least 84 vessels]	Hadjicosti 1988
Apliki <i>Karamallos</i> ['storage jars']	Du Plat Taylor 1952: 160–161 figs. 11.9, 12.4
Kalavastos village	Pearlman 1985: 167 fig. 2:1, 168 no. 1
Arediou <i>Vouppes</i>	Steel and Thomas 2008: 241, fig. 23; Steel and McCartney 2008: 14 table 1, 21
Myrtou <i>Pigadhes</i> ['Syrian jars']	Catling, in Du Plat Taylor 1957: 53–55, fig. 23: 318–320)

and Demas 1988: 399–400; Masson, in Karageorghis and Demas 1985: 283–284; Ferrara 2013: nos. 140, 156, 153; Ben-Shlomo 2014: 27–28; Georgiou 2014: 185; Hirschfeld 2014a; Nicolle Hirschfeld pers. comm., November 2014).

Amongst the 84+ Canaanite Jars found at Maa *Palaeokastro* (Hadjicosti 1988), 26 examples were analysed petrographically and chemically (Jones and Vaughan 1988: 393). Seven of the jars analysed may have been produced on Cyprus, somewhere along the south-central coast, or on the west coast near Maa itself (see further below). Georgiou's (2014: 176, 186) study of 'at least 68' Canaanite Jars found in the most recent excavations at Pyla *Kokkinokremos* also indicates (macroscopically, at least) that some of these vessels could have been produced locally. This possibility gains further interest in light of Sherratt's (1998: 300–301 n. 15, 305) suggestion that some of the oil from the pressing installations known at several Late Cypriot sites—in particular Kalavastos *Ayios*

*Dhimitrios* and *Alassa Pano Mandilares* (Hadjisavvas 1992: 21–25) but also Maroni *Vournes*, Enkomi, Kition and Hala Sultan Tekke—may have been exported in locally made Canaanite Jars or perhaps even in Group II or IB1 Cypriot *pithoi* (discussed further below; see also Papademetriou and Kriga 2013: 17–18). Moreover, the Papyrus Anastasi IV, 15.1–5 records the export of two kinds of oil (*dft* and *ynb*) from Cyprus (Ockinga, in Knapp 1996: 48, with refs.), one of which may have been olive oil.

Crewe (2012: 237–239; 2015: 122–124) has observed that production of locally made, early Plain White Handmade *pithoi* was nearly contemporary with the first appearance of many Canaanite Jars (all very fragmentary) on Cyprus. She suggests that these *pithoi* may have represented a type of ‘international shorthand’ for the transport of organic goods and produce. In her view, more asserted than substantiated, these vessels reflect the intention of the Cypriots to get involved in the exchange of bulk commodities, mainly wine; they would have ‘slotted seamlessly’ into the circulation networks of Canaanite Jars in the eastern Mediterranean, and thus might be seen as the local Cypriot counterpart of the Canaanite Jars. In this light, it is also interesting to note that combined lead isotopic and petrographic analyses suggests that three Canaanite Jar fragments from Hala Sultan Tekke were locally made, and have a lead isotopic composition that is indistinguishable from the locally made Plain White Wheelmade and coarse ware fragments. Nonetheless, the shapes of the Plain White Handmade *pithoi*, with a much wider mouth and broad flat or ring-base, indicate that they could not have served as an MTC, at least not in the manner we have defined them.

In a recent discussion of some unpublished large amphoroid kraters from the site of Pyla *Kokkinokremmos* on Cyprus, Karageorghis and Georgiou (2010: 310) state that ‘they were certainly used as transport vessels’. These kraters have a thick and flaring rim, with a short, concave neck; the body is disproportionately large in comparison with the neck of the vessel, and the belly is ‘globular’ (Karageorghis and Georgiou 2010: figs. 1, 2, 20). The only well-preserved base is flat with a splaying foot, while the short, vertical handles are attached from the flat rim to the shoulder. Such kraters are widely agreed to be storage vessels, and indeed Catling and Karageorghis (1960) long ago emphasised that the site of *Kokkinokremmos* had yielded a high proportion of ‘Minoan storage vessels’ amongst its ceramic repertoire. Exactly why one of the same authors now suggests they might have been used as transport vessels is puzzling, but based on the criteria adopted in this study, these kraters cannot be regarded as MTCs.

Finally, before turning to consider provenance work on the Canaanite Jars, we must discuss briefly another, related vessel type that appeared in the southern Levant toward the end of the Late Bronze Age and into the early Iron Age (c.1300–900 BC): the ‘collared-rim *pithos*’. In its morphology, including handles for manoeuvrability, this vessel appears to be a blown-up version of the Canaanite jar (Wengrow 1996: 308, fig. 1) (Figure 8). It is, however, a much larger vessel (c.110–117 cm in height, vs about half that for the largest examples



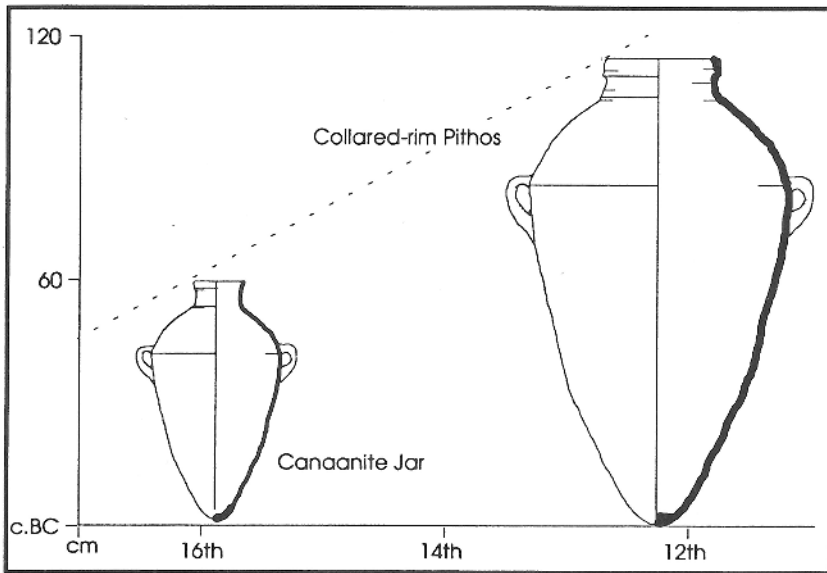


Figure 8 Collar-rim jar and Canaanite jar (Wengrow 1996: 308, fig. 1). Courtesy of David Wengrow.

of Canaanite Jars), with a rim diameter of over 20 cm and a capacity that varies between about 150–200 litres. Collared-rim *pithoi* have been found on sites stretching from the Mediterranean coast (in particular at Tel Nami, and a few at Tel Qasile, but nothing farther south) to the Jordanian plateau, and from Tel Dan in the northwest to Tawilan (southern Jordan) in the southeast.

Not least because of its size, it certainly must be regarded as a storage vessel (or in secondary use as a burial jar); it is also seen as a prime material marker of 'Israelite' settlement in the central hill country of modern-day Israel. Wengrow (1996: 321–323), however, argued—on the basis of their wide distribution in a variety of contexts, and the possibility that their contents rather than the jars themselves were in demand—that the highland villages where collared-rim *pithoi* have been found were creating large quantities of organic produce (livestock, wine, olive oil), in response to demand from Ramesside Egypt (late Eighteenth–Twentieth Dynasties) following the collapse of the 'Canaanite regional system'. Thus, in his view, the collared-rim *pithoi* were used for the packaging and land transport of bulk goods like wine, olive oil and olives from the highlands and elsewhere, through the Jezreel valley to the Mediterranean coast (i.e. at Tel Nami or perhaps Tell Abu Hawam), where they would have presumably been placed in other containers and shipped on to Egypt (none, however, are reported from Egyptian contexts). Artzy (1994), in turn, argued that collared-rim *pithoi* may have been used to transport Arabian incense—or other bulk goods, including liquids—via Jordan to the Mediterranean coast (to Tel Nami). Pedrazzi (2007: 377) suggests that they



might be regarded as ‘multi-function’ vessels, used for the storage and transport of agricultural products, for water storage in villages and possibly for transporting resins. Before such suggestions can be considered further, however, one must at least determine if these huge vessels were strong enough for transport purposes (Paula Waiman-Barak, pers. comm., February 2013). In sum, even if it can be shown that the collared-rim *pithos* might have been used as a land transport vessel, it certainly could never have served as an MTC. Not only is it far too large for such purposes, but also none have been found beyond the (mainly inland and highland) sites of the southern Levant.

*Provenance Work and ORA* Provenance studies and ORA carried out on Late Bronze Age MTCs present a complex picture. Raban (1980) reports on NAA of ten Canaanite Jars found in the Aegean, which indicated three distinct clay sources along the Levantine coast generally, from Ugarit to ‘south Palestine’ (Raban 1980: 5–6; Jones 1986: 572). Also using NAA, Gunneweg et al. (1987) argued that one Canaanite Jar from Enkomi originated in the southern Levant, perhaps in the vicinity of Ashdod. Goldberg et al. (1986) employed petrographic analyses and NAA on a group of sherds from Deir el-Balah (near modern-day Gaza), including four Canaanite Jar fragments. They concluded that all samples were made with local or southern Levantine clays, an outcome corroborated by Sugerman’s (2000: 143–144) more recent petrographic studies. Further petrographic analyses of 11 Canaanite Jars from Deir el-Balah indicated that 8 examples (fabric group DB-A1) were locally produced, while the provenance of the other three (fabric group DB-C) could not be identified, even though they ‘resembled’ Egyptian imports (Killebrew 2007: 175–176). Sugerman (2000: 105–106) termed the local fabric (DB-A1) ‘Group 6’, and identified Canaanite Jars of this fabric from Deir el-Balah, Ashdod, Lachish, Tel Batash, Tel Migne and Tell Abu Hawam. Of five fabric groups identified at Tel Migne (Ekron), three—either local or regional in origin—were used to manufacture the eight Canaanite Jars analysed from this site (Killebrew 2007: 176–177). Fabric ME-E from Migne appears to be similar to Sugerman’s Group 5, identified in Canaanite Jars from Tel Migne and Tel Batash (Sugerman 2000: 104–105). Petrographic analysis of two further jars from Tel Beth-Shan and three from Giloh also pointed to local production (Killebrew 2007: 179–180).

Petrographic analysis of 52 samples of Late Bronze Age Canaanite Jars from Memphis and Amarna in Egypt revealed six different groups (Smith et al. 2004), to which other examples from Qantir (Piramesses) have now been added (Ownby et al. 2014). Five groups are consistent with production in areas extending from Ras Shamra in the north to the region around Tel Dor in the south, while one group may derive from southern Cyprus (Bourriau et al. 2001; Smith et al. 2004; Ownby and Smith 2011: 273–277). The evidence for Cypriot production and/or shipment of Canaanite Jars to Egypt at this time, however, is slim (Åström 1991b; Jones and Vaughan 1988). While there is some variability within these groups, chemical analyses (NAA and ICP-AES) of the samples also separated them into six groups (Smith et al. 2004: 63–75; Ownby and

Smith 2011: 277). Two areas that had provided Canaanite Jars to Egypt during the Middle Bronze (inland Lebanon/Palestine, southernmost Levantine coast) no longer did so in the Late Bronze Age, while other areas (northern coastal Syria, perhaps southern coastal Cyprus) that had not exported such jars to Egypt during the Middle Bronze began to do so in the Late Bronze Age (Ownby and Smith 2011: 278–279). It bears repeating that the tentative identification of ‘Group 6’ with southern coastal Cyprus is problematic, given statements from the various analysts such as: ‘the degree of matching [petrographic, between local Cypriot samples and Egyptian samples] was not great’; ‘the results of the chemical analysis were not absolutely clear’ (Smith et al. 2004: 69). Finally, it may be noted that Canaanite Jars of Middle Bronze Age date found in Egypt showed quite variable production techniques while those found in Late Bronze Age contexts were much more consistently manufactured.

Sixty-eight Canaanite Jars excavated at Kommos on Crete—several in a good state of preservation—have been examined and published in exemplary fashion (Watrous 1992: 159–161; Rutter 2006a: 577–578, 649–653). About half of them were assigned to five of the six petrographic groups identified at Memphis and Amarna in Egypt and associated with production all along the Levantine coast (Smith et al. 2000; Bourriau et al. 2001: 140–144, figs. 7.9–7.10; Serpico et al. 2003: 368–372; Smith et al. 2004); one example may have been produced in southern Cyprus, or perhaps more likely in northwest Syria or Cilicia (Rutter 2006a: 652). One body sherd from Pseira on Crete was subjected to petrographic analysis, but its fabric could only be attributed to a non-Cretan provenance (Betancourt and Davaras 1995: 115, no. ADC 65, 152–153, fabric no. 6).

More recent analyses of 34 of these 68 Canaanite Jars from Kommos identified distinctive petrographic and chemical (INAA—Instrumental Neutron Activation Analysis) groups associated with production in the same Levantine coastal regions as the majority of similar vessels imported to Amarna and Memphis in Egypt: (1) northwestern Jezreel valley; (2) the coast of Israel south of Haifa; (3) farther north, between Akko and Sidon on the Lebanese coast; (4) north Syrian coast, near Ras Shamra/Ugarit; and (5) two samples possibly from the southern coast of Cyprus (Day et al. 2011: 549 fig. 11:b, 551, 553). Three further samples could not be related petrographically to any known material. As a corpus, the Canaanite Jars from Kommos are quite heterogeneous: of the 34 samples analysed, there are 12 distinct petrographic fabrics, most of which also exhibit discrete patterns of chemical composition. Such heterogeneity is also suggested by NAA carried out on a single example from Kommos (C7639), which is evidently ‘Syro-Palestinian’ but could not be matched to any known Levantine analytical group (Tomlinson et al. 2010: 214, and n. 29).

Some of the Canaanite Jars found at Memphis and Tell el-Amarna in Egypt, with origins all along the Levantine coast (as noted above; see also Serpico 2005: figs. 7, 13, 16, 19, 24), were also subjected to ORA (Gas Chromatography-Mass Spectrometry). These analyses indicated that some of the Amarna jars contained wine, oil and pistacia resin (Serpico and White 2000: 891–894; Stern et al. 2000), a result corroborated by hieratic inscriptions (‘jar docketts’)

occasionally found on the jars' exterior surfaces (Serpico et al. 2003: 365–366, 373). These jar docketts, which served administrative purposes, also listed details regarding production dates, the type of goods to be transported, even the names of agents involved. Some 30 jar docketts from Deir el-Medina list the captains of the ships (*hrj mnš*) on which goods such as olive oil and resin (*sntr*) were transported to Egypt (Bavay 2015: 130, 137).

ORA of the Memphite and Amarna jars has also confirmed that vessels belonging to two of the six (petrographic) groups carried pistacia resin and two others (olive?) oil (Bourriau et al. 2001: 143–144; Serpico et al. 2003: 369–372). This same result seems to hold true for Canaanite Jars from Deir el-Medina, where other products—olive oil (*nḥh*), moringa oil (*b3k*), *mrḥt* (a vegetal oil or animal fat), honey—have been associated with three other fabric groups (Bavay 2015: 131–132). One docket from a Deir el-Medina Canaanite Jar refers to the 'honey of *ikaryti*' (Ugarit), which coincides precisely with the petrographic origin proposed for fabric Group 4. Rutter (2014: 62) has suggested that resins were probably shipped to the Aegean in the two Memphis/Amarna groups identified as carrying resin, which stemmed from the coastal regions around and south of the Bay of Haifa. Of approximately 120 (Late Bronze Age) Canaanite Jars from the Uluburun shipwreck, 5 that contained pistacia resin were made from a fabric similar to that of the 40 Canaanite Jars from Amarna that held resin (Ownby 2010: 83; see also Mills and White 1989; Stern et al. 2008). Such links between the fabric of a jar and the commodity it held, once more widely established, will be invaluable for a broader understanding of production and consumption patterns in the local economies of the Late Bronze Age eastern Mediterranean, and the role played therein by MTCs.

No ORA have been carried out on the Canaanite Jars from Kommos on Crete. Of related interest, however, Rutter (2006a: 653) has noted that the occurrence of all Levantine imports at Kommos declines the farther one moves from the harbour area of the site; he suggested that such a spatial configuration is consistent with the notion that the jars' contents were 'decanted' shortly after arrival and redistributed in local containers (after Cline 1994: 96). Aside from a 'concentration' of three complete Canaanite Jars (one of which may have contained orpiment—Rutter 2014: 62) in House X, which seems to have been of special importance at Kommos (see discussion above, under *Harbours*), the largest surviving portions of other jars came from the court-centred complex of Building T and from the galleries of the ship-sheds in Building P. Both these structures had long and narrow storage rooms that could have been used for storage (or decanting) purposes. Rutter (2006: 653), however, questioned whether Building P was ever used to store Canaanite Jars, whilst Day et al. (2011: 516) suggested that this building may have served as a warehouse to stockpile the locally made Short-necked Amphorae (discussed further below).

Preliminary publication of petrographic analyses indicates that 82% of the 150 Canaanite Jars from the Uluburun shipwreck were made from sediments typical of Israel's Carmel coast, i.e. in the region around the Bay of Haifa, with a second group (14%) deriving from farther north, in the area between Tyre and

Sidon in Lebanon (Pulak 2008: 317–318, n. 5; Goren 2013: 57). Five of the Canaanite Jar fragments (base fragments, perhaps used as lids) were made of a fabric very similar to some pottery and cuneiform tablets from Ugarit (Goren 2013: 57–58). Some of the clays used to make the Canaanite Jars found on the Uluburun shipwreck seem to match those of the Fabric Group 1 Canaanite Jars from Amarna in Egypt (Smith et al. 2000; Bourriau et al. 2001—see above); both have a common source around the sites of Tell Abu Hawam and Tel Nami, in the vicinity of Haifa Bay (Serpico et al. 2003: 369, 373; Pulak 2008: 319–320, and n. 5).

The single Canaanite Jar found at Asine reportedly contained astragalus (i.e. ‘vetch’) seeds (Åkerström 1975). One example from the Uluburun wreck was filled with approximately 8000 small glass beads (Pulak 2008: 313–314) while several others contained olives or olive oil (one jar held about 2500 pits from large olives). The majority, however, are argued to have contained terebinth resin (*Pistacia atlantica*) and/or wine (McGovern 2003: 130). The resin could have been used as a type of incense in ritual functions, or it might have served as a preservative for either wine or olive oil (Mills and White 1989; Negbi and Negbi 1993: 322; Haldane 1993: 352–354; Pulak 1998: 201). More recently, Stern et al. (2008), having used a range of ORA techniques on five samples of pistacia resin found in some of the same Canaanite Jars from the shipwreck that McGovern (2003: 130) also had analysed, detected no tartaric acid (a marker of wine) in the samples, and argued that they held only resin, not wine. Pointing out some pitfalls of ORA, McGovern and Hall (2016) have now provided a detailed and critical response, stressing that ORA is an intricate and interdisciplinary pursuit, and that chemical data must be assessed in conjunction with the best archaeological, botanical and other scientific data before proposing or testing appropriate working hypotheses. They re-analysed the terebinth resin samples from five intact Uluburun Jars, using LC/MS/MS (Tandem Liquid Chromatography-Mass Spectrometry) and new extraction protocols, and conclusively identified tartaric acid/tartrate, the biomarker of grape and wine, in two if not three samples.

Thus an array of analytical techniques—petrographic analysis, NAA, ORA—conducted on Killebrew’s form CA 22 suggests a variety of possible contents and numerous production centres, from the western Jezreel valley and the Bay of Haifa all the way north to Syria if not Cilicia, but less likely on Cyprus (Raban 1980; Serpico et al. 2003; Serpico 2005; Killebrew 2007: 173).

On Cyprus itself, Raban (1980: 6, 148 table 6, 146 table 5) conducted NAA on several Canaanite Jars from Hala Sultan Tekke and Enkomi; those from Hala Sultan Tekke, at least, are said to have been both locally produced and imported from Ugarit and Cilicia. Jones and Vaughan (1988) carried out petrographic and Atomic Absorption Spectroscopy (AAS) analyses on a selection of sherds from the 84+ Canaanite Jars found at *Maa Palaekastro* (Hadjicosti 1988: 341–342, 363–368, table 4). Most of the 30 examples (26 jars, 4 ‘jugs’) analysed appeared to be Levantine in origin. The petrographic analysis assigned a possible local origin to seven samples; the chemical analyses

(AAS) assigned five of the seven to local production. Although both sets of analyses thus agreed closely, the attempt to determine a specific foreign provenance beyond the central or southern Levant was inconclusive, given the lack of comparative analytical data. Two samples were tentatively assigned an origin in the Maroni-Kalavassos area along Cyprus's south-central coast, and two others either along the same coast or in the vicinity of Maa itself, on the west coast (Jones and Vaughan 1988: 393). As already noted, Gunneweg et al. (1987) argued from NAA that one Canaanite Jar from Enkomi originated in the southern Levant.

More recently, lead isotope and petrographic analyses were combined to consider the sources of nine locally made vessels (1 coarse ware and 8 Plain White Wheelmade sherds) and 24 sherds of Canaanite Jars, all from Late Cypriot (LC) IIIA (early twelfth century BC) contexts at Hala Sultan Tekke in southeastern Cyprus (Renson et al. 2014; see also Renson et al. 2011). All the samples were eventually divided into five groups. Here, what is relevant is that the combined isotopic data and petrographic analysis identified three Canaanite Jar fragments as indistinguishable from the Plain White Wheelmade sherds, nine others as non-local but likely Cypriot in origin, and the remaining 12 as either from the Levantine coast or Egypt, although the assignments are very general (Renson et al. 2014: 273–275). The authors argue that the lead isotopic results are mostly consistent with petrographic ‘observations’ and suggest that lead isotopic composition offers ‘an excellent tool to trace the source of Canaanite fabrics’. Beyond indicating that three Canaanite jar sherds from Hala Sultan Tekke are consistent with local production, however, no other sources were pinpointed, only proposed.

Even less conclusive but worthy of note are some further analyses of other Canaanite Jar sherds and vessels from Hala Sultan Tekke. Using a combination of lead isotope and strontium isotope analyses, Makarona et al. (2014) speculate that six sherds of Canaanite ‘storage jars’ found at the site may have a local origin. Using both SIMS (Secondary Ion Mass Spectrometry) and MCA (Micro-Colour Analysis), Fischer (1991a; 1991b) analysed 25 samples of Canaanite Jars from Hala Sultan Tekke but with inconclusive results. According to the SIMS analysis, ‘More than a third of the samples appeared to have been produced on Cyprus, possibly locally’ (Fischer 1991a: 157). Although the agreement between the MCA and SIMS analysis was ‘satisfactory’, the MCA data are unique and thus cannot be compared, while the SIMS data are not calibrated to elemental data collected using either NAA or AAS. Such analyses therefore have little value for determining provenance (Sugerman 2000: 57–58).

*Summary* Over 40 years ago, Amiran (1970: 140) observed that the Canaanite Jar was not prized or traded because of its intrinsic value but rather for what it contained: ‘These large jars were not worth loading on a ship, unless they were filled with oil or wine’. Some riders must be attached to such an interpretation. First, in terms of differentiating or ‘branding’ the product, Bevan (2010: 62) has argued convincingly that the containers themselves may have become as

significant as the contents. Secondly, Monroe (2010: 24) has argued that the resin found in the Canaanite Jars on the Uluburun shipwreck may have been the most valuable cargo it contained (estimated by him to be worth some 5000 silver shekels). Finally, how should we understand the 52 Canaanite Jars made of silver and depicted on Tuthmosis III's relief in the temple at Karnak, commemorating his victory over a coalition of Levantine city-states that culminated at Megiddo (Sherratt and Sherratt 1991: 361, 386 fig. 2)? Was this sheer fantasy or a visual metaphor of the value that had become attached to such containers and/or their contents? Or did 52 silver models actually exist? Whatever the answer, we now know also that they might also be filled with terebinth resin, glass beads and olives, as well as olive oil and wine.

Although the number of Canaanite Jars known today is uncertain, Cline (1994: 95–96) counted 93 examples in the Aegean but only 58 from Kommos (the final count was 68 at Kommos, so 103 examples). Rutter (2014) tabulates nearly 70 occurrences throughout the Late Bronze Age Aegean, some of which include more than one vessel. There are more than 150 known or presumed vessels from Cyprus; another 35 from the two coastal sites in western Egypt; an unknown but probably very large number from Memphis and Amarna that have undergone various types of analyses; 150 examples from the Uluburun shipwreck; and countless more examples from the Levant, especially at coastal sites. One recently discovered example from Tell Tweini in north Syria contains a sealing with a representation of a boat (Bretschneider and Van Lerberghe 2011: 189), a unique but perhaps not surprising feature.

A conservative estimate of currently known and reasonably well-published Canaanite Jars found *beyond* the Levant and Egypt would thus be at least 500 examples. It is impossible, however, to quantify the number found within that region (cf. Pedrazzi 2007), not least because older publications list only complete examples, typically from tombs, while more recent excavations (e.g. Megiddo, Lachish, Aphek, Ashkelon) tend to publish only the rims from 'storage jars' (Ownby 2010: 85). Moreover, even if one reduced Bietak's (1996: 20) improbable guess of two million examples from Tell ed-Dab'a by a factor of ten, we are still talking about thousands of examples.

In contextual terms, these vessels are found most frequently in settlements (often ports) and shipwrecks; only on the Greek mainland were they commonly placed in burials, the whole vessels primarily in graves at sites that have been identified as 'royal' centres (Rutter 2014: 61, 63). Whatever these widely circulated jars held, and however diverse their contents, with a capacity ranging between 7–30 litres they became the MTC par excellence for Mediterranean sea trade during the Late Bronze Age; furthermore, they continued to serve—with various modifications in shape—the same function into the Iron Age (under the Phoenicians) and subsequently throughout the Greco-Roman era until the expansion of Islam into the Mediterranean during the seventh century AD (Wickham 2005: 693–824; Bevan 2014: 397 argues for the continuation of local amphora traditions as late as the thirteenth century AD). However one regards these views, the extensive distribution of Canaanite Jars at Late Bronze



Age sites throughout the Aegean and eastern Mediterranean, in Egypt and along the north African coast, and on the Uluburun and Cape Gelidonya shipwrecks, singles them out as objects that played a key role in bulk transport of goods within the intensive, ‘international’ and intercultural exchange relations of the time (Knapp 1990; Sherratt and Sherratt 1991: 370–373; Cline 1994: 95–97; Feldman 2006; Pulak 2008).

### **Egypt: Egyptian Jars/Amphorae**



*Figure 9* Egyptian Jar and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

Imports of Canaanite Jars to Egypt probably began as early as the late Middle Kingdom (Aston 2004: 176; 2011: 73) and eventually led to local imitations, using local Nile alluvial clays (already seen in some of the MB II Canaanite Jars at Tell ed-Dab‘a—McGovern 2000: 34–35; see also Hope 1978: 66–74). These ‘Egyptian Jars’ (or amphorae) become quite common during the Late Bronze Age, i.e. in the New Kingdom and Ramesside periods (Wood 1987; Bourriau et al. 2000) (Figure 10). Their Middle Kingdom or earlier predecessors—large, typically narrow ovoid jars with a pointed base used to store or perhaps to transport wine—had no handles and would have required two men, perhaps even a rope sling, to move them (Grace 1956: 83, fig. 1; Parr 1973: 178; Bourriau 2004: 84, fig. 5.5); they could not have been transported easily by boat. The earliest handled version probably dates to the Middle Kingdom, and by the first two reigns of the Eighteenth Dynasty wheel-made Egyptian amphorae began to appear (Bourriau 2004: 80–81).

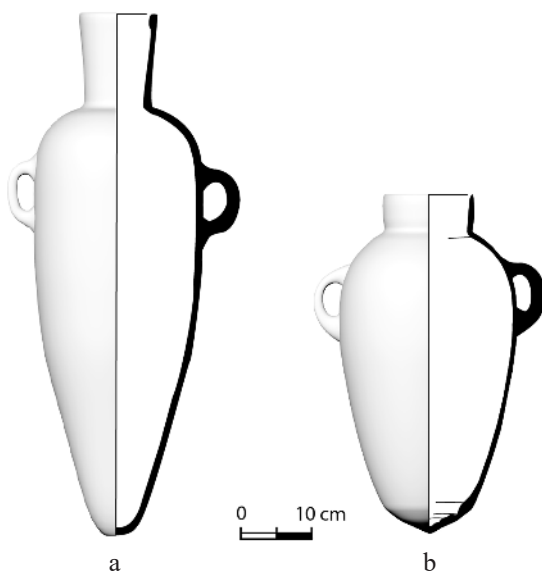
One of the most distinctive differences between the Levantine Canaanite Jar and the New Kingdom jar is the taller, often bulging neck of the Egyptian version (Martin 2011: 73). With a pointed base and a pair of loop handles, the shape of New Kingdom Egyptian Jars evolved from ovoid to increasingly narrow and angular, with a severely pointed base (Hope 1987: 9, 49; Wood 1987: 79–81; see also Grace 1956: 88, 90), much better suited for transport at sea. Furthermore, because these vessels were wheel-thrown and made in sections, their walls could be as thin as 5 mm; thus they would have been much lighter and easier to transport (Bourriau 2004: 90).

There are two main types of Egyptian Jars that concern us here, as defined by Martin (2011: 73–77, figs. 38–39, pls. 45.2, 42.1) (Figure 11): AM 1, a medium-sized or large vessel with a slender pointed body (suggested capacity, 14.7 litres), and AM 2a–b, a slightly smaller version with a broad, ovoid body





*Figure 10* Egyptian Jars from the tomb of Tutankhamun. Courtesy of the Griffith Institute, University of Oxford (Carter numbers 434, 486; Burton photograph number p1277).



*Figure 11* Egyptian Amphorae. a) type AM 1 (after Martin 2011: pl. 45.2); b) type AM 2 (after Martin 2011: pl. 42.1). Drawing by Irini Katsouri.

(suggested capacity, 11.2 litres) (see also Appendix, Table A1: nos. 8–9). Typologically these Egyptian Jars are similar to other amphorae from Egypt associated with the transport of wine (Bourriau et al. 2000: 32; Bourriau 2004: 78). Many of them have hieratic labels that were inked onto the vessels after they were filled, indicating the commodity, source, destination and even the vintner's name (Tallet 1998). In a scene from Nakht's (Eighteenth Dynasty) tomb at Thebes, the artist depicted a grape harvest, winemaking and four filled Egyptian Jars sealed with stoppers (Davies 1917: 66–71, pls. XXII, XXVI; Shedid and Seidel 1996: 57, 6–68, 71; Angenot 2012: 55 fig. 2, 56–57) (Figure 12). In another winemaking scene from the Nineteenth Dynasty tomb of Apy, the Egyptian Jars depicted have the typical slender form with a tall neck (Davies 1927: pl. XXX).

As already noted, it is widely assumed that the earliest Egyptian Jars were modelled on imported Canaanite Jars of the Middle Bronze Age, common in the eastern Nile Delta region and around the site of Memphis (Bourriau 1990; Arnold et al. 1995). Whereas it is also assumed that wine was the most common product imported in the Middle Bronze Canaanite Jars (e.g. McGovern et al. 1997; 2000), the main commodities that have been identified in Late Bronze Age (New Kingdom) Canaanite Jars from Memphis and Amarna are oils and resins (Bourriau et al. 2001; Serpico et al. 2003; Smith et al. 2004). In Bourriau's (2004: 85, 90) view, this change resulted from the increased local production of wine to replace imported varieties, and wine production on a large scale would have necessitated the production of Egyptian Jars on a comparable scale, to store and transport local wines. Indeed, the increasingly standardised shape, fabric and manufacture method of these vessels suggest specialised workshops for their production (Bourriau et al. 2000).



Figure 12 New Kingdom Tomb of Nakht, Thebes, with grape-harvest scene (from Davies 1917: pls. XXII, XVI).

*Provenance Work* Earlier petrographic studies and NAA carried out on New Kingdom Egyptian Jars indicated that they were most likely manufactured in the vicinity of the upper Nile Delta, near Memphis (Bourriau and Nicholson 1992; Bourriau et al. 2000: 17–18, 31–32). By contrast McGovern (1997: 90–91), who conducted INAA on other Egyptian Jars ('Marl D group'), suggested an origin far upriver, in the vicinity of Thebes. If the Nile Delta and Fayyum regions, near Memphis, were indeed the principal vine-growing areas of ancient Egypt (James 1996; Murray 2000), it makes more economic sense to assume these vessels were produced in the Memphite region, rather than around Thebes.

Nineteen Egyptian vessels identified amongst 88 samples of possible transport containers found at Kommos on Crete were analysed by thin-section petrography and INAA (Day et al. 2011: 518–519). Fifteen of these were Egyptian Jars, along with two flasks and two 'necked jars' (Day et al. 2011: 519 n. 24). Most of the Egyptian Jar samples from Kommos matched comparative marl fabrics from the Memphis region of the Nile Delta (Day et al. 2011: 549–550, fig. 11a). A few that were also chemically distinct matched certain Canaanite Jar fabrics whose likely origin lay in the Jezreel valley, just east of modern-day Haifa in Israel (Day et al. 2011: 551, 549 fig. 11:c). The Egyptian Jars reveal a striking homogeneity in their composition, perhaps reflecting their origin at a single location (probably near Memphis) over an extended period of time.

*Summary* The shape of the New Kingdom Egyptian Jar was very similar to that of the Canaanite Jar; certainly both vessels served similar functions. The hieratic inscriptions found on many of these vessels suggest they were used to store or possibly transport a variety of locally produced goods: most importantly wine, but also beer, honey, milk, fats, meats, fowl, fish, grains, fruit, gum and incense (Wood 1987: 76 for refs; see also Lesko 1996: 220–228 for New Kingdom wine labels; Aston 2007 for honey). It is worth recalling at this point that Egyptian tomb paintings not only show wine production scenes, including their 'bottling' into Egyptian Jars, but also the sea transport and unloading from ships of what appear to be Canaanite Jars, or their Egyptian equivalents (James 1985: 14–15, fig. 11; Shedid and Seidel 1996: 66–68; Davies 1935: pl. 15; Davies and Faulkner 1947: pl. 8). In terms of their likely role as MTCs, it should also be noted that Egyptian Jars have been found not just on Crete at Kommos but also on Cyprus at Hala Sultan Tekke and possibly at both Pyla *Kokkinokremos* and Maa *Palaeokastro* (Peltenburg 1986: 165; Eriksson 1995: 203–204). Medium-sized to large (50–90 cm tall) Egyptian Jars have also been found throughout the southern Levant, e.g. in tombs at Akko (Ben-Arieh and Edelstein 1977: fig. 10.9), Deir el-Balah (Dothan 1979: 14, 16) and Ashkelon, and in settlement or related contexts at Beth-Shan, Megiddo and Ashkelon (Martin 2008; 2011: 73–77, figs. 38–39). In Martin's (2011: 253) view, such vessels 'arrived in the southern Levant mainly by sea trade as shipping containers'.

Interestingly, especially for the likelihood that the end of the Bronze Age brought about distinctive changes—not just in the mechanisms of trade, but also in the methods of manufacture and even the production loci of maritime transport containers (see further in Chapter 5, *Discussion: Maritime Transport Containers, Bulk Transport and Mediterranean Trade*), Bourriau (2004: 92) noted that the production of Egyptian Jars had fallen off noticeably by the end of the Third Intermediate period (c. 1070–660 BC), presumably along with the consumption of wine. At Buto, she identified at least seven Canaanite ‘transport amphora’ fabrics alongside the ubiquitous Phoenician wine amphorae, but only one class of Egyptian amphora. Does this, amongst other factors that will prove to be of more interest in this study, reflect the comment of Herodotus (*Histories* 2: 77.4) that the Egyptians imbibed a drink made from barley because they had no vines in their country? It was only in the third century BC—when the Ptolemies actively encouraged wine production in the Delta and Fayyum regions—that Egyptian amphora production was renewed; but this time the prototype was the Greek transport amphora, not the Canaanite Jar.

### **The Aegean: Cycladic Narrow-necked Jars, Oval-mouthed Amphorae (OMAs) and Transport Stirrup Jars (TSJs)**

Before embarking on a detailed discussion of the Transport Stirrup Jar (TSJ), the most common maritime transport container in the Aegean world during the (Late) Bronze Age, it is important to consider to what extent this region was involved in maritime trade in earlier periods. Leonard (1996: 239) once commented that the documented trade between Canaan and Egypt in olive oil or resinous oils and wine, which began as early as the Old Kingdom in Egypt, formed part of an exchange system ‘that may have reached as far west as the island of Crete’. The references he cites, however, all revolve around the Nineteenth Dynasty Egyptian papyrus, the ‘Admonitions of Ipuwer’, which lamented that (Levantine) cedar oil and cedar wood, which had been used as far away as *Keftiu* (i.e. Crete), could not be obtained for mummification and burials (see, e.g. Smith 1965: 5, 10). This document may refer to the First Intermediate Period but is more likely of late Middle Kingdom date, and thus not reliable for Old Kingdom times (Lichtheim 1973: 150). Leaving aside the likelihood of such contacts with Crete (at a time when aspiring elites there had begun to expand their trading horizons beyond the Cyclades to the southern and eastern Mediterranean), or of Egyptian influences on Cretan stone vessel traditions during the third millennium BC (which ‘swims in something of an interpretative soup’—Bevan 2007: 94), what other material evidence is there for early Aegean involvement in the maritime trade of goods packed in pottery containers?

*Cycladic Collar-necked (Narrow-necked) Jars*



*Figure 13* Collar-necked Jar and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

Although Broodbank (2000: 301 and fig. 99) is of the opinion that the Cycladic Early Bronze (EB) I–II Kampos Group bottle ‘represents the first Aegean shape designed for transport of presumably valued liquids’, in our view this is a vessel for domestic use rather than a maritime transport container for liquids (Figure 14). Its small size (height c. 12–13 cm) is more akin to that of the later Mycenaean (small) stirrup jar (Haskell 1985), as compared to that of the Minoan Transport Stirrup Jar, a true MTC.

Thus the earliest known Aegean type of liquid transport vessel that most likely served as an MTC is the EB II Cycladic ‘Narrow-’ or ‘Collar-necked’ Jar, on average 24–25 cm tall, and thus twice the height of most Kampos Group bottles (no previous work has been done on the volume or contents of

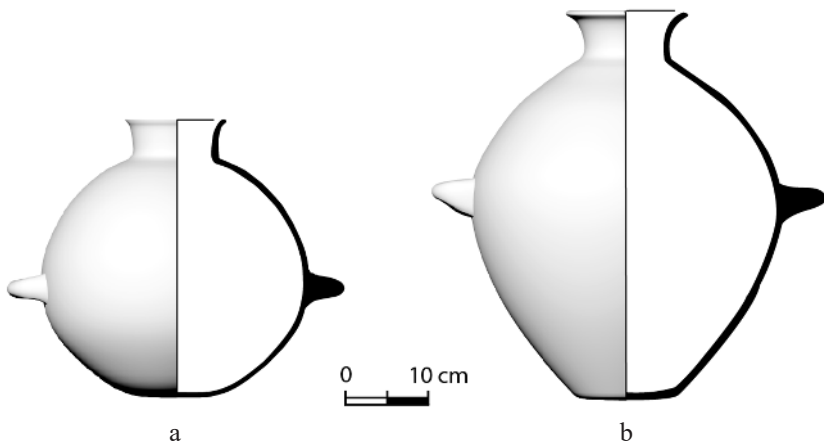


*Figure 14* Cycladic EB I–II Kampos group bottle from Antiparos; ht: 10.16 cm. ©Trustees of the British Museum, Reg. no. 1884,1213.45.

these vessels). Although not uncommon in Early Cycladic, Early Helladic and Early Minoan contexts, their maritime function and purpose tend to be mentioned only in passing. By contrast, work in progress (Day and Wilson 2016) is examining—specifically as transport amphorae—Collar-necked Jars from Poros-Katsambas on Crete, Akrotiri on Thera and Ayia Irini on Kea, highlighting Melian broad-streak painted and white painted/slipped jars from southern Attica, both of which are found widely distributed in the Minoan and Cycladic region.

At least one entire Collar-necked Jar and fragments of others (with strap handles) found at Poliochni on Lemnos have been interpreted as likely vessels for transporting liquids; the same holds true for several *orci*—ovoid, narrow-necked vessels with vertical handles attached at mid-body—found at the same site (Bernabò-Brea 1976: 266–269, pls. 213–214). From the site of Skaros on Ios (south-central Cyclades) come several examples of both imported and locally made Collar-necked Jars (Marthari 2008: 79–80, fig. 9.18) (Figure 15a–b; see also Appendix, Table A1: nos. 1–3). Similarly, imported examples (termed ‘two-handled container jars’) were recovered from Early Cycladic II–III levels at Korfari ton Amygdalion on Naxos (Angelopoulou 2008: 151, 155 fig. 16.5:5–6, 157 fig. 16.6:7). At Lerna (III = Early Helladic II), very similar forms of these jars are regarded as water-carrying vessels (Wiencke 2000: 563–565, types 2, 5 and 6); other parallels are noted from central and southern Greece (Wiencke 2000: 567–568).

Amongst the 124 clay sealings found in the House of Tiles at Lerna, at least 9 may have been used to cover the mouth of a jar (Heath 1958: 97–99: type D; see also Pullen 1994). Sealed Collar-necked Jars have been found in the cave of Zas on Naxos (Zachos and Dousougli 2008). At Petri, Corinth, 255 fragments



*Figure 15* Cycladic Collar-Necked Jars. a) from Skarkos, Ios (after Marthari 2008: 80, fig. 9.18); b) from Korfari ton Amygdalion, Naxos (after Angelopoulou 2008: 155, fig. 16.5). Drawings by Irini Katsouri.

of approximately 100 clay seals were recovered, some around Collar-necked Jars (Kostoula 2000: 138–139, figs. 2a, b). Evidence of successive sealing episodes, and the fact that these seals were associated with storage jars (*pithoi*) as well, is indicative of a sealing practice that is not exclusive to maritime transport. Although the association of these sealings with the Collar-necked Jars found at the site is uncertain, taken together they may point to a practice of sealing the mouths of closed vessels—whenever they were used as transport containers—in order to protect their contents.

More importantly, one variant of these Collar-necked Jars—several with broad, sharply curved, vertical strap handles, some of which are stamped—formed a significant part of the cargo on the Early Helladic (EH) II wreck found at Dokos (Papathanasopoulos et al. 1995: 20–21). Survey of another EH II–III shipwreck has recently been reported from the bay of Yagana, some 40 m off the coast in the channel between the Ionian islands of Ithaka and Kefallonia (Evangelistis 2000; n.d.; Dellaporta 2011: 21). The cargo of this wreck consists primarily of ‘large vessels of closed shape’, some 40 cm in height). They are termed ‘*hydria*’ because they bear the characteristic three handles of these water jars (two horizontal handles and a small vertical strap handle), but otherwise they indisputably share the features of Collar-necked Jars (Evangelistis 2000: figs. 20–21; Dellaporta 2011: 21 fig. 2) (Figure 16).

Petrographic analyses on Kampos Group material (e.g. from Early Minoan [EM] IB Aghia Photia, Gournes, Poros) indicated that most of the ‘Cycladic-style’ pottery found on Crete at that time was not imported, but made locally by potters well versed in Cycladic traditions (Day et al. 1998; Wilson et al. 2004: 69; Wilson et al. 2008: 262; Day et al. 2010: 214–215). The ‘Cycladic-style’ pottery

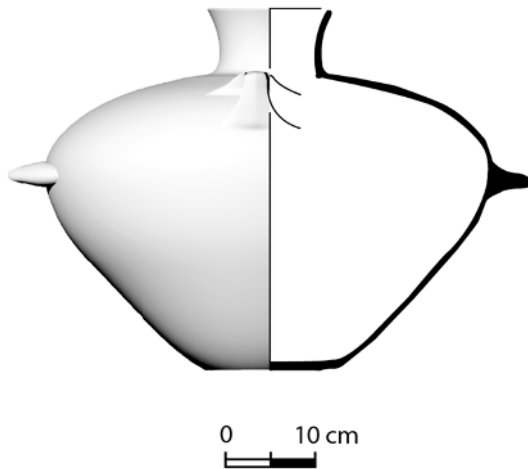


Figure 16 Yagana ‘*hydria*’, from Yagana wreck deposit (Ephoria of Underwater Antiquities, Inventory no. BE 2009/9-2). Courtesy of Dionisios Evangelistis. Drawing by Irini Katsouri (after the original).



from Poros dated to the following, EM IIA period, however, was indeed imported, and in great quantities, with over 400 vessels thus far identified (Wilson et al. 2004: 71; 2008: 265–266, fig. 26.4; Dimopoulou-Rethemiotaki et al. 2007: 90). Most of these vessels—up to 90% of the imports—are Collar-necked Jars, presumably sought for their contents (Brogan 2013: 557 and n. 26). According to Dimopoulou-Rethemiotaki et al. (2007: 89; see also Day and Wilson 2002: 153; Wilson et al. 2008: 269), these vessels, all with collars and grooved horizontal or broad-strap handles, were best suited for the transport of liquids in large quantities from the Cycladic islands. In Broodbank's (2000: 305–306) view, they may have held 'a more precious, socially significant and probably alcoholic beverage'.

Unlike their predecessors (the EM IB Kampos material), which moved around the island in small amounts, most of the EM IIA jars were uncovered at Poros, although some also reached Knossos (Dimopoulou-Rethemiotaki et al. 2007: 90; Wilson 1994: 40). Petrographic analyses suggest that the jars were produced in the central and western Cyclades (e.g. on Thera, Melos, Siphnos, Kea), with a local version deriving from north central Crete (Wilson et al. 2004: 71–72; 2008: 265; Dimopoulou-Rethemiotaki et al. 2007: 90). Thus it seems that the port at Poros-Katsambas served as the major conduit for (EM IIA) imported Cycladica, including the typical 'sauceboats' as well as a large amount of obsidian (Dimopoulou-Rethemiotaki 1993: 458; Dimopoulou 1997: 433–434).

Beginning in EM IIA (c.2650–2450 BC), therefore, the movement of Collar-necked Jars (and their contents) in some quantity within the Cyclades and beyond to Crete points to the earliest use of what we would define as an MTC in the Aegean (also Day and Wilson 2016). The identification of this vessel as an MTC is further corroborated by the fact that the jars made up nearly 30% of the identifiable sherds (well over 500 of them) on the EH II shipwreck from Dokos (Papathanasopoulos et al. 1995: 20, figs. 2–3), and were the principal finds from the survey on the EH II–III Ionian wreck at Yagana (Dellaporta 2011: 21). Beyond the work cited above, however, no further petrographic or chemical analyses have been done on any of the mainland or Cycladic examples.

Our purpose here (and in the following section on Oval-mouthed Amphorae) is not to exhaust the published corpus of these vessels, but rather to provide indicative examples in order to classify them—based on their size, form and distribution/contexts—as MTCs. In this case, the date of the Collar-necked Jars (EB II) seems to coincide with the emergence of a regular system of maritime trade in the Aegean world (Wilson 1999: 235), stemming in part from the Cyclades, but also involving Crete and the Greek mainland (Broodbank 2000: 261; Renfrew 2010: 289; Broodbank 2013b: 539–540; Day and Wilson 2016; see also Marthari 2008: 82–83, with map [fig. 9.19] suggesting links of EB II sites along possible maritime routes via Ios). The appearance of MTCs in the Aegean also coincides to some extent with developments in the EB II–III southern Levant, where we see the emergence of vessels—loop-handled, with thickened walls and bases, an elongated body, and a shaped rim—well suited to long-distance seaborne trade in the eastern Mediterranean. As already noted,

the Metallic Ware jars and jugs shipped to Egypt during the EB II period probably bear witness to much broader systems of maritime exchange, to which these Aegean vessels may now be added.

Given that the Cycladic islands are widely regarded as being instrumental in Aegean trade and exchange throughout the Bronze Age (e.g. Horden and Purcell 2006: 734; Papageorgiou 2009: 216; Knappett and Nikolakopoulou 2014), we might consider briefly what became of this EB Cycladic network, or if there was ever a Middle Bronze Age successor to the Collar-necked Jar. In Rutter's view (pers. comm., April 2015), one possible contender is the Middle Cycladic II 'barrel jar'. The latter were manufactured in several islands of the central and western Aegean (e.g. Melos, Thera, Aegina and Kea), and distributed widely on the eastern Greek mainland from the northern Peloponnese to coastal Thessaly (e.g. Barber 1987 139–141, fig. 102; Siedentopf 1991: 19–21, pls. 21–25 ['kleine Pithoi' only]; Nikolakopoulou 2007: 349–354). These vessels, ranging between 18–49 cm in height, may well have held agricultural produce, but seem unsuitable for liquids such as olive oil or wine: the 15–30 cm-diameter rim, far too wide for an MTC, would have had to be secured with a lid (perhaps by means of the multiple perforations seen in the rim of some examples). If indeed they functioned as both storage and transport vessels, in the latter capacity they occur widely—not just on several Cycladic islands and on the Greek mainland, but notably at the key Middle Helladic *emporion* at Kolonna on Aegina (see various papers in Felten et al. 2007; Klebinder-Gauß and Gauß 2015: 77–82), which played a key role in Middle Cycladic, Helladic and Minoan pottery exchange (Lindblom 2001; Tartaron 2013: 220–232).

### ***Oval-mouthed Amphora (OMA)***



*Figure 17* Oval-Mouthed Amphora and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

The literature on Aegean Bronze Age pottery generally uses the term 'amphora' to describe different kinds of closed vessels with two handles, either horizontal or vertical. The amphora had become a common Minoan ceramic shape by the time of the transition between MM IIB and MM III (around 1750–1700 BC, the transition between the Protopalatial and Neopalatial periods); the Oval-mouthed Amphora is well documented at this time in various contexts on Crete (Betancourt 1985: 100, 105, pls. 12B–C, 13F). Although their function has not been discussed widely, most are considered to be storage or table vessels.

Along with the Cycladic collar-necked jar, the Oval-mouthed Amphora (OMA) is one of the earliest vessel types in the Aegean repertoire that has most of the characteristics representing what we describe as an MTC (Figure 18). Fitton et al. (1998: 131) remarked some time ago that this vessel ‘could have been adapted for transport’ in foreign trade. The most common types have an ovoid or piriform body, a short tapering neck, and two thick, wide, strap handles. Excepting Pratt’s (2016) recent work, no systematic study of the OMA and its likely function has yet been published, which has made it difficult to produce sound conclusions concerning its use as a transport or storage container. Betancourt (1990: 31, 39–40, emphasis added), for example, maintained that the OMA was ‘the most common *storage* vessel during the MM IIA period’ (beginning *c.* 1875 BC), and that during MM III (*c.* 1750–1700/1675 BC) it ‘was still popular but it shared its role as storage container with the pithoi’.

The most distinctive feature of the OMA is its flaring mouth, which would have lost its round shape with the addition of the two handles during manufacture; it could have served very well for stoppering. The position of the handles would have facilitated tying strings or cords to secure the clay stopper (Levi and Carinci 1988: 40). One such stopper was found in Room 15 at Ayia Irini on Kea, and was most likely associated with an OMA (Davis 1986: 58, no. AA62 [amphora], 60, no. AA106 [stopper], pl. 68; see also p. 82). According



*Figure 18* Cretan Oval-mouthed Amphora, Knossos Temple Repositories; ht: 42 cm, wt: 4 kg. ©Trustees of the British Museum, Reg. no. 1906,1112.90.

to Poursat and Knappett (2006: 153), at Malia on Crete all the OMA found had 'a restricted mouth making them highly suitable for transporting liquids, notwithstanding the existence of a few rather large and bulky examples better suited to storage than transportation'.

OMAs have been found at many sites on Crete and, most importantly, at several sites beyond the island, including the Greek mainland. Within Crete, they have been recovered from excavations at sites including Malia, Knossos, Kommos, Phaistos and Myrtos (Poursat and Knappett 2005; Macdonald and Knappett 2007; MacGillivray 1998: 130, 157, pls. 48:166, 116:740–741, 145:A–C, 150:1010; Betancourt 1990: 76 no. 178, 79–80 nos. 215–216, 98 no. 474, 119 no. 755, 158 nos. 1254–1257; see also figs. 16:178, 24:474, 36:756, 51:1255, 1257; Rutter and Van de Moortel 2006: 339–340; Warren 1972; Levi and Carinci 1988; Walberg 1987: 134–135, type 16).

To take what is perhaps the most informative example, excavations in Protopalatial (MM IIB) levels at Malia on Crete (Quartier Mu) have divulged 91 whole OMA and hundreds of others represented by sherds (Poursat and Knappett 2006: 153). These have been divided into three principal shapes: ovoid-conical, ovoid-concave and *amphoriskoi*. The standard form ('Type 2') of the ovoid-conical examples typically held 10–15 litres and, based on petrographic analyses (Poursat and Knappett 2006: 154 n. 1), was manufactured over a wide area of east and east-central Crete, the south coast (around Myrtos), the Mirabello Bay area and at Malia itself. 'Types 4 and 5' of the ovoid-conical examples seem to have been made exclusively at Malia. 'Type 1', by contrast, is a form brought in from the Mesara plain (south coast). The ovoid-concave examples—similar to the 'tipo allungato' found at MM III Phaistos (Levi and Carinci 1988: table 32:f–i)—were much smaller, with a capacity of only 4–5 litres; typically these examples originated in the Mirabello Bay area ('Type 3a'), although some ('Types 3b–c') were manufactured locally around Malia. The *amphoriskoi*—strictly local products—had a capacity of only 1–2 litres, and should not be considered as MTCs for bulk transport. Poursat and Knappett (2006: 156) concluded only that, during the Protopalatial period, Malia imported substantial amounts of liquid commodities from the south coast and Mirabello areas, less so from the Mesara.

OMAs from Crete, termed 'storage' vessels, were widely exported to Akrotiri, Thera, especially in Phase C deposits (c.1800–1750 BC) (Nikolakopoulou 2009: 34). Elsewhere, Knappett and Nikolakopoulou (2008: 7–9; 29 no. 9435) refer to local imitations or adaptations of these same amphorae as 'transport' vessels. Most of these OMAs are decorated with motifs very common in Thera (Marinatos 1969: 38, pl. 23; 1971: 35, and pls. 66a–b, 67a; 1976: 29, and pl. 43d). One had a double-axe incised on its shoulder before firing (Marinatos 1971: 45, and pl. 110a); another, undecorated one was found in the West House with a stone lid on it (Marinatos 1974: 32, and pl. 74c). OMAs have also been found on the Greek mainland in MB contexts at Lerna (Jeremy Rutter, pers. comm.).

A notable group of 47 Oval-mouthed Amphorae also formed part of the cargo of the MM IIB (c.1800–1750/1700 BC) wreck deposit found off the island of Pseira, Crete (Hadjidaki, pers. comm.). The OMAs found there are described as one of the most common ‘maritime containers in Minoan Crete’ (Hadjidaki and Betancourt 2005–06; Bonn-Muller 2010). More recently, another wreck site with OMAs and jugs amongst its cargo was discovered at Koulenti off the Laconian coast in the Peloponnese (Spondylis 2012) (Figure 19); see also Appendix, Table A1: nos. 6–7).

Even farther afield, from excavations in Egypt at the location ‘Ezbet Rushdi (about 1 km north of the main excavations at Tell ed-Dab’a), come at least ten fragments of OMAs—including five body sherds, a rim and three handles (Czerny 1998: 46, fig. 21; Bietak and Marinatos 2000: 40). Marcus (2007: 162–164, with further refs.) suggests that these containers could have been used to transport liquids, resin and ointments, or dry goods—from the Aegean to Egypt—around the time represented by the Mit Rahina inscription of Amenemhet II (c.1911–1877 BC) (discussed above, under *The Levant: Canaanite Jars*). At that time, ‘Ezbet Rushdi likely served as a Deltaic port for the transshipment of foreign goods.

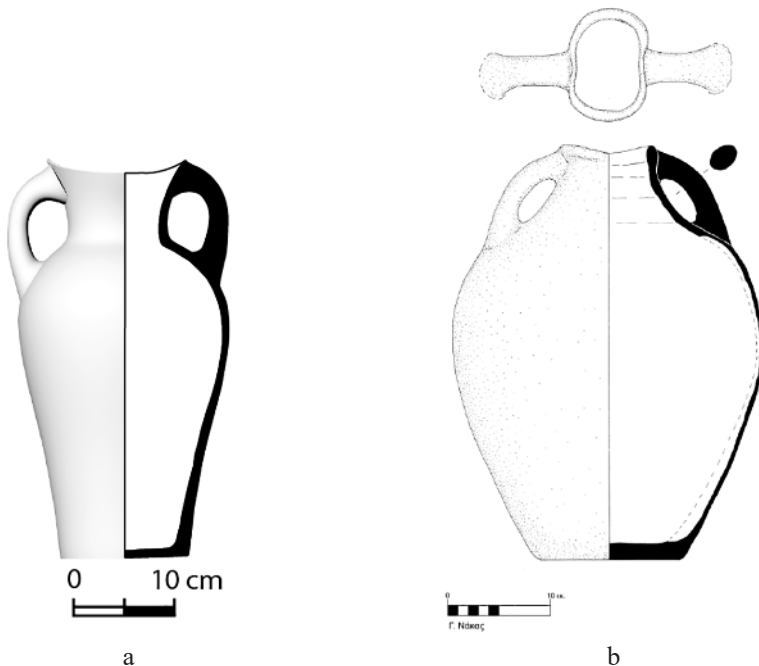


Figure 19 Oval-mouthed Amphora. a) from Pseira (Crete) wreck deposit (after Hadjidaki 2004: 46, fig. 2). Drawing by Irini Katsouri; b) from Koulenti (Laconia) wreck deposit (Inv. no BE 2009/3-3). Courtesy of Elias Spondylis. Drawing by Y. Nakas.

As was the case with the Cycladic Collar-necked Jars, our purpose here is not to present an exhaustive list of these vessels, only a sufficient number of examples to demonstrate their likely function as MTCs. In particular, what Poursat and Knappett (2006: 154) define as their ‘Type 2’ (ovoid-conical), which held 10–15 litres and was produced over a wide area of eastern and central Crete, stands out as an MTC. Also found in two MM shipwreck deposits (Pseira, Crete; Koulenti, Laconia), the appearance of these vessels in MM II–III (*c.* 1875/1850–1700/1675 BC) coincides in large part with a shift in the design of Levantine MTCs, from a flat to a more rounded base, which made the Canaanite Jar much more suitable as a vessel for transporting liquid commodities over long distances. By the end of the Middle Bronze Age, new types of buildings appeared—‘patrician houses’ in the Levant, ‘villas’ or ‘town houses’ in the Aegean—with substantial storage and working areas that may have been devoted to oil and wine production (Papademetriou and Kriga 2013: 14, with further refs.). Could such production have been geared for the seaborne transport of oil and wine in the increasingly standardised Canaanite Jars or in Minoan OMAs (or, perhaps, in the slightly later TSJs)? The OMA may not represent the same level of technological or economic innovation as the Canaanite Jar, but it should be regarded as a material representation of an economic reorientation to longer distance seaborne trade within the Aegean world, and beyond that to Egypt if not western Anatolia. The same reorientation is also indicated by the fragmentary remains of Canaanite Jars imported to Protopalatial Knossos (MacGillivray 1998: 106), already noted above.

### *Transport Stirrup Jars (TSJs)*



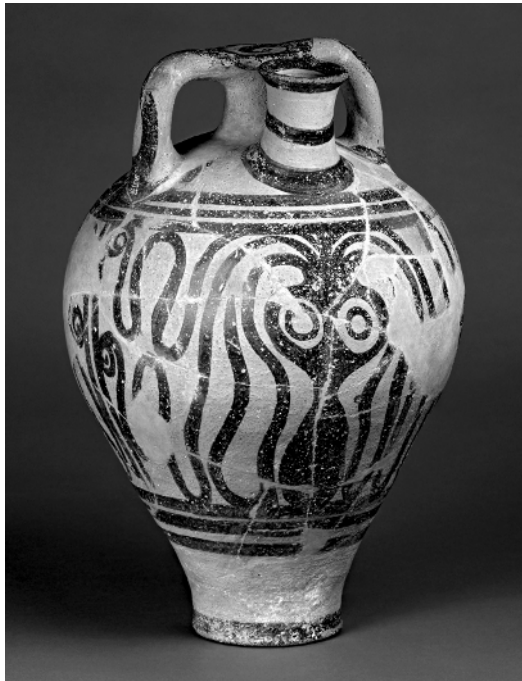
*Figure 20* Transport Stirrup Jar and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

Turning now to Transport Stirrup Jars (TSJs), the recent study by Haskell et al. (2011: 1) provides a useful description:

The transport stirrup jar ... was a vessel type used extensively in the Late Bronze Age III Aegean world. Found in a variety of contexts from domestic deposits to cargoes in ships’ holds (and only rarely in tombs), the type was used both to transport and to store liquid commodities in bulk.

The TSJ corresponds to Furumark shape FS 164 (Furumark 1972: 36 fig. 8, 39). According to him, all ‘conical and piriform’ shapes are of Minoan origin (Furumark 1972: 19). On average, the TSJ is about 40–50 cm in height and has a maximum diameter of 27–35 cm, with a volume ranging between 12–18 litres (Ben-Shlomo et al. 2011: 334). Its closed shape has a narrow, permanently capped, false neck; vertical ‘stirrup’ handles on both sides of this neck extending down to the shoulder; and an open spout (5–7 cm in diameter) set into the shoulder (Figure 21). This narrow, open spout could be closed easily and securely for sea transport or long-term storage: a clay plug fitted neatly into the top and a clay cap could be pressed over the plug and around the outside of the spout (Haskell et al. 2011: 3, fig. 1.2).

With the production, development and use of the TSJ, we have a vessel—like the Canaanite Jar—that fulfils all the criteria deemed crucial for an MTC. Day et al. (2011: 518) suggest that the TSJ played the same role in the Aegean as the Canaanite Jar did throughout the Levant, Cyprus and Egypt. And, just as the Canaanite Jar was evidently produced at several sites throughout the Levant, including Cilicia and Egypt, so too the TSJ seems to have been manufactured in more than one centre throughout its zone of principal use—but in particular on Crete, and especially in western, central and southern Crete.



*Figure 21* Transport Stirrup Jar, Late Minoan III, from Episkopi *Bamboula*, Cyprus, ‘Site D’, tomb 50; ht: 45 cm, wt: 4 kg. © Trustees of the British Museum, Reg. no. 1896,0201.265.

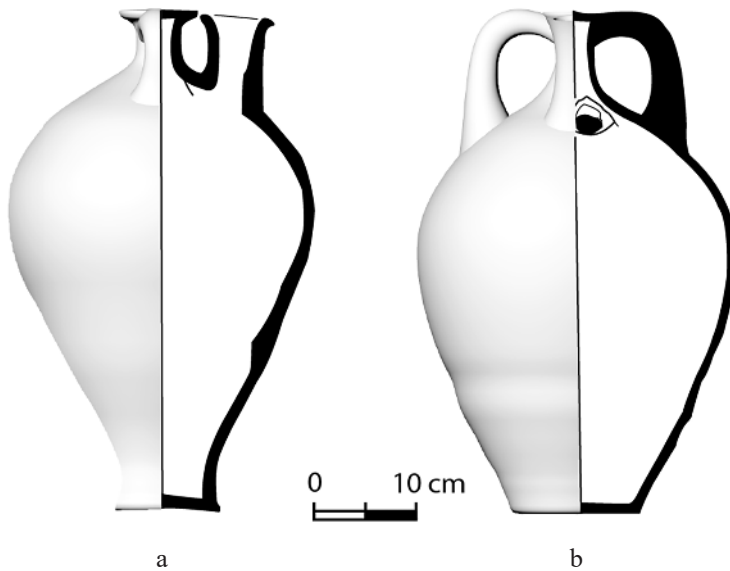


TSJs formed a regular component in the repertoire of Late Bronze Age (LBA) ‘coarse’ wares, but many of those produced in Greece could be classified as fine wares (e.g. Thomas 2005; Haskell et al. 2011: 122). They appear at almost every major site, typically in large numbers on both Crete and the Greek mainland (in the latter, usually in palatial storerooms, e.g. at Thebes, Mycenae, Tiryns). In Greece they also appear at Midea, Orchomenos, Eleusis, Athens, Sparta (Menelaion), Tsoungiza, Mitrou, Zygouries, Aigeira and Pylos, and in the Dodecanese at Ialysos on Rhodes and Pigadia on Karpathos.

Although earlier excavators likely discarded substantial amounts of coarse ware sherds in general (e.g. at Knossos—Hallager 1977:60–71), Haskell et al. (2011: 1; see also Ben-Shlomo et al. 2011) still estimate that over 500 TSJs are known from contexts throughout the eastern Mediterranean. Leonard (1994: 46–50, 197–199), writing much earlier, tallied only 23 examples of TSJs, i.e. FS 164—or, including FS 165–167, 29 additional examples. Especially significant is the wide distribution of TSJs at coastal sites (see, e.g. Lolos 1995: 77–78; Ben-Shlomo et al. 2011: 335–336), mainly in the Aegean but with notable numbers on Cyprus (110 examples) and in the Levant (over 70 examples, most from Tell Abu Hawam—Ben-Shlomo et al. 2011: online appendix; see further below). Smaller amounts turn up in Anatolia (e.g. at Troy, Miletos) and in three LBA wreck deposits. There are a few in south Italy (Scoglio del Tonno, Rocavecchia, Leporano), on Sardinia (Antigori) and Sicily (Cannatello), and one from the Aeolian island of Filicudi (Vagnetti 1991: 279, no. 85, fig. 4b). TSJs have been recorded at both Marsa Matruh (4) and Zawiyet um el-Rakham (4) along the north African coast (Russell, in White 2002: 7–8, nos. 7.14–17; Snape 2003: 67–68, fig. 4; Snape and Wilson 2007: 59, fig. 3.22). In Egypt proper, a complete vessel is known from Tomb 59 at Sidmant while fragmentary examples are reported from Qantir and Deir el-Medina (Ben-Shlomo et al. 2011: 336, with refs.).

According to Haskell (1985: 223, 225), TSJs began to be exported (within the Aegean) almost immediately after their earliest appearance, c.1700–1500 BC; if so, they may have been designed specifically for trading purposes. Hamilakis (1996: 22–24) has suggested that their introduction on Crete may be associated with the systematic production of (olive) oil. Certainly by the fourteenth century BC, they had become the Aegean MTC of choice. Unlike Canaanite Jars (not found on the Iria wreck), TSJs formed part of the cargoes of all three well-known LBA shipwrecks (Cape Gelidonya, Point Iria and Uluburun) (Figure 22; see also Appendix, Table A1: nos. 13–14).

Although there are two Linear B signs taken to represent amphorae (A-PI-PO-RE-WE, the Mycenaean form of ἀμφιφορεύς) and stirrup jars (KA-RA-RE-WE), there is little to be learned from the Linear B corpus beyond their likely storage functions within a palatial system (Ventriss and Chadwick 1973: 324–328, fig. 16). One Linear B tablet from Knossos (KN K 700), for example, lists 1800 stirrup jars, but whether these were small vessels (1–2 l. capacity) or larger transport jars (12–14 l. capacity) is unclear (Shelmerdine and Bennet 2008: 304). Nonetheless, the Linear B inscriptions painted (before firing on about



*Figure 22* Transport Stirrup Jars. a) from the Uluburun shipwreck, no. KW 255 (after Abdelhamid 2013: fig. 7.1); b) from Point Iria wreck deposit, no. A86 (after Lolos 1996: 24, fig. 5). Drawing by Irini Katsouri.

180 ‘inscribed stirrup jars’ (ISJs), almost all found in the Aegean (Judson 2013: 69, nn. 2, 4; note also the often overlooked examples from Tiryns—Sundwall 1915; Pakkanen 2014), may point to various aspects of transport or ‘communication’ (Catling and Millett 1965; Catling et al. 1980; Killen, in Haskell et al. 2011: 2, 91–107; Judson 2013: 69–70). The inscriptions might have identified who was responsible for the jars and/or their contents, and perhaps their origin, but not their destination (Palmer 2003: 131). Van Alfen (2008: 238) and Zurbach (2006) regard the inscriptions as part of a Minoan administrative recording system that kept track of the (mainly) oil producers who provided goods to the palaces. Based on their relative scarcity vis-à-vis uninscribed examples, the preponderance of personal names, and their find contexts, Driessen et al. (2015; following Duhoux 2010), suggest that the ISJs served as elite ‘guest-gifts’, identifying the person who made a gift of the vessel and/or its contents. Because the inscriptions were added pre-firing, they may have been intended to be associated permanently with the vase rather than with its contents (Duhoux 2010: 58, 64). Finally, we also note here the absence of ISJs from Mycenaean tombs, which in this respect stands in contrast to Canaanite Jars (Jeremy Rutter, pers. comm. April 2015).

While the archaeological and Linear B evidence is far from conclusive about the ISJs’ contents, it suggests that at least some of them contained high-quality (perfumed?) oil, others wine (Haskell et al. 2011: 5, with refs.), still others olive oil (Day 1999: 69; Palmer 2003: 131–132; Judson 2013: 69 n.2). One transport

stirrup jar found on the Uluburun shipwreck held a potpourri of seeds, stone beads, faience and orpiment—a mineral used as a pigment for dyeing or tanning (Bass et al. 1989: 11; Pulak 2008: 294).

Although no systematic programme of ORA has been conducted on TSJs, two vessels from Khania on Crete reportedly contained traces of resinated wine, as did a Canaanite Jar from Mycenae (Tzedakis and Martlew 1999: 157, 173). If that (disputed) assumption is correct, then these vessels could have formed part of a systematic trade in wine, beer and honey mead, or a mixture of such fermented beverages (Tzedakis et al. 2008; Haskell et al. 2011: 5). Indeed, Linear B documents suggest that both Minoan Crete and contemporary polities in mainland Greece produced a range of wines, and traded them within the Aegean, in one case involving up to 12–14,000 litres (Palmer 1994; 2000). Just how much of this early Greek wine trade involved TSJs is uncertain, but as a range of provenance work shows, these containers circulated widely in and beyond the eastern Mediterranean.

*Provenance Work* The results of carefully coordinated typological, chemical (AAS, INAA) and petrographic analyses suggest that, regardless of their find-spots, the majority of the ‘canonical’ TSJs were produced in western, central and south-central Crete (Mesara plain), with a few deriving from east Crete (Haskell 2005; Haskell et al. 2011; Day et al. 2011). This pattern would seem to confirm much of the earlier analytical work carried out on these vessels (Haskell et al. 2011: 41, 77, 85, 127; Ben-Shlomo et al. 2011: 338). West and central Cretan TSJs and ISJs were exported primarily to mainland sites, in particular to Thebes, Tiryns and Mycenae (Haskell et al. 2011: 123). TSJs manufactured in south-central Crete also turn up in the assemblages at Thebes and Mycenae (Day and Haskell 1995). East Crete produced a few transport-sized stirrup jars, mainly for local use, and possibly some for export to the Dodecanese. Maran (2005: 427–429) and Stockhammer (2008: 276–278) have suggested that Cretan TSJs represented tribute shipped directionally to certain Argive and Boeotian (but not Messenian) centres on the mainland. A Late Minoan IIIB TSJ from Sidon in Lebanon, with Linear B signs possibly painted on its shoulder, was analysed by INAA and assigned a probable origin in the western region of Khania (Karageorghis 2008, citing analysis by H. Mommsen; Doumet-Serhal 2013: 133).

Petrographic and INAA analyses of 18 TSJs from Kommos indicate that the majority came from central or south-central Crete and were most likely produced in the Mesara plain; the four exceptions point to production in west or east Crete (Day et al. 2011: 546–547, and fig. 10; see further discussion below). Mainland Greek production of TSJs was perhaps not on the same scale, but ten large examples from Zygouries in Corinthia seem to have been manufactured locally (Haskell et al. 2011: 122). At least one petrographic group (Fabric 6) analysed could not have originated on Crete, while other groups were assigned sources in Greece near Boeotia (Fabric 5), the Argolid (Fabric 17) and on the island of Kythera (Fabric 24) (Haskell et al. 2011: 77–78, and table 17). Work

in progress by Peter Day and a team from Tiryns indicates multiple mainland production centres (as well as on Kythera), and once published may alter significantly our understanding of the production and distribution of TSJs (Peter Day, pers. comm., 15 December 2014). In this light, it is worth noting that Pakkanen (2014) suggests that 17 ISJs from Tiryns, 7 from Thebes (plus 4 uninscribed jars) and 1 from Khania may be attributed to a single (Tiryns) workshop (see also Bennett 1986: 136–140).

Again in petrographic terms, the eight coarse ware TSJs recovered from the Iria shipwreck were manufactured, most likely from a single source, in (south-) central Crete (Lolos 1999: 45; Day 1999: 65–67). Ten examples from the Uluburun shipwreck were manufactured in a variety of locations—different fabric groups from western and central Crete, and two apparently non-western and non-southern Aegean sources (Day 1999; Haskell et al. 2011: 78, table 27). The two analysed TSJs from the Cape Gelidonya wreck were enigmatic; only one *could* have been produced on Crete. Could these ‘non-Aegean’ sources possibly represent the products of coastal western Anatolia?

A single example of an inscribed, coarse ware TSJ, from Kourion (Episkopi) *Bamboula* on Cyprus, was assigned a west or central Cretan origin (Palaima et al. 1984: 68–69). TSJs found at several other sites on Cyprus (Akanthou *Moulos*, Athienou, Dhenia *Kafkalla*, Enkomi, Kition *Bamboula*, Hala Sultan Tekke, Kalopsidha, Kazaphani, Nitovikla *Korovia*, Kourion, Kouklia *Mantissa*, Stephania, *Toumba tou Skourou* and Pyla *Kokkinokremos*), most of which were analysed by both AAS and petrography, probably originated in central or western Crete. The same holds true for two examples found at Antigori on Sardinia, while two examples from Cannatello on Sicily are associated only with central Crete (Day and Joyner 2005). From the Levant, Haskell et al. (2011: 115–118) report on three TSJs from Minet el Beidha, two of which came from west or central Crete (or Boeotia) and one from the Argolid; one vessel from Ras Shamra may have been made locally. Of two examples from Tell Abu Hawam analysed by Haskell et al. (2011), one came from central Crete (or Boeotia) while the provenance of the other was uncertain. The medium-sized TSJ from Sidmant in Egypt (noted above) was also of uncertain provenance.

Other, thin-section petrographic analyses were conducted on 36 samples of TSJs from Late Bronze Age sites in Israel: 24 from the harbour site of Tell Abu Hawam, the remainder from Ashkelon, Ashdod, Akko and Deir el-Balah (Ben-Shlomo et al. 2011: 340, table 1). Of the five groups established by petrographic analyses, Fabrics 1–3 represent production on Crete; Fabrics 4 and 5 indicate production elsewhere. Six samples could not be assigned to any group (Ben-Shlomo et al. 2011: 341). Nearly 60% of the (coarse ware) TSJs from Tell Abu Hawam, and a few of the other examples from Ashkelon, Ashdod and Akko were assigned an origin in central or south-central Crete. Several other production centres are indicated by analyses on the other ten samples from Tell Abu Hawam and the remaining samples.

On present evidence, there are only two ISJs known from the eastern Mediterranean (both noted above), one from Sidon on the Lebanese coast (with

a possible painted Linear B inscription—Karageorghis 2008), the other from Kourion on Cyprus (Palaima et al. 1984). There are also about 35 medium-sized ISJs from the Argolid or Crete with incised signs (on one or both handles). Some scholars have argued that these signs were incised before firing and the vessels then exported to Cyprus or the Levant (Döhl 1979; Haskell et al. 2011: 128). According to Hirschfeld (1993: 312, 315; 1996: 291–293, and see below), however, these Argolid or Cretan transport vessels were incised with signs (primarily Cypro-Minoan) after firing (Hirschfeld 1993: 312). Ben-Shlomo et al. (2011: 339 and n. 88, 343 nn. 107–109) mention that two or three examples of TSJs from Tell Abu Hawam had incised marks (on their handles—see online appendix to *AJA* 115 [2011]), but exactly what these marks represent is unclear. In general, one must assume that such post-firing marks referred to those who handled the products in the course of their distribution or, less likely, that they were intended to identify the producers and thus the products themselves.

Two of the coarse ware were Aegean stirrup jars found at Zawiyet um el-Rakham in western Egypt have what appear to be Cypro-Minoan marks on their handles (Snape 2003: 67–68, fig. 4). Four ISJs from the Uluburun shipwreck, both of Aegean and uncertain origin, also had Cypro-Minoan signs incised on their handles after firing (Day 1999: 68; Haskell et al. 2011: 130). Four Cretan ISJs (from Amnisos, Knossos, Kommos, Tripiti) were incised with signs after firing; the vessel from Amnisos and two (handles) from Kommos may have Linear B rather than Cypro-Minoan signs (Hirschfeld 1993: 312, 316–317, nn. 11, 14; Bennet 1995: 316 no. 7, 317 no. 13). One TSJ recovered in excavations on the island of Salamis in the Saronic Gulf has two horizontal, parallel incisions made after firing, which may be related to the Cypro-Minoan script (Lolos 2003: 113, fig. 24). It should also be noted here that several Canaanite Jar handles from Hala Sultan Tekke *Vyzakia* and at least one from Maa *Paleokastro* bear incised Cypro-Minoan signs (Karageorghis and Demas 1988: 162, pl. CCXX: 3; Ben-Shlomo 2014: 127–128, with refs.), as do several other Canaanite Jars from other Cypriot sites (see Table 1, above). Even so, the distinction between the marks on all these jars and ISJs is not clear (Hirschfeld 2002: 92–93). Eleven Canaanite Jars (six handles, five shoulders) from the Uluburun wreck also have incised marks (Nicolle Hirschfeld, pers. comm., November 2014).

Day (1999: 68) suggests that the Cypro-Minoan signs on all these ISJs may indicate that they were re-used, possibly on Cyprus and perhaps when new contents were put into them for re-shipping (Yasur-Landau and Goren 2004 make such an argument for a locally made ‘amphora’ from Tel Aphek in Israel, whose handle was incised with a Cypro-Minoan sign; see also Hirschfeld 2014b: 266). In discussing the pattern of potmarks on vessels from Enkomi on Cyprus, Hirschfeld (2002: 69–72 table 1, 93) noted that all the marks definitely associated with the Cypro-Minoan script appear on either locally made vessels or Aegean imports; they never appear on Canaanite Jars (also Ben-Shlomo 2014: 27–28). This is an important observation and suggests that those who produced the Canaanite Jars found at Enkomi, at least, were unfamiliar with Cypro-Minoan

or else chose not to use it. In Hirschfeld's (1993: 313; 1996: 291–293; 2014b) view, vessels with clearly made signs incised after firing, most of which are taken to be part of the Cypro-Minoan repertoire, were either shipped to or *via* Cyprus, or were handled by people familiar with the Cypriot marking system. Those found in the Argolid and on Crete, if not marked locally for shipment to Cyprus, may represent vessels that had been sent to or *via* Cyprus earlier, and later shipped back. Ben-Shlomo's (2014: 28–29) analysis (including petrography) of 'jar handles' from Tel Mique, Ashkelon and Aphek suggests that the jars with 'possible' Cypro-Minoan signs were likely produced, and marked, on Cyprus, whilst those with similar marks but produced in the Levant could have been marked either in Cyprus or the Levant. He suggests that the system of marking jars on the handle was clearly linked to 'some small-scale administration or redistribution system in the region' (Ben-Shlomo 2014: 29).

Clearly the meaning(s) that lay behind all these vessels with incised Cypro-Minoan and related signs remain complex and difficult to determine. Nonetheless, it seems logical to assume that merchants (or the equivalent of customs officials) in the receiving ports may have marked these vessels to keep track of offloaded items of cargo, as was the case in later periods (Arnaud 2011: 66). Whatever the reality may have been, because most Bronze–Iron Age marking practices are very unevenly preserved (many with inked or painted labels are subject to degrading), and because most MTCs were probably reusable and/or multi-purpose, it is unlikely they referred to singular contents (Bevan 2010: 63–64), much less to sizes, producers, provenance or even vintages as was the case in later periods (see, for example, several papers in Eiring and Lund 2004).

*Summary* Given their wide distribution in the Aegean, the Levant, Cyprus, Anatolia, Egypt and the central Mediterranean, TSJs clearly played a significant role in the wide-ranging trade systems that characterised the LBA in the Mediterranean. Most examples found beyond the Aegean, whether or not of Cretan origin, were recovered from three LBA wrecks (Gelidonya, Iria, Uluburun), or else at coastal sites and especially in clusters at particular harbour sites (Ben-Shlomo et al. 2011: 346): on Cyprus at Hala Sultan Tekke, Enkomi, Kition and Kourion (Episkopi) *Bamboula*; in the northern Levant at Ugarit and its port Minet el-Beidha; in the southern Levant at Tell Abu Hawam; along the north African coast at Marsa Matruh and Zawiyet Umm el-Rakham; in Italy at Rocavecchia (Apulia), on Sicily at Cannatello and at Antigori on Sardinia.

Ben-Shlomo et al. (2011: 347–348), moreover, observe that just as the known Levantine finds of TSJs are concentrated overwhelmingly in one harbour site, Tell Abu Hawam on the Bay of Haifa, so too most Canaanite Jars found in the Aegean come from the harbour town of Kommos in southern Crete. Furthermore, whereas almost 60% of the TSJs from Tell Abu Hawam analysed by petrography indicated an origin in central or south-central Crete (and thus in the vicinity of Kommos), roughly 30% of the Canaanite Jars found at Kommos were shown by petrographic analyses to have originated south or east of the Bay of Akko



(and thus in the vicinity of Tell Abu Hawam). In other words, it is possible that these two harbours—Kommos and Tell Abu Hawam—may have served as major access points and outlets for the agricultural products of, respectively, Crete's Mesara plain and the southern Levant's Carmel coast and Jezreel valley, 'end terminals' in a widespread eastern Mediterranean system of trade in bulk commodities (Ben-Shlomo et al. 2011: 348).

Yasur-Landau (2010: 205–207) has argued that Tell Abu Hawam was a major *emporion*, a gateway community for the southern Levant; amongst Levantine coastal sites, only Ugarit exceeds the amount of imported Aegean and Cypriot pottery found at Tell Abu Hawam (on a possible Late Bronze Age anchorage at Tell Abu Hawam, see Artzy 2006a: 47–48; 2013: \*10–\*13). Moreover, Artzy and Zagorski (2012: 3) have recently suggested that the harbours of Akko and Tell Abu Hawam might have been partners in very distinctive trade networks. They suggest that the limited number of Egyptian imports and the diversity of Cypriot pottery found at Tell Abu Hawam (Artzy 2006a; 2013: \*15–\*20) might indicate that while Akko's contacts were focused on Egypt (seen both in the Amarna letters and in the wealth of Egyptian pottery found there), those of Tell Abu Hawam served more northerly (Levantine coast) and westerly areas (Cyprus, the Aegean, western Anatolia).

In this light, it is worth noting that Catling long ago remarked that Canaanite Jars represented the 'reverse trade' to that attested by coarse ware TSJs found in the eastern Mediterranean (Lolos 1995: 81). TSJs served as containers for transporting such goods as olive oil and wine, perhaps beer and honey mead (McGovern 2003: 267). Ben-Shlomo et al. (2011: 346; also Rutter 2006a: 653) suggest that these commodities could have been decanted at various harbour sites and redistributed inland in other types of vessels. They point out that more standard types of Aegean and Cypriot household containers or tablewares—traded for their own sake rather than for their contents—often turn up at inland sites in the Levant (e.g. Mühlenbruch 2009; Zuckerman et al. 2010), whereas the TSJs seldom do. The majority of extant examples come either from clusters in particular harbour sites or from the three best-known LB shipwrecks, while others turn up everywhere from domestic deposits to storage rooms, but rarely in tombs.

From its inception at the beginning of the Minoan Neopalatial period on Crete, the TSJ seems to have been designed specifically for trading purposes, and it was used primarily to transport and/or store liquid commodities in bulk. It was only during the Postpalatial era (LM/LH III A-B), however, i.e. after the demise of the Minoan regime and the emergence of Mycenaean influence on the island, that the Cretan TSJ became mass-produced and shipped in bulk to areas around the eastern Mediterranean, including the hundreds found in Greek mainland palatial storerooms and Levantine ports. When the Mycenaean palaces collapsed around 1200 BC, TSJ production suffered significantly. In fact, the few TSJs that continued to be produced on Crete were smaller, squatter and simplified in technique. In addition, if any were shipped off the island after the end of the Late Bronze Age, they were very few in number, and that too



ended within 50 years when TSJ production was abandoned entirely (Maran 2005; Haider 2007).

If Canaanite Jars indeed formed the reverse trade to TSJs, why did they continue to be produced for hundreds of years after the end of the Bronze Age while the TSJ fell out of use almost immediately? One explanation is that TSJs were so bound up with the economy of the Mycenaean era that when those regimes collapsed, there was no longer any incentive (whether palatial demand or commercial enterprise) to continue to manufacture a very complicated and non-versatile vessel (Pratt 2016). In its place, Cretan potters exclusively produced a less complicated and flexible shape—the amphora—that had been used locally on the island all along, and was better designed to do the same basic job.

### **Other Bronze Age Transport Containers?**

Several scholars have suggested that at least four other vessel types may have been used as transport containers, for liquid or other commodities, during the Bronze Age. These are (1) Cypriot *pithoi*, (2) Cretan Short-necked amphorae, (3) Southwest Anatolian reddish-brown burnished jugs and (4) Sardinian *olle a colletto*. For differing reasons, but in particular with respect to their size and shape, we do not feel that these vessel types correspond well with the criteria we have established for MTCs. Nonetheless, because most of them have been found in contexts foreign to their place of production, and some of them on shipwrecks, they certainly could have been used for storage if not transport purposes. We present brief discussion of each type here.

#### ***Cypriot Pithoi***



*Figure 23* Cypriot *pithos* (Group II) and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

Most types of these *pithoi* do not fit the criteria we have set for MTCs, particularly in terms of their size. Moreover, their primary function is widely acknowledged to be storage, not shipping (e.g. Keswani 1989b; 2009; Pilides 2000). Here, Blitzler's (1990) ethnographic study of storage jars made at Koroni in the southern Peloponnese of Greece during the nineteenth and twentieth centuries (AD) offers some potentially relevant observations.

Tracing an impressive distribution of the Koroni storage vessels over much of the Aegean and eastern Mediterranean, Blitzer (1990: 703, fig. 7, 707–709) suggested that this network might help us to understand better the complexity of prehistoric trade mechanisms. Despite the dangers of over-simplification or anachronism, some analogies seem entirely appropriate. The Koronian storage jars were transported along with other goods, especially olive oil and currants, staple products of this part of the Peloponnese. Blitzer (1990: 700–701) describes in detail the different ways that local merchants, well connected to the ships' captains who stopped over at the Koroni port, transported and distributed the storage jars together with smaller ceramic vessels and other local products. In another recent study on *pithoi*, Giannopoulou (2010: 141) also points out that although other storage-jar producing centres existed in the Aegean (e.g. Crete, Siphnos), it was mainly those from Koroni that were widely exported. In a similar manner, storage vessels from France and Italy were also traded throughout the eastern Mediterranean at this time. Such 'foreign' storage jar types are still found today in the storerooms of old houses, often together with locally produced ones (Blitzer 1990: 705; see also Giannopoulou and Demesticha 2008 for jars from Chios).

Blitzer (1990: 704–707) paid particular attention to the reasons behind the popularity of Koroni Type 1 jars in the market, associating it with the involvement of Greek traders (instead of French ones) in the Aegean network and with the rise in demand for olive oil in the Aegean and on Crete. She emphasised that the trade in storage jars declined after the 1920s, when the traffic that traditionally had passed through the Koroni port was taken over by the ports at Patras and Corinth, and when Messinia lost its monopoly over olive oil cultivation in the Peloponnese.

In our view, this ethnographic example demonstrates well the nature and role of a storage jar like the *pithos* in maritime transport. Such vessels are not *designed* for seaborne transportation but they are carried on ships when market conditions are favourable. Because manufacturing storage jars is a demanding task that requires special skills and dedicated kilns (Giannopoulou 2010: 55–77), the export of good quality *pithoi* must always have been welcome. Because of their size, however, stowing them in the hold of a ship leaves a lot of dead space, which diminishes the cost-effectiveness of the trip. Thus the transport of organic goods or fragile fine wares, temporarily stored in robust *pithoi*, should have been advantageous, but this was not the case in Koroni (Blitzer 1990: 701).

Thus we might venture to say, in general, that when *pithoi*-production kilns are located close to a port with good maritime trade connections, their wider distribution within specific networks is encouraged. When those networks change or decline, however, the production of *pithoi* continues in order to fill *local* needs, but they are no longer exported. In this respect, *pithoi* might indeed be used as markers of maritime transportation, but it is the trade of the vessels themselves, not their production, that is sensitive to economic change, as seems to be the case for all MTCs.

Because some Cypriot *pithoi* might have served one function or another in maritime trade, we summarise certain points about them here. While the 4–5 Cypriot *pithoi* from the Point Iria shipwreck may have been empty (Lolos 1995: 73), some of the 9–10 examples found on the Uluburun shipwreck are argued to have been ‘multi-purpose vessels’, used during transport as containers for liquids, pomegranates, possibly figs and ‘probably other commodities’ (Pulak 2008: 296; also Pulak 2001: 40). One of the largest *pithoi* found on the Uluburun wreck (KW 251) in fact was used to store and transport 18 pieces of Cypriot pottery, including White Shaved juglets, White Slip and Base-ring bowls, Bucchero jugs and saucer-shaped oil lamps (Pulak 2001: 41, fig. 3; Hirschfeld 2011: 119); it also contained some scattered fig seeds as well as some small fragments of tin ingots (Pilides 2000: 49). Hirschfeld (2011: 120) suggests that at least three of the ten Cypriot *pithoi* found at Uluburun were used to transport pottery vessels, but that none of them would have been filled with ceramics. Tomlinson et al. (2010: 218) note that four Plain White Cypriot *pithoi* found at Kommos—shown by NAA to have been produced in the Limassol area (one sample), Kition (two samples) and in the neighbourhood of Enkomi (one sample)—may have been filled with some of the small to medium-sized Cypriot table or fine wares found at Kommos.

Cypriot *pithoi* are found at several (excavated) sites on Cyprus (Pilides 2000: 12–47), and Keswani (2009; 2015) has emphasised the likelihood of regional production centres for them. Those exported from the island, and possibly used for transport, generally belong to the medium-sized ‘Group II’ vessels; they have restricted rim diameters (19–44 cm) and medium-neck heights (50–65 cm), which could have facilitated the transport of produce or possibly of liquids (Pilides 2000: 49; Keswani 2009: 111, table 2). Group IB1 vessels are also of medium size (but lack an adequately restricted orifice); in Hulin’s view (in White 2002: 29), they ‘represented the best compromise between portability and volume’ (for illustrations and form/size categories of all *pithos* groups, see Keswani 2009: 107–112, fig. 1, tables 1–2).

Late Cypriot *pithoi* found on shipwrecks and other sites throughout the Mediterranean indicate that, despite their bulk, they were often traded over long distances (Keswani 2009: 112). Group II *pithoi* were found at Kommos on Crete and on the Point Iria and Uluburun shipwrecks (Figure 24a–b; see also Appendix, Table A1: nos. 10–11); at Ugarit and its port Minet el-Beidha in Syria (over 60 vessels, in both Group I and Group II, one of which contained fish and sheep bones); in Lebanon at Tell Kazel, Tyre and probably at Sarepta; at several southern Levantine sites, including Ashdod, Ashkelon, Hazor, Megiddo, Tel Batash and Tell esh-Shari’a; in Sardinia at Nuraghe Antigori and in Sicily at Canatello (Pilides 2000: 48–51, with refs.; J. Rutter, pers. comm.). All but one of the 15 Cypriot *pithoi* recorded at Marsa Matruh along the coast of western Egypt belonged to Group I (largely IB1); the single exception belonged to Group II (Hulin, in White 2002: 29–38). A *pithos* rim fragment from Kommos and a body sherd from Antigori were analysed using both chemical and petrographic analyses, and both proved to have an origin in south-central Cyprus, in the Maroni-Kalavasos area (Jones and Day 1987: 262).

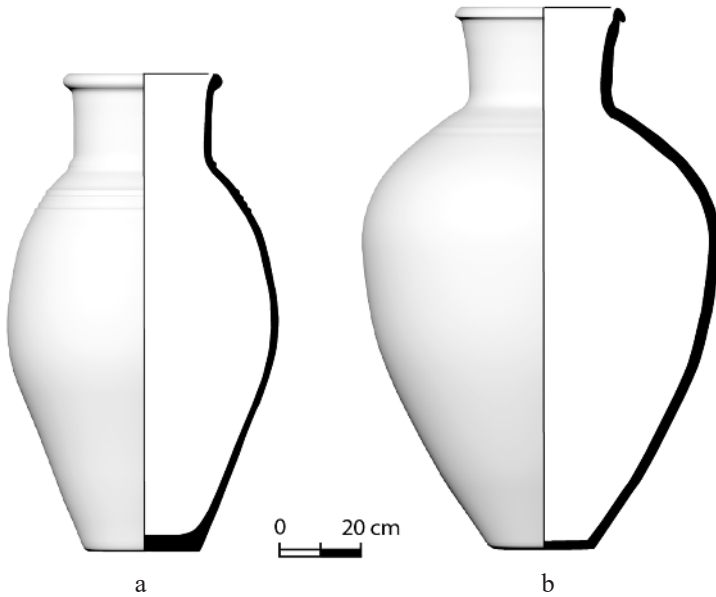
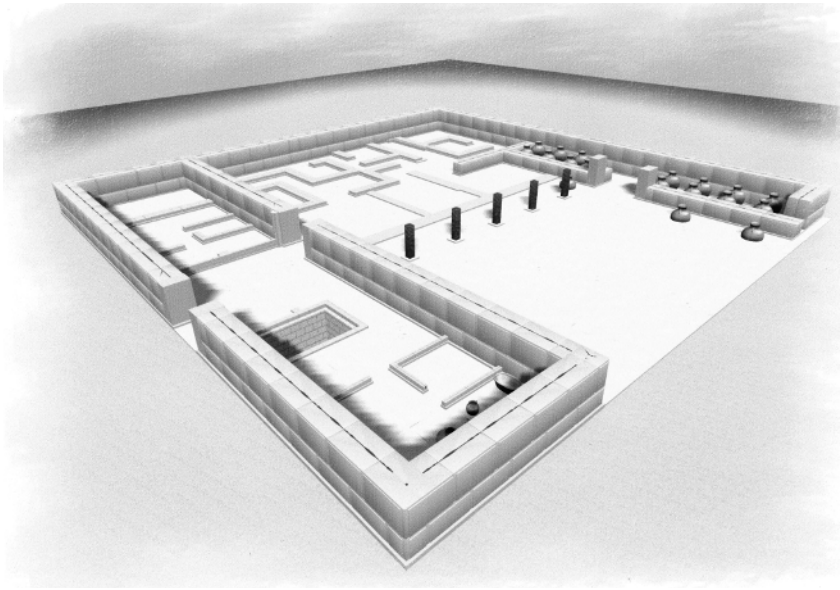


Figure 24 Cypriot 'Group II' *pithoi*; a) Point Iria wreck deposit (after Pennas et al. 1995: 12, fig. 8c, no. A5); b. Uluburun shipwreck (after Pulak 1997: 242, fig. 10, no. KW255). Drawing by Irini Katsouri.

Certainly none of the Group III *pithoi* (the largest)—which have 3–6 cm-thick walls and which stand up to 200 cm in height—could have served to transport liquid commodities. If one takes into account some later examples, it is estimated that Hellenistic and Roman amphorae holding up to 25 litres of wine could have been managed easily by one person; larger amphorae weighing about 60–70 kg filled would have required at least two people to carry them (Koehler 1996: 323–324). A Group III *pithos* filled near to its brim with any liquid commodity (the largest would have held more than 600 litres—South 1989: 321) would have been impossible to lift or move and, unless tightly sealed or firmly set in place, would surely have lost a large proportion of its contents, especially aboard ship. Many of these large, Group III *pithoi* were found concentrated in specially designed storage areas in LBA structures on Cyprus, such as Building X at Kalavassos *Ayios Dhimitrios* (South 1992: 133–134, fig. 1) or Building II at Alassa *Paleotaverna* (Hadjisavvas 2003: 31–32, figs. 3–4; 2009: 130–131, 133 fig.3; Smith 2012: 40–41) (Figure 25). Such contextual evidence demonstrates that these *pithoi* were used for storage and/or regional redistribution of their contents (for olive oil at Building X—Keswani, in South 1992: 141–145), possibly for ceremonial feasting activities (Keswani 2009: 114). On board a ship, they might have served to store water, or (dried) fruit, or meats/fish—victuals for the seamen.



*Figure 25* Building II at Alassa Paleotaverna; isometric reconstruction showing *pithos* storage area at upper right (Hadjisavvas 2003: 32, fig. 4). Courtesy of Sophocles Hadjisavvas.

Although the use of *pithoi* as a scuttlebutt (water tank), or as cargo or for storage in ships is a very distinctive phenomenon, we might also consider an instructive example from the western Mediterranean during the Roman era, involving 29 documented shipwrecks carrying *dolia* (Heslin 2011). The *dolia* is a large pottery vessel, like the Cypriot Group III *pithos*, but stands up to 190 cm high and is thus capable of holding an estimated 2000+ litres of liquid. Also, like the Cypriot Group III *pithos*, *dolia* are known primarily from terrestrial, not maritime contexts, and typically were buried up to their shoulders in the earthen floors of warehouses. Thirteen of the 29 shipwrecks that carried *dolia* have been classified as ‘tanker-style’ ships, a distinctive class in terms of ship-building design and technology. The *dolium* was probably an inappropriate vessel for maritime transport of liquids, as accidental spillage of its contents in the hold of a ship might have been enough to capsize the vessel. The weight concentration of *dolia* on a ship, furthermore, would have made the ships ‘stiff’ (Heslin 2011: 161) and less seaworthy. Although a ship fully loaded with *dolia* might have been able to transport more liquid per hold space than amphorae, the disadvantages of the large container—loading it on board the ship, filling or emptying it, its sheer bulk and weight—meant that its use was quite limited both in time and space.

All known ‘tanker-style’ wrecks date within a maximum use period of 150 years, from the late second or early first centuries BC until about the middle of the first century AD (Heslin 2011: 161). It is likely that wooden barrels, which first appear in the archaeological record from the end of the first century BC,

were intended—like the *dolia*—for transporting liquid commodities en masse, even if they proved in the end to be less suitable for maritime use (Bevan 2014: 395, 402; see also Marlier 2008). From this comparative case, we could suggest that any Group III Cypriot *pithoi* found on board ships might have been used to store water, wine or other victuals for the use of the crew, but were no more useful as MTCs than the Roman-era *dolia*, whose use on ships was a temporary experiment in the mass transport of liquids that ultimately failed.

Petrographic analyses carried out on a sample of 34 *pithoi* (Groups I, II and III) from 10 Late Bronze Age Cypriot sites reveal that they were all made from local sources of clay (Pilides 2000: 110–111; Xenophontos et al. in Pilides 2000: 167–182; see also Nodarou 2015). Some 200 *pithoi* bearing seal impressions have been recorded on Cyprus (Smith 2007; 2012; Keswani 2009: 119–121), but even the most intricate analyses conducted on them tell us nothing certain about their contents or specific use; it is likely that they had more than one function (i.e. they were ‘multi-task’ vessels), which could have included administrative, storage and/or transport, maintenance of inter-site economic relationships, social exchange of gifts, etc.

When it comes to the several examples of Cypriot *pithoi* found on board the Iria and Uluburun shipwrecks or in sites beyond Cyprus, the Group II vessels are the most common, and thus the ones that were most likely used, if only occasionally, for transport purposes (e.g. filled with smaller cargo items to avoid loss during the trip). Once they arrived at their destination, they would have been used either as containers for the imported product, or as general storage jars for other commodities. We would suggest that although their primary purpose was for storage, certain types of Cypriot *pithoi* (Groups IB1, II) may have served at times for the bulk transport of organic materials, but less commonly if ever for liquids.

### *Cretan Short-necked Amphorae*



Figure 26 Cretan Short-necked Amphora and Canaanite Jar (for comparison). Drawing by Irini Katsouri.

During the Late Minoan (LM) IIIA2–IIIB (or Postpalatial) periods (c.1390–1200 BC), the Short-necked Amphora (SNA) was introduced, evidently in workshops at Kommos or nearby in the western Mesara plain (Rutter 1999: 146–147, figs. 3–4; Rutter 2000; Day et al. 2011). It was by far the most

common type of vessel found in Building P (the ship-sheds) at Kommos (Rutter 2000: 180, estimates 100–200 complete vessels). Day et al. (2011: 516) suggest that Building P may also have served as a warehouse for stockpiling SNAs, ostensibly used as containers to ship local products in bulk to consumers elsewhere in Crete or abroad. However, no examples of SNAs have yet been identified anywhere else in the Aegean (excepting one at Knossos—Evans 1928: 627–629, fig. 392.3) or in the eastern Mediterranean (Day et al. 2011: 516–517). Watrous (1992: 135) identified some sherds from Enkomi on Cyprus as possibly belonging to a related shape (Dikaïos 1969: pl. 102, no. 5), but this identification remains inconclusive (Rutter 2000: 182). While accepting that future fieldwork in the Levant, Egypt or Anatolia might identify some of these still poorly known and very plain vessels, the current, highly localised distribution of the SNAs makes them unlikely candidates for what we define as MTCs.

Other factors and views, however, may be considered. Watrous (1992: 135), for example, noted that the SNA shared three features with the Canaanite jar: (1) durability; (2) a base relatively small for its height; and (3) standardised size. Rutter (2000: 186; 2006: 663), in turn, suggested that this form was designed intentionally to rival the Canaanite Jar and the Aegean TSJ as a maritime transport container. At first, it actually drew some inspiration from these vessels, having an angular shoulder like the Canaanite Jar and sporting the broad, horizontal wavy bands seen on the body of a typical Cretan TSJ (Day et al. 2011: 516). The standardised manufacturing technique as well as the shape and dimensions of the SNAs indicate that they were mass-produced. On average, this distinctive amphora is about 40 cm in height with a capacity of 9.3 litres of liquid, or 7.75 kg of grain (Watrous 1992: 135) (and see Appendix, Table A1: no. 16). It has a round mouth, a comparatively low neck and two almost cylindrical handles attached at the shoulder and rim (Day et al. 2011: 512, 513 fig. 2) (Figure 27).

By the thirteenth century BC, the SNA had developed into a plain, round-shouldered shape; it represents a novel combination of the traditional OMA (found on Crete from Middle Minoan times onward), the Canaanite Jar and the TSJs decorated with an octopus (or stylised tentacles) (Rutter 1999: 146–147; Day et al. 2011: 512). With their wider necks, the SNAs could have carried either liquids (olive oil in Rutter's opinion) or solids, although the only commodity found in any of them thus far was identified tentatively as haematite, perhaps red ochre (Rutter 2000: 181, 183 n. 13). These vessels might have been sealed with lumps of clay like those used on some TSJs (e.g. Watrous 1992: 75 no. 1283, 87 no. 1524, 88 no. 1526), and perhaps secured with a string. As to the purpose of this container, Rutter (2000: 185) proposed that a newly established polity in the Mesara (centred at Ayia Triadha) may have shipped the agricultural surplus that formed the basis of its wealth in a new, clearly identifiable form of vessel, just as its predecessor (the OMA) had done in earlier times, before Knossos centralised control over the island during the Neopalatial period.



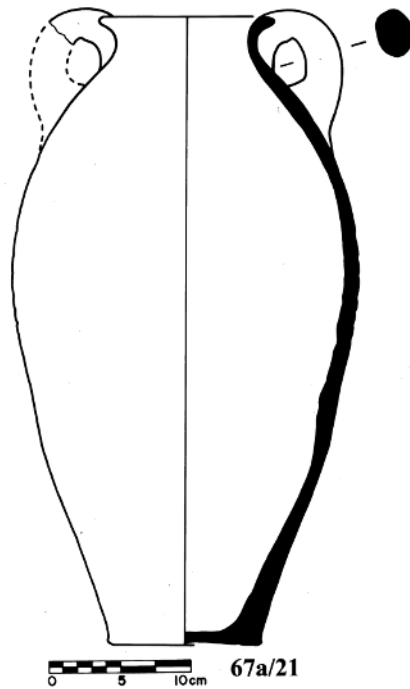


Figure 27 Short-necked Amphora from Kommos, Crete (after Rutter 2006: 1171, pl. 3.78, no. 67a/21). Courtesy of Jeremy Rutter.

Thirteen of these SNAs were included in a recent and ambitious comparative study, using both thin-section petrography and INAA. As already noted, Day et al. (2011) examined 88 samples of different kinds of MTCs recovered from the excavations at Kommos. In addition to the 13 SNAs, the other samples comprised 18 TSJs, 34 Canaanite Jars and 19 Egyptian Jars (Day et al. 2011: 514–515, table 1; results of analyses on the Canaanite and Egyptian Jars have been presented above, under each type).

Day et al. (2011: 522, table 2) classified the thin sections of the 88 samples into 26 fabric groups, which divided neatly (and in close agreement with typological divisions) into those thought to be Cretan (TSJs and SNAs, Fabrics A–J) and those considered to be imports (Canaanite Jars and Egyptian Jars, Fabrics 1–12). All 88 samples were also analysed chemically by INAA (Day et al. 2011: 534–536, table 3). Nine chemical groups were determined, three of which largely define the Cretan TSJs and SNAs (with a few individual outliers), while the other six mainly define the Canaanite and Egyptian Jars (again with some outliers). While the two analytical techniques treat different compositional characteristics, their results tally quite well, especially concerning the distinction between the locally produced and imported wares (Day et al. 2011: 540–543, figs. 8–9). Samples of most TSJs and some of the SNAs from Kommos belong

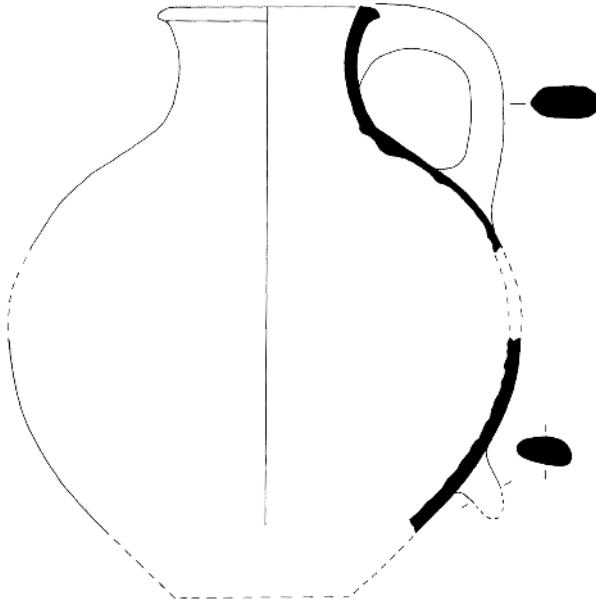
to a south-central Cretan fabric (A), and were almost certainly produced somewhere in the western Mesara (Day et al. 2011: 546). At the same time, both petrographic and INAA analyses of the SNA samples in four of the fabrics (A, B, C, E) and in three of the chemical groups (I, II, III) also indicate an origin in the Mesara Plain. Four of the TSJ samples had fabrics indicating origins in western or eastern Crete (Day et al. 2011: 547).

As already noted, Rutter (2000: 186; 2006a: 663) suggests that the SNA might have been designed intentionally as a transport vessel to rival the Canaanite Jar and the Aegean TSJ. Indeed its form recalls the Canaanite Jar and perhaps, at least initially, it drew upon that vessel for some of its basic features and design (angular shoulder, standardised size, durability, small base). Given such features and the overall form, as well as the comparatively wide neck, there is little doubt that the SNA could have served as a container to ship local products—liquid or solids—in bulk to consumers. But because the only example of an SNA found beyond Kommos came from Knossos, and since haematite (red ochre?) is the only content yet identified, its *maritime* function and its use to transport bulk organic goods remain to be demonstrated; it may even be stretching the evidence to argue that it was intended to transport the agricultural surplus of the Mesara in a distinctive form of vessel (Rutter 2000: 185).

### ***Southwest Anatolian Reddish-Brown Burnished Jugs***

Once again from Kommos on Crete comes another type of possible transport vessel, the ‘southwest Anatolian reddish-brown burnished jug’ (Rutter 1999: 143 and figs. 1–2; Rutter 2006b). Other, similar rim-handled jugs have been found in Crete (Knossos, Katsambas, Kephala tholos near Knossos, Chondros Viannou, Palaikastro, Karphi and Sissi), at Akrotiri on Thera and in several tombs on the island of Kos (J. Rutter, pers. comm., February 2012; Rutter 2006b: 145–146, nn. 13–19 with refs.). The most common shape is a closed, rim-handled, full-bodied ovoid jug that occasionally sports a subsidiary lug directly below the handle on the lower body (Figure 28). The vessel’s approximate dimensions are: rim between 7–10 cm, base between 7–11 cm, maximum width between 20–30 cm; the volume is estimated to be between 4.5–5.5 litres, roughly half the capacity of the SNAs found at Kommos (Rutter 2006b: 141–142, fig. 5, 149, n. 29).

Although no formal provenance analyses have yet been carried out on these vessels, one (Kommos inv. no. C5731) was inadvertently subjected to both petrographic and chemical analysis (Watrous et al. 1998: 339; Rutter 2006b: 141 n. 9). The results indicated the example was possibly ‘Aegean’ in origin, but definitely not from the volcanic Sardinian fabric that formed the basis of the study (J. Rutter, pers. comm., July 2013). In any case, the colour, fabric and array of inclusions of these vessels look distinctively different from anything produced locally in the western Mesara (Rutter 2006b: 139–141, fig. 4 and n. 9). The shape, too, is foreign to the local pottery repertoire (Rutter 2006b: 142–144, figs. 5–7). Moreover, on stylistic and other grounds, several features



*Figure 28* Southwest Anatolian reddish-brown burnished jug from Kommos, Crete (after Watrous 1992: 43 no. 740, fig. 31.740, Kommos C1174). Courtesy of Vance Watrous.

typical of these reddish-brown burnished jugs found at Kommos—surface colour and treatment, the profiles of rims and necks on closed shapes—are regularly found at sites in southwest Anatolia around the Gulf of Izmir, e.g. Panaztepe, Bayraklı and Liman Tepe, while similar jug-shaped vessels are also found inland (Rutter 2006b: 148–149, and nn. 24–25 with refs.).

Equally important for our concerns, two other jugs closely resembling the larger examples from Kommos in fabric, profile and size (albeit without the lug or handle on the lower body) formed part of the Sheytan Deresi ship's cargo, recovered some 25 km east of Bodrum, Turkey. These two jugs are provisionally dated to the end of the Middle Bronze Age and thus are much earlier than the Kommos examples (Rutter 2006b: 149; Bass 1976: 298–299, fig. 5 b–c; Catsambis 2008: 19–20, figs. 7–8). In Rutter's (2006b: 149) view, while these parallels are not close enough to postulate specific production centres for the Anatolian reddish-brown burnished jugs, 'in combination they serve to mark the coastal regions between the Gulf of Izmir and the Gulf of Kerme as the probable source area of these imports'.

So why consider these as possible transport vessels in the first place? Beyond the fact that two similar (but larger) jugs formed part of the cargo of an earlier shipwreck (Bass 1976), a rim and neck fragment of one vessel preserves what appears to be a circular perforation pierced vertically through the lip, and a possible second perforation obliquely placed through the lower neck some 4.5 cm

directly below (Rutter 2006b: 142, and figs. 2a, 9b). These holes might have facilitated attaching a lid to the vessel, thus implying a possible transport function. At least two vessel fragments from Kommos have a semi-circular lug projecting prominently downward on the lower body, and other Cretan examples reveal that the lug was placed directly below the vertical handle, presumably to help in carrying the vessel and in pouring liquids from it (Rutter 2006b: 143, fig. 5, 147 fig. 10, and nn. 13–16 for the other Cretan examples). The frequency of these medium-sized, reddish-brown burnished jugs in Cretan and other insular Aegean contexts (about 65 examples in all—J. Rutter, pers. comm.) suggests that these vessels could have been used to transport a particular product—perhaps wine—from Anatolian to Minoan ports (Rutter 2006b: 149). Their small size may be a function of whatever product it was they were intended to carry.

Rutter has argued, reasonably, that these reddish-brown burnished jugs were imported from Anatolia. Equally it seems reasonable to suggest (although it has yet to be demonstrated analytically) that they may have been used to transport a specific product, perhaps a specialised type of wine. Even so, these vessels fail to meet our criteria for an MTC. Their size and shape in particular are quite dissimilar to the other vessel types considered here, and their numbers are quite limited. On present evidence, we would suggest that even if they served some transport function, they were never intended specifically for the bulk transport by sea of liquid or other commodities.

### ***Sardinian Olle a Colletto***

From a room in a residential complex at Pyla *Kokkinokremos* on Cyprus, dated to the end of the LBA (c. 1200 BC), renewed excavations have produced several fragments of a more or less complete ‘Handmade Burnished Ware’ vessel, whose form is described as an *olla a colletto* (Karageorghis 2011: 89–90, 94 fig. 2). From the same room came several fragments of large, local plain ware storage jars, one Late Helladic IIIB three-handled jar and a local imitation of that jar.

The *olla* from Pyla had been broken in antiquity and mended, inside and out, with two lead pieces. Repairing pottery vessels—usually large *pithoi*, in Sardinia called *ziri*—with lead clamps is fairly common in Final Bronze Age–Iron Age Sardinia (e.g. Badas 1987: 134, 144 pl. 5). Lead isotope analysis of a sample from the repair clamp used on the Pyla vessel indicates that the lead is consistent with production from Sardinian ores (Gale, appendix IV in Karageorghis 2011: 107–112). Petrographic analysis of five sherds from the Pyla excavations discerned two groups: one compatible with local lithologies of Cyprus’s ophiolite complex, the other (the imported *olla*) characterised by andesitic lithologies compatible with an origin in northwest Sardinia (Fragnoli and Levi, appendix III in Karageorghis 2011: 101–106).

The Pyla vessel is of closed type, with an ovoid body and a short ‘collared’ neck, two ‘inverted elbow’ handles at mid-body (or ‘shoulder’), and a more or less flat base (Figure 29). The shape of the restored vessel (appendix II in

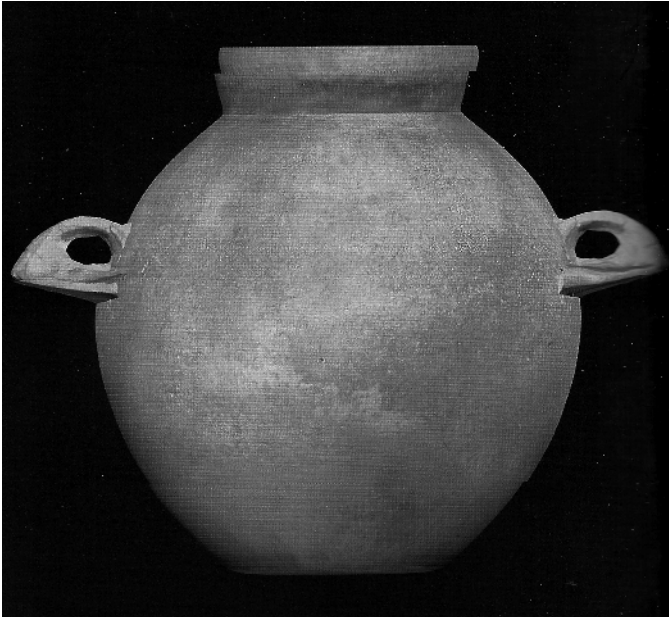


Figure 29 *Olla a colletto* from Pyla Kokkinokremos, Cyprus; digital restoration of fragmentary vessel (from Appendix II, Karageorghis 2011: 100 fig. 5). Courtesy of Vassos Karageorghis.

Karageorghis 2011: 100 fig. 5) corresponds to the wide category of Sardinian vessels known as *olle* (Campus and Lionelli 2000: 470–518), more specifically to a sub-group designated *olla a colletto* ('little neck'). In fact, the example from Pyla belongs to a distinctive sub-class of the *olla a colletto* with *ansa a gomito rovescio* ('inverted elbow handle'—Campus and Lionelli 2000: 505–518, 629–632). It seems safe to say that such vessels served as containers of some sort, perhaps even as storage vessels. In general they are not very large (the restored height of the *olla* from Pyla is about 40 cm) and there is no evidence they had lids, thus little reason to suppose they might have been used specifically for transport purposes. Even so, their closed shape, manageable size and obvious use for storage might have encouraged their occasional use for transport.

Karageorghis (2011: 91) emphasises that the Pyla jar, thin-walled and made of soft clay, cannot be considered as an ideal transport vessel, or even a cooking pot. He notes, however, that several Sardinian vessels found at Kommos on Crete were 'very similar to the jar from Pyla Kokkinokremos': they were also handmade burnished, mottled jars with flaring necks (but note that virtually all Nuragic Final Bronze Age–Iron Age vessels could be described as handmade, burnished and mottled—Peter van Dommelen, pers. comm.). Petrographic analyses of 19 fragments of the Sardinian wares found at Kommos identified two different fabrics, both of which were compatible with a Sardinian provenance (Watrous et al. 1998: 338–339).

Amongst some 50 examples of Nuragic *impasto* pottery from Kommos, also of similar date (Late Minoan IIIB), are 12 ‘collar-neck jars’; there are also some bowls with simple tapering rims that might have served as lids for these jars. Rutter (2006a: 677) suggests, following Watrous (1992: 182), that these ‘jar-and-bowl’ pairs—along with some Sardinian *dolii* (storage jars)—might have served as ‘transport vessels’ while en route to Crete, but then functioned as ‘storage vessels’ once they reached their destination. Watrous (1992: 182) also suggested, based on cases cited from Sardinia and Italy, that some of these jars might have been used to transport bronze scrap (also Rutter 2006a: 677). Yet there is no clear evidence that they ever served this function on Bronze Age Sardinia (but see below).

The (Bronze Age) Nuragic pottery repertoire lacks any type of dedicated transport vessel. Campus and Lionelli (2000: 428–430) discuss a category of (closed shape) *anfore* but do not say they were used for transport. In any case, this term seems to have no relation to the vessel’s function(s). In continental Italian protohistoric archaeology, *anfora/anforetta* generally refers to a fairly small vessel with two vertical handles on the upper part of the body; it thus looks similar to a classical Greek amphora but otherwise has nothing to do with it. During the Iron Age, however, a new shape appears, one clearly modelled on Levantine amphorae and found all over the island as well as abroad (e.g. in Carthage in Tunisia, and at Huelva and Málaga in Spain—Hayne 2010: 155–156, and fig. 8.4). Interestingly, the earliest examples of these amphorae locally produced in Sardinia (late ninth–eighth century BC) were used to store and/or transport copper (Oggiano 2000), and one was recently recovered off the east coast of Sardinia (Sanciu 2010: 4–5, fig. 6). Thus they might represent another example of a vessel whose primary use was for storage or land transport, but served occasionally as an MTC.

On the one hand, it seems unlikely that any of the *olle a colletto* or ‘collar-neck jars’ found at Kommos on Crete, or the *olla a gomito rovescio* from Pyla Kokkinokremos on Cyprus, should be regarded as purpose-made transport vessels, designed for shipping by sea liquid or related commodities in bulk (like Canaanite Jars in the Bronze Age or transport amphorae in later periods). On the other hand, one might argue that a vessel used for storage on a ship is de facto a transport vessel. The *olle* may well have served partly for storage at Kommos, but the Pyla jar thus far is a unique example. Accordingly, it seems unjustified to regard it so readily as representative of the *Shardana* group of the Sea Peoples (Karageorghis 2011: 90–91; Jung 2009: 145; cf. Sherratt and Sherratt 1993: 335; Russell 2009: 11–12). And yet, since it was made in Sardinia and mended in Sardinian fashion, we can accept that it may have arrived on Cyprus with someone from or closely associated with Sardinia.

### ***Pithoid Jars, Pithoi and Hydria: The Modi Shipwreck***

From the shipwreck at Modi (off Poros, in the Argo-Saronic Gulf), Agouridis (2008; 2011; 2012) reports a cargo of ‘large transport vessels’, some of which

might be considered MTCs. All these vessels have been published in at least preliminary form. They include 11–15 plain, two-handled pithoid jars that Agouridis (2011: 29–30) compares to vessels from the cargo of the Point Iria wreck (i.e. the ‘plain, two-handled jars of traditional Helladic type’ mentioned by Lolos 1999: 45; see also Agouridis 2012: 76, fig. 8α–8β) (Figure 30). Also recovered were two handleless *pithoi*, one of which had a relief band with ‘fishbone’ (i.e. herringbone) engravings (Agouridis 2011: 30 and fig. 13 a–c; 2012: 78, fig. 9γ–9δ). The author suggests that (Cypriot) *pithoi* such as those found on the Uluburun, Point Iria and Cape Gelidonya wrecks (on the last, see Hirschfeld et al. 2010: 22, 24 fig. 13; Bass 2013: 66, 70) were used for long-distance transport of liquid or other commodities; meanwhile, Wachsmann (1998: 205) suggests that the Cypriot pottery from the Point Iria wreck ‘may constitute one of the largest assemblages of Late Cypriot transport containers found to date in the Aegean region’. However, we have already presented the reasons we do not classify most Cypriot *pithoi* as MTCs. Agouridis (2011: 31), in any case, maintains that the intact *pithos* from Modi is probably not Cypriot, but instead shows parallels with smaller vessels found at Pylos and Mycenae. Both the pithoid jars and the handleless *pithoi* (respectively 80 cm and nearly 100 cm high) would make very unwieldy containers for transporting liquids, even if they might have been used to transport other goods such as fruits, dried fish, grain and the like. Finally, the Modi wreck deposit also includes 13 large, linear-decorated Late Helladic IIIB or IIIC *hydrias* (Agouridis 2011: 30–31, figs. 14–16), vessels that we regard as tablewares (i.e. water containers), not MTCs.

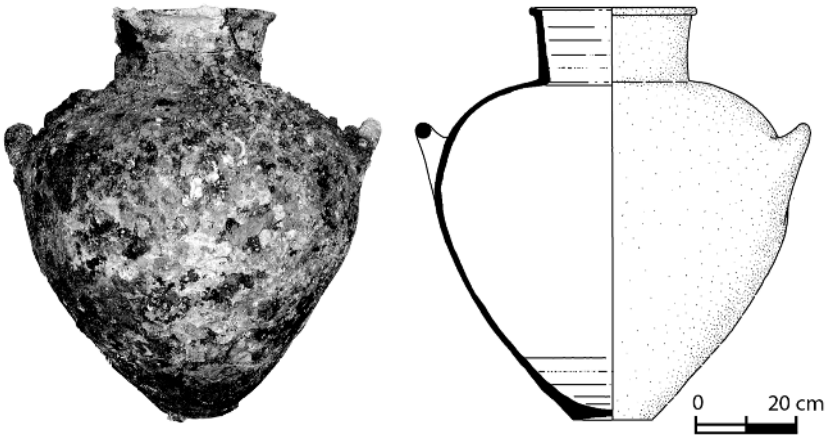


Figure 30 Plain, belly-handled pithoid jar from Modi shipwreck at Modi, off Poros, from Agouridis 2012: 76, fig. 8α–8β. Courtesy of Christos Agouridis.



## **Maritime Transport Containers: Into the Iron Age**

### ***Iron Age Levant: Background and History of Research (Robert Martin)***

The Levantine Iron Age I (c.1200–900 BC) and II (c.900–700 BC) periods (Table 2) followed the disruptive events that characterised the end of the LBA (Knapp and Manning 2016). Recent research, however, continues to challenge the concept of an ensuing ‘dark age’, as data from modern excavations have increased, along with evidence for continuity amidst the change (e.g. Mazzoni 2000; Gilboa et al. 2008; Harrison 2009).

As was the case during the Bronze Age, the production and distribution of MTCs still involved the West Semitic-speaking peoples of the Levantine coast. Despite its somewhat problematic, ethnically charged name, the ‘Canaanite Jar’ certainly originated with and proliferated amongst these groups, most of whom likely identified themselves with their city-states of origin (Sherratt 2010: 122), but are typically referred to in the literature as (Bronze Age) Canaanites or (Iron Age) Phoenicians (e.g. Cross 1989: 80; Regev 2004: 337). During the Iron Age, trade still radiated from these central Levantine polities, and it was these ‘surviving Canaanite-Phoenician cities’ (Master 2009: 118) that continued to produce and refine the Canaanite-type commercial jars. In turn, these gave rise to the Phoenician MTCs of the Iron Age II (Ballard et al. 2002: 159; locally produced Philistine pottery is not included in this study, but see Ben-Shlomo 2006).

A great deal of effort has gone into establishing typologies as well as basic chronologies for these ceramic containers; even so, a definitive nomenclature still does not exist. Ceramic analyses and excavation reports alike present pottery typologies without distinguishing between transport and storage containers (cf. Regev 2004), let alone those that were produced specifically for maritime transport. While the term ‘storage jar’ is almost ubiquitous, there are also designations such as ‘commercial jars’ (Amiran 1970; Raban 1980; Gilboa et al. 2008; Pedrazzi 2010), ‘transport amphorae’ (Regev 2004) or ‘transport and storage jars’ (Pedrazzi 2007). By the Iron Age II period, terms such as ‘crisp ware’, ‘wasp-waisted’ and ‘torpedo-shaped jar’—emphasising morphological features of Phoenician MTCs—enter the literature. The Phoenician ‘torpedo-shaped’ jars found on two key shipwrecks (discussed below), however, stand apart as the only Iron II types that have been seen explicitly as ‘purpose-built marine containers’ (Ballard et al. 2002: 159) or as vessels ‘primarily made for marine transportation’ (Finkelstein et al. 2011: 257).

The great diversity of Middle–Late Bronze Age jar forms termed ‘Canaanite’—which had various origins, contents, uses, re-uses and depositional contexts—gave rise to the notion that such containers had a general, multi-

*Table 2* General Chronology for Iron Age I–II Levant

<i>Iron IA</i>	<i>Iron IB</i>	<i>Iron IIA</i>	<i>Iron IIB</i>
1200–1150 BC	1150–1000 BC	1000–850 BC	850–700 BC

purpose function (e.g. Leonard 1996: 252). The same issue arises with regard to Iron Age forms, but is compounded by other factors: e.g. the relatively poor visibility of Iron I archaeological contexts; a lack of analytical data regarding provenance or contents; and a more complex ethnic composition within the region at this time (Joffe 2002). Thus it becomes challenging to categorise forms within a corpus of what are typically termed storage jars, but are here presented as Levantine MTCs (as found in maritime contexts or at least beyond their area of production). Although some very detailed work has been conducted on Iron Age Levantine 'commercial jars' (e.g. Gilboa et al. 2008; 2015; Pedrazzi 2007; 2010), this section attempts to identify various types that were not only *used* as MTCs but may have been *designed* specifically for that purpose.

The material presented here represents an overview of relevant evidence from the thirteenth through eighth centuries BC, i.e. from the transitional LBA through the Iron Age I–II periods in the Levant. Nearly all of the Early Iron Age Levantine 'storage jars' retain a morphological similarity to the Canaanite Jars of the LBA. Some forms even reveal consistency in their distribution patterns throughout the eastern Mediterranean, especially on Cyprus and Crete (Gilboa 1998: 423; Regev 2004: 339–340), but also in Egypt and at Tarsus in Cilicia. Given the Phoenician material excavated at Lefkandi (Kourou 2008: 309), the absence of Levantine MTCs from mainland Greece remains conspicuous. The corpus of fragmentary material found at Kommos on Crete remains difficult to assess typologically or to date accurately (but see further below). To this we may add a handful of poorly recorded examples of imported Phoenician MTCs in Egypt and the western Mediterranean.

In general, there is only evidence of a limited number of documented MTCs being exported during the Early Iron Age (EIA), as well as an inconclusive knowledge of their precise origins and contents, and at best a partial understanding of the networks through which they travelled. Even so, the presence of exported Levantine 'commercial jars' on Cyprus and Crete supports their function as MTCs involved in sustained or renewed maritime contacts. There follows a brief history of scholarship and the current state of research, after which the archaeological evidence for exported Iron I Levantine MTC types is presented, and a rough outline of representative types is sketched.

Although Grace (1956; 1961) clearly linked the Canaanite Jar and associated ceramic products of LBA Canaanite culture to the proliferation of Iron Age amphorae and maritime trade in the classical era, she did not explicitly address EIA continuities with the LBA. Amiran's (1970) seminal work noted some links with Bronze Age forms, but her EIA ceramic typology was limited by the data then available. The emphasis she placed on maritime activity during the LBA and the role of 'commercial' Levantine jars (Amiran 1970: 140) is absent from her discussion of Iron Age I *pithoi*, 'storage jars' or *amphoriskoi* (Amiran 1970: 191–192, 232–237, 250). Raban (1980), who produced some of the earliest analytical work on Levantine 'commercial jar' types, surveyed a large corpus of Bronze and Iron Age material. He examined the development of ceramic forms over time, their function and association with maritime trade,

their contents, and their centres of production and distribution. He provided the earliest Iron Age typology of ‘commercial jar’ forms manufactured in the Levant, and noted distinctive regional trends from the very onset of the Iron Age (Raban 1980: 9); his work was constrained, however, by a lack of excavated and published Iron I material.

Sagona (1982) noted the problematic diversity of terminology, and the overall lack of a typological framework from which one might analyse these vessels. Nonetheless, he catalogued 13 categories of Levantine ‘storage jars’ from the Levant, Cyprus, Egypt, Anatolia and the Aegean (along with a few from Mesopotamia and Iran), dated between the thirteenth and fourth centuries BC (most are from the later Iron Age and thus not relevant here). Although at times he provided specific contexts, his discussion mainly revolved around stratigraphic evidence and the various sites and chronologies involved. There are 900 separate entries in Sagona’s catalogue, spread over at least a score of sites, but no contextual or chronological table clarifying possible origins or datings.

Bikai (1987: 45–47, pls. 22–23) catalogued 51 further ‘Canaanite storage jars’ from Cyprus that Sagona overlooked. Her concerns, however, lay primarily in the description, decoration and dating of these vessels, not their contents or contexts (virtually all come from tombs), nor their potential functions or meanings. Focusing on the same general corpus of vessels, Regev (2004: 337) described them as ‘Phoenician transport amphorae’. She briefly examined provenance, distribution and some morphological variants that developed during the Iron Age. Following Bikai’s work, she noted that the earliest Phoenician transport amphorae were known only in the Levant, on Cyprus and on Crete. By the Iron Age II period, however, Phoenician MTCs became more widely distributed throughout the Mediterranean, whilst remaining very common in the Levant (Regev 2004: 340–341).

Pedrazzi’s (2007; 2010) work, which we adopt in establishing our own corpus of EIA maritime transport containers, is the most detailed study to date of Levantine ‘transport and storage jars’ produced between c. 1400–900 BC. She considered the vessels’ provenance, contents and volume, provided a functional analysis, discussed the socioeconomic implications and clarified that ‘storage jars’ could have been used for transport over medium to long distances (Pedrazzi 2007: 367). Finally, Gilboa et al. (2008; 2015) provide a more focused ‘Phoenician’ ceramic analysis, as well as a detailed relative chronology to frame the discussion of Iron Age Levantine MTCs and the maritime activities underlying their continued production and distribution.

### ***Levantine MTCs: Late Bronze Age/Iron Age Transition and Iron Age I (c.1200–900 BC)***

Apart from one apparent wreck deposit at Dor (Kingsley and Raveh 1996), there are no known or published Iron I shipwrecks from the eastern Mediterranean. Thus we must look to examples of exported vessels and/or material excavated in distinctive maritime contexts to define the MTCs of the

early Iron Age. In this respect, Cyprus and Crete figure prominently, as do other relevant data from Egypt, Cilicia and the Levant. Despite some contraction in interregional and long-distance trade, it is nonetheless evident that maritime trading networks continued to operate during the transitional period between the LBA and EIA. There are signs of continuity in regional Levantine ceramic repertoires, as well as some consistency in their distribution, production and container volume. Although analytical data regarding provenance and contents are limited, it is likely that bulk liquid staples like those common to the Bronze Age—wine, resins and oils—still moved over the sea.

Pedrazzi (2007) was able to distinguish between the broader category of LBA jar forms termed ‘Canaanite’, and the morphologically distinct and appreciably standardised ‘angular-shouldered’ variants (her Type 5.4; Killebrew’s type CA 22) widely associated with LBA long-distance maritime trade. She notes the virtual disappearance of this angular-shouldered type by the beginning of the Iron Age (Pedrazzi 2010: 54–55), perhaps the result of some retraction in long-distance trade. Her description of morphological developments with Type 5.4 is generally consistent with Amiran’s (1970) work, but notes two EIA variants (most types mentioned are illustrated and discussed below in the sections on *Levantine MTC Typology*; see also Figure 43, below). These trends are all significant in refining the typology of EIA Levantine MTCs, with carination remaining common and the nearly complete elimination of the neck emerging as an important chronological marker for the Iron I period.

Other commercial jar types continued in use (i.e. Killebrew’s Type CA 21; Pedrazzi’s Type 1 variants), whilst the carinated version tended to develop a more cylindrical body, with multiple regional variants (Pedrazzi 2007: 368, 374, 376). Pedrazzi (2010: 54, and fig. 3) argues for a shift to the predominance of high-rimmed, globular storage jar forms at the onset of the Iron Age, concentrated in the regions of the northern Levantine coast, and extending south at least to Tell Kazel, west to Cyprus and north to the area of Cilicia. These continuations of LBA forms were obviously important in maritime trade, as attested by their continued import to Cyprus throughout the Late Cypriot IIIA–Cypro-Geometric I periods (Gilboa 1998: 423; see also Bell 2006: 97–99) (for all sites mentioned in this section, see Figure 31).

Gilboa et al. (2008: 130) discuss the complicated nature of reconstructing the commercial jar repertoire along the Phoenician coast during the Early Iron Age. They divide this material into four ‘pre-colonization’ stages, beginning with Iron IA and IB (equivalent in their view to Late Cypriot IIIB–transitional Cypro-Geometric I) and extending to the Iron IIA horizon (early Cypro-Geometric III) (Gilboa et al. 2008: 123–168). They maintain that the only Cypriot context in which Phoenician jars of this early stage are documented come from the Ingot God ‘sanctuary’ at Enkomi (Gilboa et al. 2008: fig. 6.5; see also Courtois 1971: fig. 96). Approaching the end of the Iron IA sequence, they note that two other commercial jar types appear at Dor, which both reach their zenith during Iron IB (early to mid-Cypro-Geometric I, their Stage 2).



*Figure 31* Iron Age archaeological sites and shipwrecks mentioned in text. Data provided by the University of Toronto CRANE Project; shape files created by Stephen Batiuk and Dominique Langis-Barsetti.

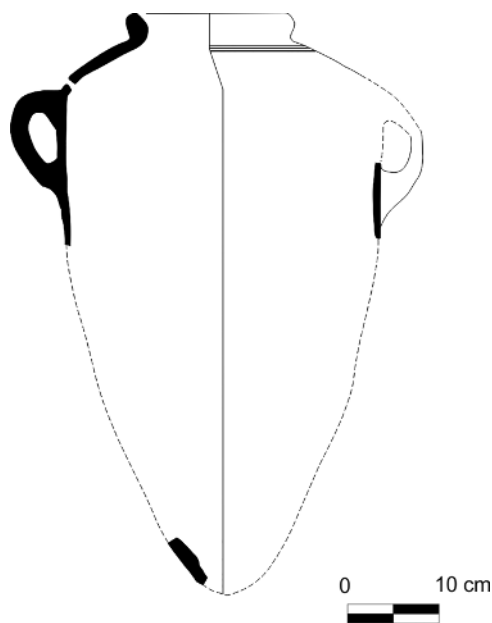
Bikai's detailed studies (1978; 1983; 1987; 2000) are concentrated mainly on Phoenicia, or on 'Phoenician storage jars' excavated on Cyprus and Crete. According to her (Bikai 2000: 309), there are three general classes of these storage jars, the earliest corresponding to Pedrazzi's Type 5.5, a direct descendent of the Bronze Age 'storage' jars (for correlations between different typologies, see below, Tables 3–4). Bikai (2000: 310) refers to the complete examples from Tell Keisan (Pedrazzi's Type 5.5.1 variant) with a bulbed base,

a feature that Pedrazzi (2007: 369) also associated with a Phoenician tradition. Thus Type 5.5 and its variants are very common in Levantine coastal sites, with some examples exported to Cyprus (Pedrazzi 2007: 78–84). Bikai (2000: 309–310) equated her second Iron Age class with examples of storage-jar type SJ9 at Tyre, a problematic classification (Gilboa et al. 2008: 130, 139) that includes several Pedrazzi types and variants. Indeed, Tyre SJ9 includes a number of other body types and forms because its classification is essentially based on rim and base morphology. Bikai (2000: 310) noted rims of this type at Kommos on Crete, dated no earlier than 925 BC. Evidence of such jars from Palaipaphos *Skales* on Cyprus, however, suggests they were involved in maritime trade as early as Cypro-Geometric I (1050–1000 BC), with later examples known at Kition and Salamis. Finally, Bikai's (2000: 310) third Iron Age class, predominant by Iron II, was termed 'crisp ware' or 'torpedo storage jars' (discussed below in Iron II section).

The (presumably) imported corpus of Phoenician jars from tombs at Palaipaphos *Skales* on Cyprus is exceptional for the preservation of complete Iron I vessels. Bikai (1983) divided this 'corpus' of 12 examples into two main groups, Type 1 with ten examples, and Type 2, the heaviest of the imported jars, with two examples. Karageorghis (1983: 371–372) observed that the discovery of these 12 'amphorae' at *Skales*, along with other Levantine pottery types, was unprecedented at other early Cypro-Geometric sites on the island. He concluded that either *Skales* was the most important trading centre on early Iron Age Cyprus, or else the Phoenicians began their westward expansion earlier than previously thought and used the site as a trading base (see also Bikai in Karageorghis 1983: 405; Bell 2006: 90–91). The latter possibility was eventually reinforced by the discovery of 'Phoenician storage jars' at Kommos on Crete (Bikai 2000), although these are dated closer to terminal Iron Age I.

Maier (1999) also stressed the importance of Phoenician imports at Palaipaphos *Skales*, whilst Gilboa (2005) argued for close and continuing contacts between Phoenicia and Cyprus overall at this time. Indeed, at least 66 Canaanite Jars sherds were noted in tomb material from Palaipaphos *Marchello* (Maier 2008: 200, 247), but it is not clear if these include the six examples mentioned in an earlier publication (Maier 1999: 81, 84 n. 14). Renewed work by Iacovou (2008; 2014a) on the Palaipaphos Urban Landscape Project has identified fragments of several further Canaanite Jars at *Hadjiabdoulla* (2009–2010) and *Marchello* (2006–2008) (to be published in a forthcoming issue of the *Report of the Department of Antiquities, Cyprus*).

The Iron Age I Phoenician commercial jars excavated at Kommos on Crete are extremely fragmentary (Figure 32). Bikai (2000: 302) isolated 339 sherds as being of Phoenician origin, 308 (91%) of which belonged to 'storage jars'. Of these sherds, 68% had ferrous inclusions, which were regarded as a marker of Phoenician coastal pottery. Chemical analyses (AAS) also assigned the sherds to the central Levant but noted, significantly, that the best comparanda seemed to lie with the imported Canaanite Jars from Maa *Palaeokastro* on



*Figure 32* Reconstructed jar from Kommos, Crete (after Shaw and Shaw 2006, Vol.2: pl.4.63). Drawing by Rob Martin.

Cyprus (Jones 2000: 332). Interestingly, Bikai (2000: 302) also noted 23 sherds of apparent ‘crisp ware’ fabric (discussed below under Iron II wares), which did not stand apart chemically. Bikai identified all of the Kommos fragments as being of the same type as SJ9 from Tyre, in her view the pre-eminent type of Iron I Phoenician storage jar.

One of the Kommos jar handles had a finger impression at its base, a well-attested feature of early Phoenician jars (Bikai 2000: 308). Eight rim fragments also had distinctive ridges or grooves (termed ‘incisions’) on the upper part of the shoulder, and were all of the same fabric; Bikai (2000: 309) noted that most rims showed similar treatment. Similar marks were so common at both Tyre and Sarepta that they were initially disregarded. One published parallel of a ‘storage jar’ of similar type to the Kommos examples with these incisions near the rim comes from Sarepta (Pritchard 1988: 15, no. 18, fig. 3.18). Bikai (2000: 309) felt that these imported jars might well be associated with production at Sarepta, not least because of the large, specialised and long-lived pottery manufacturing area excavated there (Anderson 1987; 1989).

Given the complexity of possible parallels, and the wide diversity in dates assigned to the Phoenician jars excavated on Cyprus and in the Levant, Bikai (2000: 310) suggested that the Kommos jar fragments ought to be dated on the basis of their excavated context at the site (a date range closer to Iron II). She also speculated that this material might represent a single shipment, dated contextually to *c.* 920/880 BC. Gilboa et al. (2008: 190, n. 261), however, have



since noted the problematic nature of the dating and determinations of these types at Kommos. More recent petrographic and chemical analyses of their fabric indicate that most of the jars are from southern coastal Lebanon, i.e. in the area between Tyre and Sidon (Gilboa et al. 2015).

Pedrazzi (2007; 2010) has provided the most extensive typology of EIA Levantine transport and storage jars. Although her detailed typological classifications do not isolate MTCs per se, her nomenclature nonetheless provides a foundation upon which to build such a classification, and we have adapted her ‘storage jar’ types for the Levantine MTC typology presented here.

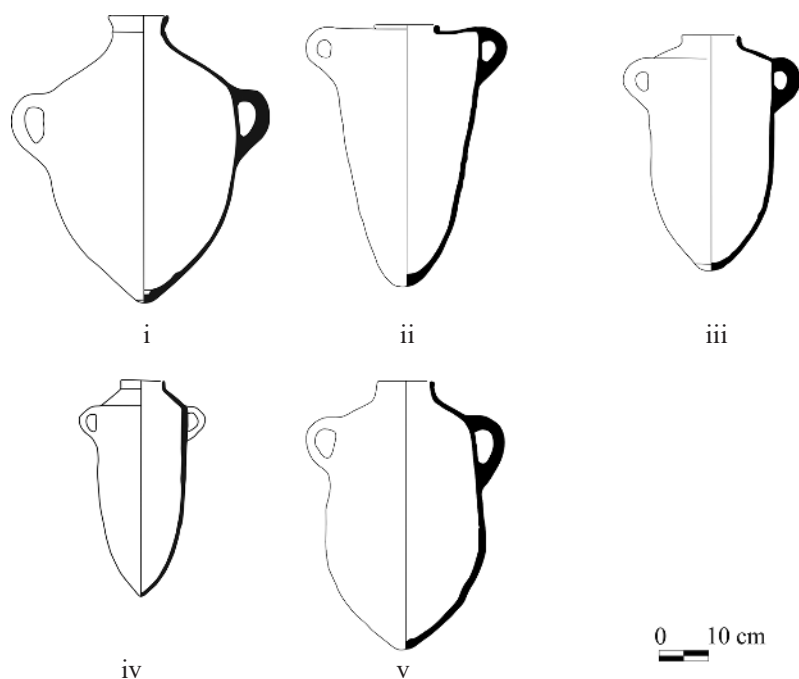
### *Levantine MTC Typology*

(See Figure 33 for all vessel types, and Table 3 for Iron Age I typological correlations)

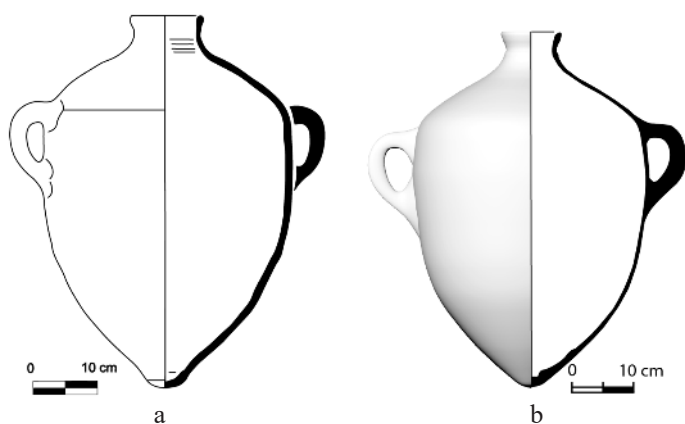
Pedrazzi Type 4 (Figure 34) The most commonly exported LBA/EIA Levantine MTCs found on Cyprus initially correspond to variants of Pedrazzi Type 4 (Pedrazzi 2007: 65–70, 368), a high-rimmed container with a light shoulder carination and a rounded body. Most Type 4 vessels are assumed to have originated in the northern Levant (from coastal Syria to southern Anatolia/Cilicia) during the LB II–Iron I periods (Pedrazzi 2007: 368; 2010: 54). Jones and Vaughan (1988) also suggested that most of the Canaanite Jars from Maa *Palaeokastro* originated along the Levantine littoral. Fully preserved forms of this type are common in the Levant at Tell Kazel (Figure 34a), although there are multiple regional and exported variants, the frequencies of which all fall off rapidly after Iron Age I. Pedrazzi records two main exported types, Type 4.1 (LBII/Iron Age I) and Type 4.2 (mainly LB II, but also occurring in earlier contexts). She suggests that these jars functioned within ‘a more local network, in a northern Levantine trade circuit, from coastal Syria to Cyprus and Cilicia, with the possible minor involvement on the part of Egypt and some Palestinian sites, such as Tell Keisan’ (Pedrazzi 2010: 55). Although these Type 4 jars thus provide some evidence for continued production and export in Early Iron Age trade, Gilboa et al. (2015) now assert that by the early Iron Age, Syria and northern Lebanon were no longer exporting ceramics to Cyprus.

*Table 3* Iron Age I Typological Correlations (after Pedrazzi 2007: appendix 1)

<i>Pedrazzi 2007</i>	<i>Bikai 1983 (Skales)</i>	<i>Aznar 2005</i>	<i>Gilboa et al. 2008</i>	<i>Sagona 1982</i>	<i>Bikai 1978 (Tyre)</i>
Type 4					
Type 5.5	Type 1	Type 1B	Type A-B		SJ9
Type 5.2	Type 2		Type C		SJ10
Type 5.7					SJ9
Type 16	Type 1	Type 9A	Type D	Type 1	SJ9



*Figure 33* Iron Age I MTC typology. (i) Pedrazzi Type 4 from Maa *Palaeokastro* (after Karageorghis and Demas 1988: pl.194:319); (ii) Pedrazzi Type 5.2 from Palaipaphos *Skales* (after Bikai 1983: 397, T83/40); (iii) Pedrazzi Type 5.5 from Palaipaphos *Skales* (after Bikai 1983: 397, T44/134); (iv) Pedrazzi Type 5.7 from Deir el-Medina (after Nagel 1938: fig. 101:8); (v) Pedrazzi Type 16 from Palaipaphos *Skales* (after Karageorghis 1983, Vol. II: fig. 138:20). Drawing by Rob Martin.



*Figure 34* Iron Age I: Pedrazzi Type 4. a) From Tell Kazel (after Pedrazzi 2007: fig.3.16:a); b) From Maa *Palaeokastro* (after Karageorghis and Demas 1988: pls. 194:319). Drawings by Rob Martin and Irini Katsouri.

Pedrazzi (2007: appendix 3) identified variants of Type 4 dating to the transitional LC IIIA period on Cyprus, with exported examples of Type 4.1 found at Enkomi (Dikaios 1969–71, vol. IIIA: pl. 120.11), Hala Sultan Tekke *Vyzakia* (Öbrink 1979: figs. 196, 198), Kition (Karageorghis and Demas 1985: pls. 51:839, 188:5362A, 237:4637) and Maa *Palaeokastro* (Karageorghis and Demas 1988: pls. 176:656, 194:319, 211:441, 230:251) (Figure 34b; see also Appendix, Table A1: no. 20). Examples of Type 4.2 are found in transitional contexts on Cyprus at Kition (Karageorghis and Demas 1985: pls. 188:5362A) and Maa *Palaeokastro* (Karageorghis and Demas 1988: pls. 211:441, 236:340; Hadjicosti 1988: pl. B:1).

Pedrazzi Type 5.2 (Figure 35) These thick and heavy jars, transitional between the LBA–EIA, have a limited distribution and appear predominantly in coastal maritime and exported contexts (Pedrazzi 2007: 72–73). They may well be tied directly to a single production centre, perhaps the elaborate pottery workshops at Sarepta (Anderson 1987: 43–44). Their absence from the hinterland, together with their presence on the Dor wreck deposit and other coastal (e.g. Tyre, Qasile, Tell Abu Hawam) or exported contexts (Cyprus, Egypt, Tarsus), suggest that this jar was a coastal phenomenon associated with maritime exchange. Anderson (1987: 44) regarded this type as indicative of continuity in LBA pottery production at Sarepta, and in general the form seems to represent a transitional type that continued to be produced and exported during IA I; it is amongst the earliest displaying a vestigial rim.

The work of Gilboa et al. (2008: figs. 9, 13) helps to elucidate the earliest appearance and development of this commercial container (their Type C), noting its prominence during what they term Stage 2 (Iron IB) (see also Table 3 for correlations of typologies). This type is never decorated and the earliest known examples are very similar to vessel T.83/40 from *Skales* on Cyprus (Figure 35a), with other variants found in early Iron Age levels at Tel Dor

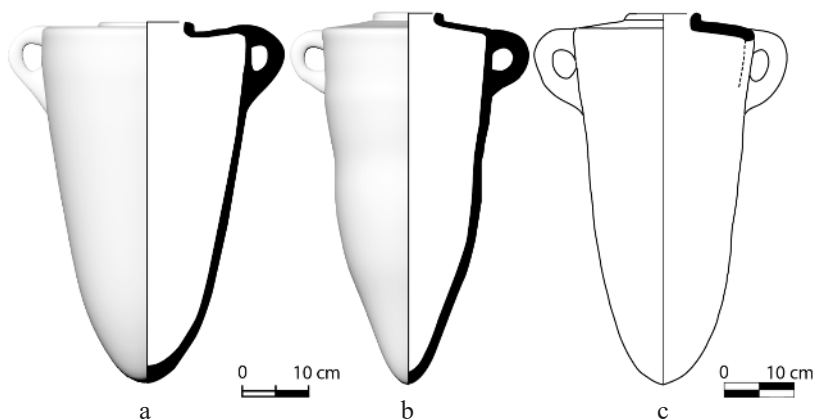


Figure 35 Iron Age I: Pedrazzi 5.2. a), b) from Palaipaphos *Skales* (after Bikai 1983: 397, T83/40 and T80/46); c) from Dor Wreck 13 (after Kingsley and Raveh 1996: fig.38:PW1). Drawings by Rob Martin and Irini Katsouri.

(Gilboa et al. 2008: fig. 9:8–9; Raban 1995b: fig. 9.24:7,18,19), at Tyre (Bikai 1978: pl. 35:12) and at Sarepta (Anderson 1988: 623, pl. 32.7; Pritchard 1988: fig. 43.6). Rims of this type were also documented at Tarsus in Cilicia (Hanfmann 1963: fig.119, no. 252). The next morphological manifestation of Type 5.2 (Gilboa et al. 2008: 152, and fig. 13.8, Type C) corresponds to a variant of those found at *Skales* on Cyprus (Figure 35b); a nearly identical example was found in Egypt at the Amarna River Temple (Peet and Woolley 1923: pl. LI:XLIII/105), and both are comparable to the reconstructed example of Type 5.2 from ‘Shipwreck 13’ at Dor (Kingsley and Raveh 1996: fig. 38.PW1; Figure 35c). Examples of Type 5.2 like that retrieved from the Dor wreck have recently been sourced to the northern coast of Israel, and vessels of similar shape, locally produced, are also now known from Dor itself (Paula Waiman-Barak, pers. comm., September 2015). Aston (1996: 86, figs. 64:400, 110:XLIII/105, 168:J, 234:d) describes Type 5.2 as a ‘vessel often found in Egypt with examples known from Thebes, Memphis, Amarna and Medinet Habu. The fabric of the Amarna examples shows them to be Levantine in origin’. The ‘Phoenician amphorae’ that Regev (2004: 341) noted from Heracleopolis Magna are of this same type (Padró 1991: 1104–1108, fig. 4.c–d).

Based upon their unique morphology, limited distribution and weight, Bikai (1983: 396) had already speculated that Type 5.2 might have been manufactured at a single workshop and used in transporting specialised cargoes. Having recovered variants of this type from Shipwreck 13 at Dor, Kingsley and Raveh (1996: 57–58) postulated that the thickness of these vessels may have facilitated their transport by sea. They also suggested that, given the association of the Sarepta kiln with a complex producing purple dye, some of these vessels might have contained murex dye (some thirteenth century BC contexts at Sarepta contained Canaanite Jar sherds coated with purple dye on the interior; McGovern and Michel 1990: 72).

Pedrazzi Type 5.2 enables us to define the unique features of a typical Iron Age carinated shoulder jar. It has a generally conical profile and a nearly flat, horizontal shoulder, with a marked angular shape in the transition to the belly. The neck becomes vestigial at the rim, which is full or thickened and set directly on the shoulder, with an abrupt and internally angular joint. Apart from the reduced neck, the proportions, thickness and morphology of this type would seem to be a continuation of specific variants of LBA Canaanite Jars, especially the LB II angular-shouldered examples (Pedrazzi Type 5.4; Killebrew form CA 22). This suggestion is also supported by volumetric analysis of Type 5.2 from *Skales* (T.83/40), which according to Pedrazzi (2007: 239) held some 18.2 litres (l) (her second group of Type 5.4 had similar capacities, ranging from 18–22 l; Pedrazzi 2010: 54). Volumetric analysis of Type 5.2 examples from Tyre and Tell es-Sa’idiyeh in Jordan had, respectively, capacities of 9.5 and 10.4 l, roughly half the volume of the larger variant. Our own volumetric analyses of Type 5.2 indicate similar capacities of 11.9–18.9 l (see the Appendix, Table A1: nos. 21–22).

Pedrazzi Type 5.5 (Figure 36) Sub-types and variants of Type 5.5 typically are associated with the central or southern coastal Levant, with intact examples most common at Tell Keisan (Pedrazzi 2007: 77–84) (Figure 36a). This container has a moderately high-rim but a longer body than Type 4, with multiple regional and exported variants divided into two groups, Type 5.5.1 (knobbed base, a Phoenician tradition), and Type 5.5.4 (rounded base, a Philistine tradition). Variants of this type flourished during Iron Age I, and are common at coastal Levantine sites such as Tyre (Bikai 1978: pl. 49.3–5), Sarepta (Anderson 1988: pls 31.7, 49.6–9), Dor (Gilboa 1998: figs. 6.1, 6.4) and Tel Qasile (Mazar 1985: figs. 26:13, 30:3,4, 48.10). On Cyprus, variants and sub-types have been excavated at Kition (Karageorghis and Demas 1985: pl. 55.565), Enkomi (Dikaio 1969–71, vol. IIIA: pl. 120:12), Pyla *Kokkinokremos* (Karageorghis and Demas 1984: pl. 37. trial A/2) and Palaipaphos *Skales* (Figure 36c; Karageorghis 1983: fig. CLIV:1). Bikai's (1983: 396–397) Type 1 from *Skales* (Figure 36b; see also Appendix, Table A1: no. 23) is compared to Type 5.5 jars from Tell Keisan.

Aznar's (2005: 151–53) petrographic analyses of two such jars (her Type 1B) from Tell Keisan suggest that one was likely produced along the Lebanese coast, the other in the region of Keisan itself. These jars correspond to examples of Pedrazzi Type 5.5.1 (Pedrazzi 2007: fig. 3.27.d) (Figure 36a), and Aznar (2005: 204) felt they were '... connected to the Phoenician coast and the Phoenician area of interaction (Keisan)'. She also maintained that her Type 1B was the Phoenician variation of her Type 1A, '... made on the Phoenician coast and on the (Israeli) northern coast, the latter probably in imitation of the Phoenician model' (Aznar 2005: 205).

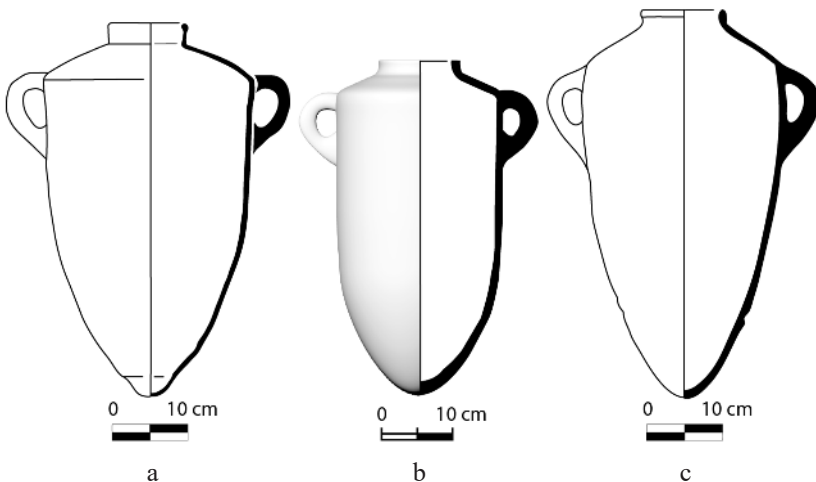
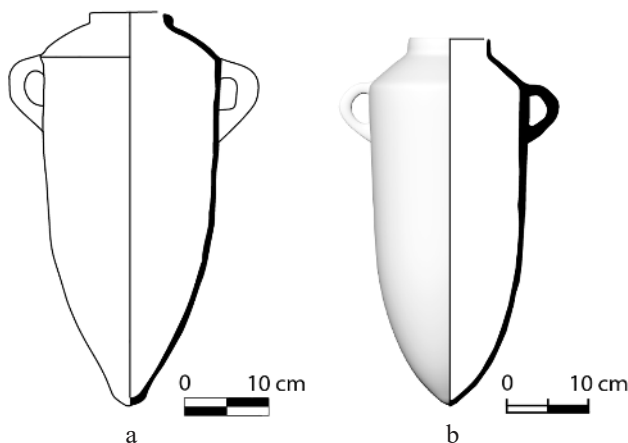


Figure 36 Iron Age I: Pedrazzi 5.5. a) from Tell Keisan (after Pedrazzi 2007: fig. 3.27:b); b) from Palaipaphos *Skales* (after Bikai 1983: 397-T44/134); c) from Palaipaphos *Skales* (after Karageorghis 1983: fig. CLIV:1). Drawings by Rob Martin and Irini Katsouri.



*Figure 37* Iron Age I: Pedrazzi Type 5.7. a) from Tyre (after Bikai 1978: pl. 41.5); b) from Deir el-Medina (after Nagel 1938: fig. 101.8). Drawings by Rob Martin and Irini Katsouri.

Pedrazzi Type 5.7 (Figure 37) In terms of its morphology, Type 5.7 falls between Type 5.5 (Figure 36), which has a rounded and carinated shoulder, and Type 5.2 (Figure 35), which has a more tapered and narrow bottom. Pedrazzi (2007: 86) thus suggests that Type 5.7 represents a key shape that may anticipate the so-called torpedo (or ‘sausage’) types of Iron Age II (see below), with a more elongated profile. In the absence of analytical or provenance data, she was nonetheless able to document the form at Tyre (Bikai 1978: pl. 41.5) (Figure 37a), Sarepta (Pritchard 1988: 295, fig. 43.11) and Tel Yoque’am in Israel (Ben-Tor et al. 2005: fig. I.10.2). One exported, intact example was excavated amongst mixed and Late Period remains in Egypt at Deir el-Medina (Nagel 1938: fig. 101.8; cf. fig. 103) (Figure 37b; see also Appendix, Table A1: no. 24); this was first noted in Raban’s (1980: pl. 26g) analysis of Iron I material. Type 5.7 is still under-represented in terms of numbers, exported or otherwise, but that may change along with the increased archaeological visibility of the Iron I period.

Pedrazzi Type 16 (Figure 38) There is significant morphological variation within Pedrazzi’s Type 16, said to derive from her Type 5.5 (compare Figure 36). She identified two main groups, with many examples morphologically midway between one type and the other (Pedrazzi 2007: 130). Type 16 often has an elongated and pear-shaped profile, with the maximum diameter typically in the lower half of the body. Some variants have a bulb base and/or a carinated shoulder (16.3, 16.4, 16.6), whilst others (16.1, 16.5) have a shoulder connected to the belly in a relatively continuous curve.

Type 16 jars are common throughout the Levant but were also regularly exported. Figure 38 shows two exported variants (Pedrazzi 2007: 130–139): 16.1.1 (from *Skales* on Cyprus; see also Appendix, Table A1: no. 25) and 16.1.2

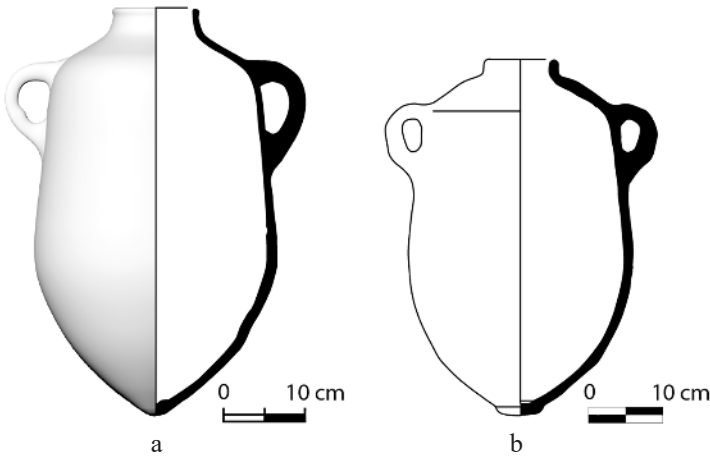


Figure 38 Iron Age I: Pedrazzi Type 16. a) from Palaipaphos *Skales* (after Pedrazzi 2007: fig.3.79;b); b) from (Iron Age) Amarna River Temple (after Peet and Woolley 1923: pl. LIII:LX/82). Drawings by Rob Martin and Irini Katsouri.

(from the Amarna River Temple in Egypt; Peet and Woolley 1923: pl. 53:LX/82). The imports of Type 16 from Palaipaphos *Skales* correlate well with examples from Tyre, where Cypriot pottery is found in quantity; Type 16.1.2 is also recorded at Kition (Karageorghis and Demas 1985: pl. LV:1056). Pedrazzi noted the typological correlation between variant 16.1 and Aston's Type A4 Iron Age 'Canaanite jars' from Egypt (see Table 3).

The earliest examples of Pedrazzi Type 16, from Palaipaphos *Skales*, provide a date no earlier than Cypro-Geometric I (c.1050–950 BC), although the forms continue to occur in tombs dated throughout Cypro-Geometric II–III (c.950–750 BC). The more pear-shaped variants of Pedrazzi Type 16 correspond generally to Type D of Gilboa et al. (2008:144) (see Table 3), which appears in their Stage 2 (Iron IB/Cypro-Geometric IB–II), and continues into their Stages 3 and 4 (Gilboa et al. 2008:148, 162), likely reflecting an Iron II morphology. Bikai (1983: 396) had already noted a general trend for a more triangular form in the earlier part of the Iron Age and a more bulbous (pear-shaped) form later. Variants within the Type 16 series clearly fall into Bikai's extremely broad classification of SJ9 at Tyre. No complete exported examples of this type have been analysed for provenance, but if the association between the very broad category Tyre SJ9 and Type 16 is correct, jars amongst this general type have been attributed to the Phoenician coast (Bikai 2000: 302).

*Summary* The still-limited evidence for exported Levantine MTCs speaks to both continuity and change. Certainly some degree of interregional and long-distance trade in Levantine MTCs continued. Although Phoenician pottery is rarely attested along the north Syrian coast and in Cilicia during Iron Age



IA–IB (Lehmann 2008: 221), some continuity in commercial contacts with Tarsus may be reflected by the import there of the earliest Iron Age morphological form of Pedrazzi's Type 5.2.

Although the focus here falls north of Philistia, in terms of the southern coastal Levant it may be noted that Ashkelon has yielded a great number and variety of such 'commercial jars' (Barako 2008: 429). Whilst Master (2009: 114) notes that the transitional Iron Age levels at Ashkelon suggest that 'variants of the "Canaanite" jar continued to be the overwhelming choice for large storage containers', Barako (2008: 437–438, and fig. 23.7–8) discusses only two excavated Iron I jar types, both likely variants of Pedrazzi Type 5.5. Examples like those at Ashkelon occur at other Iron I southern Levantine coastal sites (Ashdod, Tel Migne, Gezer and Tel Qasile) with parallels elsewhere (Dor, Tell Keisan and Megiddo; Barako 2008: 429). Like Pedrazzi, Barako speculates that those forms which lack an articulated bulb and have a rounded base may be associated with the Philistines.

Moving into the Mediterranean, specific contacts with Cyprus are clear, as shown by the continued import of variants of Pedrazzi's Type 4—and, to a lesser extent, variants of Type 5.5 and its later iterations in Type 16—throughout the Late Cypriot IIIA–Cypro-Geometric I periods (Gilboa 1998: 423). The MTC corpus from the tombs at Palaipaphos *Skales*—largely variants of Pedrazzi's Types 16, 5.2 and 5.5—would seem to complement the broader corpus of pottery exchanged between Cyprus and certain Levantine coastal sites (e.g. Tyre, Sarepta) during this transitional period. Gilboa et al. (2008: 143), however, caution that although such jars appear to be relatively common in the Cypro-Geometric IA levels at sites such as Kition, we should not classify them on morphological grounds as 'Phoenician' without further corroboration by clay analyses.

By the eleventh to mid-ninth centuries BC, Gilboa et al. (2015) note that Syria and northern Lebanon are no longer exporting transport jars to Cyprus, perhaps reflecting the diminishing importance of this area in maritime commerce after the 'crisis' at the end of the LBA. By contrast, the Carmel coast seems to have remained prominent for a time, with the port at Dor producing MTCs and boasting large numbers of Cypro-Geometric wares as well as Egyptian jars. Eventually, the southern Lebanese littoral (Tyre-Sidon area) emerged as a major supplier of transport containers to Cyprus during the early Iron Age. The mid-ninth to eighth centuries BC are largely represented by the Phoenician assemblage at Kommos, for which recent chemical and petrographic analyses indicate a source area in this region of southern Lebanon (Gilboa et al 2015).

In all cases, the EIA jar forms exhibit some morphological (if not technological) link to the Canaanite Jars of the LBA. In terms of provenance, however, apart from the likelihood of Tell Keisan in the case of Type 5.5 (and some iterations of Type 5.2 in the region of Dor—Paula Waiman-Barak, pers. comm., September 2015), we await further petrographic and chemical analyses before we can identify specific production centres. Even so, it is worthwhile taking note of Bettles' (2003b: 73) petrographic analyses of 30 'carinated-shoulder amphora'

sherds from Sarepta. These vessels, dating from the late Iron Age to the Persian period (c. 1000–332 BC), as well as similar examples from 21 southern Levantine coastal sites, suggest that at least some of the MTC production indeed took place at Sarepta. According to Anderson (1989: 199), the ceramic industry at Sarepta operated without disruption for over a millennium, covering an area of some 3000<sup>2</sup> m, with more than 100 kilns. All this lends weight to his conviction (Anderson 1987: 43–44) that vessel types such as Pedrazzi Types 5.2 and 5.7 were produced at Sarepta during the transition to the Iron Age. Although the relationship between specific morphological types or variants and their production centres remain uncertain, presently Tyre, Dor and Sarepta remain the most likely candidates for production centres on the Phoenician coast (Tell Kazel in Syria is still an attractive candidate for the production of Type 4).

In terms of chronology, Bikai (2000: 310) suggested that the archaeological visibility of EIA Phoenician trade is impaired because of the ‘less than spectacular form’ of data, such as the material at Kommos on Crete. Yet these fragmentary coarse ware sherds, along with the imported corpus of preserved jars from *Skales* on Cyprus, remain key to our understanding of Iron Age Levantine MTCs and their chronological development. Indeed, given the notably slim evidence, both from archaeological sites and documents, for Phoenician maritime activity during the earlier part of the Iron Age (Stieglitz 1990; Gilboa 2005; Sommer 2007), ceramic evidence forms the only basis on which we can establish at least a relative chronology.

The characterisation of Iron Age trade patterns as a ‘Levantine initiative’ (Sherratt and Sherratt 1993), one ‘centered in the old Canaanite world’ (Master 2009: 118), corresponds well with the available Iron I data. Byblos seems to have been involved in extensive trade with Sidon (Postgate 1974: 390–391), while the limited exposures at Tyre clearly reflect a close Cypriot connection (Master 2009), also evident on a smaller scale at Sarepta (Bell 2006: 99). Master (2009: 118) posits that during the eleventh century BC, ‘this Phoenician cartel extended as far south as Dor’ (see also Stern 1998) and revealed a pattern of trade that would set the stage for the Iron Age ‘radiating out from the surviving Canaanite-Phoenician cities’. Thus the ongoing development of the Canaanite Jar into the more explicitly articulated MTC forms of the Iron Age must also have been concentrated in Phoenicia.

### ***Phoenician MTCs: Iron Age II (c.900–700 BC)***

Unlike the situation in Iron Age I, for Iron Age II there are more sites with relevant archaeological material, more provenance studies and, most importantly, good evidence from two Phoenician shipwrecks. The spotlight here thus falls mainly on the jar forms documented from these deepwater wreck deposits, which provide good indicators of contemporary ‘Phoenician’ MTC types. In the literature, as noted above, most Iron II types are variously termed ‘storage jars’ (Amiran 1970: 241–42; Zemer 1977: 14–17; Sagona 1982; Aznar 2005), ‘transport amphorae’ (Regev 2004) or ‘commercial jars’ (Raban 1980:

9–13). With respect to the corpus of purpose-built MTCs, the ‘Crisp Ware Torpedo Jars’ that typify the Iron II period (see below), with their unique morphology and manufacture, stood apart from the larger body of contemporary ‘storage jars’ even before the fortuitous discovery of the Iron II shipwrecks (Ballard et al. 2002).

Amiran (1970: 241; pls. 81.4–8, 82.6) attributed Bikai’s ‘Crisp Ware Torpedo Jars’ (Amiran’s Group 2: ‘sausage-shaped jars’) to Iron II C; of the three main morphological forms discussed here, she further attributed two types to the northern Levant and one to the southern Levant (see Figure 39, below). Raban (1980: 10) similarly argued that, while the ‘sausage-shaped jar’ was more common in the north, a ‘wasp-waisted’ form was common in the south. Amiran (1970: 241) also observed that, unlike other Iron II storage jar types, all the ‘sausage-shaped jars’ were particularly well made, ‘well levigated and well-baked to give off a metallic sound’. It is precisely this auditory feature that later led Bikai (1978: 46) to term such forms and their fabrics as ‘Crisp Ware’ at Tyre. Bikai (1983: 396) felt that the Iron II jars evolved into the more compact-waisted varieties that became common in Iron II–III (Bikai 1987: 49).

Raban (1980) argued that the heyday of the ‘sausage jars’ was limited in time, as such long and narrow jars would have been impractical for storing upright in the hold of a ship. Thus he saw the shorter, more conical forms of the late Iron II–III as part of their continued evolution into vessels specifically designed for maritime transport. He regarded these ‘jars of a conical shorter type, known as Torpedo Shape’ as the more definitive MTCs of the Iron Age (Raban 1980: 11). Sagona (1982), following Amiran, noted the same three principal forms of ‘Levantine Storage Jars’ that characterise the Iron II.

More recently, Aznar (2005) developed a refined typology for the ‘Crisp Ware’ corpus of Iron II, adding some much needed petrographic analyses and tentatively identifying some production centres. Her work thus provides a foundation on which to build an Iron II MTC nomenclature, and it has been adopted in our MTC typology (below). Sagona’s (1982) Types 1–3 also form part of the same ‘Crisp Ware’ tradition; they are treated here as morphological variants of Aznar’s Types 9B1 and 9B2 (see below, Figure 39b–c). The three primary Iron II forms examined here, therefore, are of Aznar’s (2005: 58) ‘Type 9 cylindrical storage jar family’ (Sagona Type 1–3); the majority of complete, exported examples of her Type 9B1 derive from the Iron II shipwrecks.

### *Iron Age II Phoenician Shipwrecks: The Tanit and Elissa*

The cargoes of two shipwrecks—the *Tanit* and *Elissa*—shed crucial light on the central place of MTCs in Phoenician maritime trade during Iron Age II (Ballard et al. 2002; Stager 2003; Finkelstein et al. 2011). Lying some 2 km from each other, these wrecks were discovered in deepwater explorations (–400 m), about 30 nautical miles off the coast of the Gaza Strip in 1997; further investigations in 1999 indicated that the wrecks should be dated to the eighth

century BC. Both ships are argued to be of 'Phoenician' origin, laden with wine-filled jars (estimated to weigh over ten tons on each ship) and destined—in the excavators' view—for either Egypt or, perhaps, Carthage. The Phoenician origin was proposed on the basis of other types of pottery vessels found on the wreck and common on Phoenician sites in the central or southern Levant. These include in particular a small incense stand and a 'mushroom-lipped decanter', described as the 'calling card of Phoenicians from Tyre to the Pillars of Hercules' (Ballard et al. 2002: 163, 160 fig. 9.1).

Using an array of specialised equipment, the project first identified and mapped the stacked amphorae, which appeared to show their vertical orientation and arrangement in intercalated layers. The team then raised 16 vessels (of 385 visible in the top tiers) from the *Tanit* and 7 (of 396 visible) from the *Elissa* for closer examination and provenance analyses. The 'torpedo-shaped' jars from both wrecks appear to be standardised, averaging 68.8 cm in height, 22.3 cm in maximum diameter, and with an average estimated volume of 17.8 litres of liquid (but cf. the Appendix, Table A1: no. 27). These vessels have close parallels from mid-to-late eighth century BC contexts at sites such as Megiddo III, Hazor VI–V, Tyre III–II and Sarepta (Ballard et al. 2002: 158, nn.13–14, fig. 7; 160 fig. 9; 162 table 3). The authors maintained that the small-sized handles of these vessels were designed for 'guide ropes', used to contain and consolidate seaborne cargo. They also asserted that 'the petrographic profile of these jars is consistent with the Phoenician coast' (Ballard et al. 2002: 159–160), a point reinforced by subsequent studies (Aznar 2005: 66–68, 157–160; Singer-Avitz 2010: 188–190). The vessels were deemed impractical for terrestrial transport, having been designed as 'purpose-built marine containers' (Ballard et al. 2002: 159). More recently, Finkelstein et al. (2011: 257) have described them as 'primarily made for marine transportation'. Infrared spectrometry, liquid chromatography and wet chemical analyses indicate that at least one of these amphorae contained tartaric acid, which occurs in grape products such as wine (McGovern, in Ballard et al. 2002: 160–161).

Based upon Stager's (2003: 239) calculations for the volumes of the torpedo-shaped vessels recovered from the *Tanit* and *Elissa* shipwrecks, their dry weight ranged between 6.7–7.2 kg, whilst their wet weight (i.e. filled with water or wine) ranged between 22.5–27.6 kg. Thus the weight of each pottery vessel being shipped represented 30–35% of the jar's weight when full. Given that these ships carried some 400 jars (nearly ten metric tons) and that any increase in capacity presumably meant an increase in efficiency and profit, this factor may have been a consideration for the potters and merchants involved. The vessels might also have doubled as ballast, but in any event it seems unlikely that the modified morphology of the Iron Age II torpedo-shaped jars was motivated by a need to reduce MTC vessel weight.

Apart from any perceived need for standardisation, these vessels may have offered a better answer to an essential problem facing all pottery shipments by sea, namely how to modify the shape in order to maximise the number and capacity of jars that could fit into the hull of a ship (or into a kiln for that

matter). At the same time, such vessels needed to be manufactured in such a way that they could handle the stress and distribute the weight and compression of being stacked in the hull of a ship. The clustering of upright jars along the centre of these sunken ships—from keel to stern—thus may reflect their original placement and intended orientation in the hull during shipment (Ballard et al. 2002: figs. 3, 5).

The most representative examples of intact, cylindrical variants of the ‘Crisp Ware Torpedo Jars’ (Aznar Type 9B1/Sagona Type 2) are found among the 781 vessels counted on these shipwrecks. Finkelstein et al. (2011: 250–251), who note that land-based excavations have produced less than 300 examples of this type of vessel, sought to determine if the corpus of jars from the shipwrecks reflected any level of standardisation, especially in comparison with torpedo-shaped vessels found on land sites. They undertook volumetric analyses of 20 examples from the wrecks along with 134 examples from land sites (based on published drawings) to generate 3D computer models of volume. The jars were compared according to their profile, variability in shape and approximate volume (see also Zapassky et al. 2009). Fifty-one of the 154 jars analysed formed a compact sub-cluster that included all 20 of the vessels from the shipwrecks (Finkelstein et al. 2011: 254) (see further discussion in the Appendix).

Given the long history of Egyptian contacts with the Levant, Finkelstein et al. (2011: 255) also assessed the shape and volume of these jars with respect to ancient Egyptian units of measure (the Egyptian royal cubit as the unit of length, and the *hekat* as the unit of volume). They concluded that the cylindrical variants represent a standardised form, made in specialised pottery workshops, primarily for the maritime transport of liquids (Finkelstein et al. 2011: 258). The jars displayed less than 5% difference between the narrowest and widest diameters. According to their analyses, physical measurements and 3D modelling indicate that ‘simple and directly taken outer measurements of the height and circumference of a torpedo jar’s cylindrical part’ could guarantee a volume of 4 *hekats* (=19.2 litres)—the standard liquid trade unit of this period (Finkelstein et al. 2011: 255–257) (but compare our discussion in the Appendix).

That there was a close relationship between these cylindrical variants and the Mediterranean wine trade seems evident, as does their place within a broader corpus of ‘Crisp Ware’ emanating from production centres on the Phoenician coast (Aznar 2005: 206). Much like the development of the Canaanite Jar into a more standardised form used in long-distance maritime trade, the question remains whether the documented morphological variation of the ‘Crisp Ware Torpedo Jar’ relates more to a need for standardisation, or to new technological production methods (as intimated by the limited evidence for pottery workshops at Tyre), to the requisite attributes of an MTC (i.e. for specific maritime usage), or perhaps to all of these factors.

The Iron Age II Crisp Ware Torpedo Jar is essentially a streamlined and standardised development of the Canaanite Jar. By the Levantine Iron Age II period, this tradition of MTCs had undergone its most distinctive technological and morphological development, even if it was not the first purpose-built MTC.

The stubby, bulbous, reinforced bases of the Iron Age I forms were replaced by a sturdy ‘beaked’ base, which perhaps more easily withstood the stresses confronted during transport in a ship’s hull without breakage. In Stager’s (2003) view, supported by the volumetric analyses of Finkelstein et al. (2011), the Iron Age II ‘Crisp Ware Torpedo Jar’ (Aznar Type 9B) became the most standardised ‘commercial jar’ yet known from the Levant. To understand more about the production and use of these MTCs, sourced mainly to the Phoenician coast, we turn now to Aznar’s (2005: 56–68) ‘cylindrical storage jar family’, which forms the basis of our Phoenician MTC typology.

### *Phoenician MTC Typology*

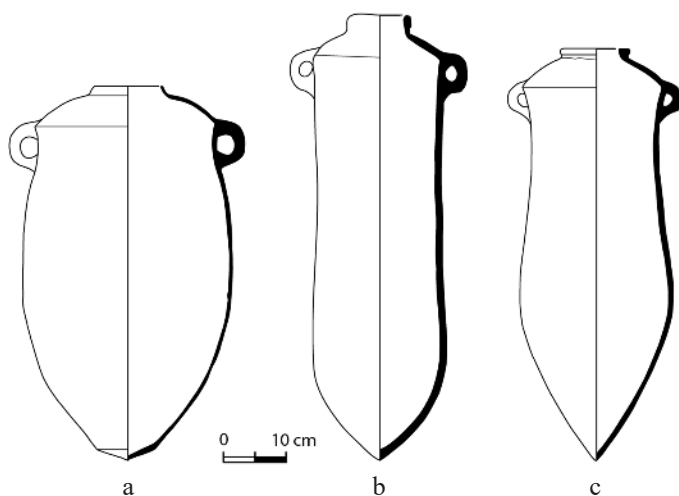
(see Figure 39 for all vessel types, and Table 4 for Iron Age II typological correlations)

Aznar Type 9A (Pedrazzi Type 16.3; Sagona Type 1) (Figure 40) The general type corresponds to later iterations of Gilboa et al.’s (2008: 152, 163) Type D, particularly their Stage 3 and 4 commercial jars, some of which are equivalent to variants of Pedrazzi’s Type 16.3 (Pedrazzi 2007: 133). These are amongst the Iron Age ‘coastal Phoenician storage jars’ that Bikai (2000: 310) felt continued, with minor variation, until the rise of the ‘Crisp Ware’ vessels (Aznar’s Type 9B, discussed below). Sagona (1982: 92) recorded one very early and fragmentary example from Myrtou *Pigadhes* on Cyprus, while Bikai (1987: 50; pl. XXIII:612) added a late form from Salamis, dated c.850–750 BC. Exported examples also appeared in Egypt in the Twenty-second Dynasty cemetery at Qurneh (Petrie 1909: pl. L:795), along with an example of Type 9B. Reviewing an example retrieved from the sea, Zemer (1977) cited others at Megiddo, Lachish, Hazor, Tell en-Nasbeth, Tell Abu-Hawam, Samaria and Ein-Shems; he also suggested a volumetric capacity of 25.6 litres for them (Zemer 1977: 14; cf. Appendix, Table A1: no. 26).

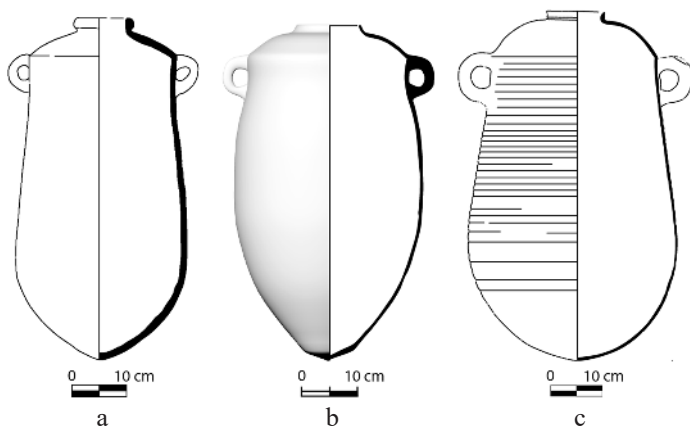
Aznar’s (2005) analysis distinguished two sub-types based upon form (one ‘sack-shaped’, the other more cylindrical), with dates ranging from the late Iron I–Iron II. She analysed examples of type 9A jars from various sites in Israel: Horvat Rosh Zayit (3), Tell Abu Hawam (3), Rehov (1) and Hazor (5) (Figure 40a). Although most analysed vessels of this type appear to have been manufactured along the Phoenician coast, three fabrics seem to indicate local

*Table 4* Iron Age II Typological Correlations

<i>Aznar (2005)</i>	<i>Sagona (1982)</i>	<i>Pedrazzi (2007)</i>	<i>Gilboa et al. (2008)</i>	<i>Bikai (1978) Tyre</i>
Type 9A	Type 1	Type 16.3	Type D?	SJ9
Type 9B1	Type 2			SJ15
Type 9B2	Type 3			



*Figure 39* Iron Age II MTC typology. a) Aznar Type 9A, from Saqqara (after Aston 1996: 174, fig. 72.2); b) Aznar Type 9B1, from *Elissa* shipwreck (after Ballard et al. 2002: 160, fig. 9.5); c) Aznar Type 9B2, from Tyre (after Bikai 1978: pl. III:7). Drawing by Rob Martin.



*Figure 40* Iron Age II: 'Thick cylindrical storage jar', Aznar Type 9A. a) from Hazor (after Amiran 1970: pl.81.5); b) from Saqqara (after Aston 1996: 35, fig. 72.2); c) from Pithekoussai (after Buchner 1982: fig. 4c). Drawings by Rob Martin and Irini Katsouri.

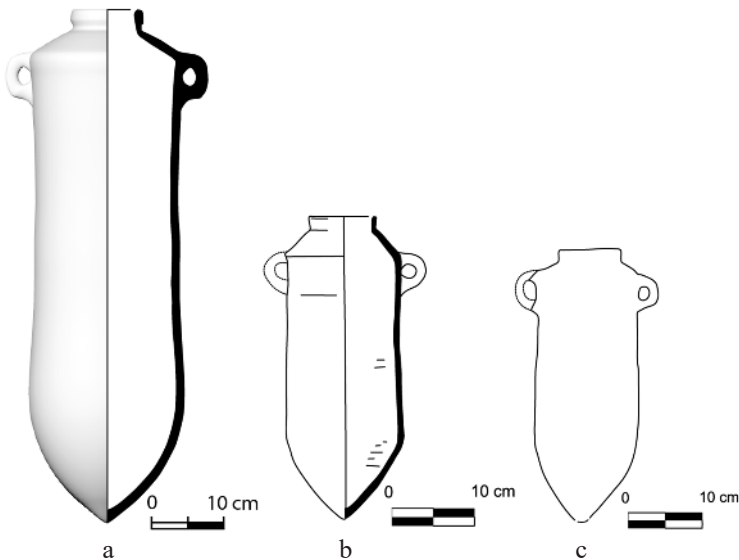
production in the sites where they were found. Aznar (2005: 156–157) observed that Phoenician jars may be distinguished from non-Phoenician types by the 'marked carination in the shoulder, elongated bodies and rounded, slightly pointed, or bulbous bottoms'. Aston (1996: 35, figs. 72.1–2) discusses an example from a disturbed context at Saqqara (Figure 40b; Appendix, Table A1:



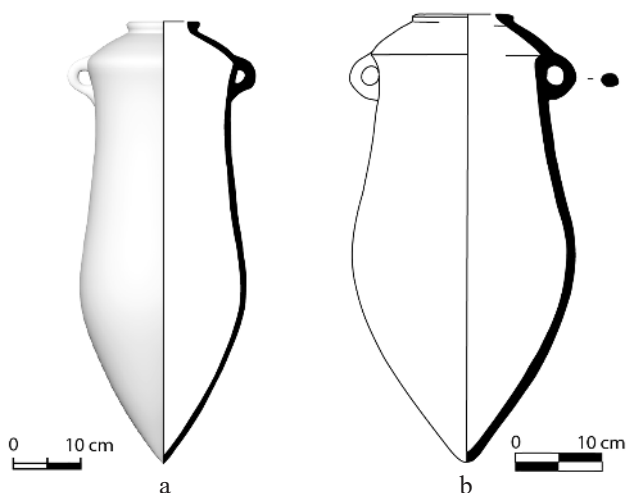
no. 26), and notes that this ‘Levantine import’ was found with an Egyptian copy. He also noted that imported transport amphorae ‘are not uncommon at tombs in Saqqara, Lahun and Thebes’, and provided other late examples that correlate well with this type (Aston 1996: 85, fig. 234a–c); they are comparable to forms from Cyprus reconstructed by Bikai (1987: pl. XXIII:611–612). Compelling parallels are found amongst the late eighth century BC ‘Phoenician amphorae’ (Regev 2004: 340) from Pithekoussai in Italy, where three complete examples were found in the necropolis, together with a ‘miniature’ example of Aznar Type 9B1 (Buchner 1982: 280–283; fig. 4a–d) (Figure 40c).

Aznar Type 9B (9B1–B2) (Sagona Types 2 and 3) (Figures 41–42) Aznar (2005: 58) assigned two types of jars to this group (she terms them ‘9.B.i’ and ‘9.B.ii’): 9B1 (cylindrical and elongated) and 9B2 (S-shaped and elongated). 9B1 is commonly known as the ‘torpedo’ jar, 9B2 as the ‘wasp-waisted’ jar. The later the date of both types, the more pointed and curved (as opposed to straight-sided) their bottom tends to be. These elongated cylindrical storage jars stand about 60–70 cm high.

Aznar’s Type 9B thus includes both morphological variants of the ‘Crisp Ware Torpedo Jars’: 9B1 (Sagona Type 2), the type retrieved from the *Tanit* and *Elissa* shipwrecks, and 9B2 (Sagona Type 3). Both variants are prevalent throughout Iron Age II and are believed to be ‘Phoenician’ in origin. Apart from their



*Figure 41* Iron Age II: ‘Cylindrical elongated jar’, Aznar Type 9B1. a) from *Elissa* shipwreck (after Ballard et al. 2002: 160, fig. 9.5); b) ‘miniature’ Type 9B1 from *Elissa* shipwreck (after Ballard et al. 2002: 160, fig. 9.4); c) ‘miniature’ Type 9B1 from Pithekoussai (after Buchner 1982: fig. 4d). Drawings by Rob Martin and Irini Katsouri.



*Figure 42* Iron Age II: 'S-shaped elongated jar', Aznar Type 9B2. a) from Tyre (after Bikai 1978: pl. III:7); b) from the sea, off southern Levantine coast (after Zemer 1977: 17, pl. 4 no. 11). Drawings by Rob Martin and Irini Katsouri.

distinctive metallic fabric, these highly fired, perhaps standardised jars carry forward the conical shape, the lowering of the vessel's maximum diameter and the concentration of increasingly vestigial handles at the rim (presumably designed exclusively for ropes, as argued by Stager 2003: 241; fig. 7). Regev (2004) suggests that by the eighth century BC, this 'Crisp Ware Torpedo Jar' had become the predominant type of Phoenician transport vessel, as well as the most common type found (and imitated) on Phoenician sites in the western Mediterranean (Regev 2004). Differences in the rim type appear to distinguish between coastal Phoenician and hinterland traditions (Gilboa et al. 2004; Aznar 2005). Bikai (1978: 310) noted that such vessels may have been 'mass produced', a possibility also suggested by some of examples from the Iron II shipwrecks (Figure 41a–b; Appendix, Table A1: nos. 27–28) and the level of standardisation found in the volumetric analyses conducted by Finkelstein et al. (2011: 257–258; and cf. our discussion in the Appendix). In Bikai's view (2000: 310), the uniformity in rim types not only made them easy to classify but also may have had implications for identifying production centres (see also Gilboa et al. 2004). Stratum II at Tyre contained 'a large number of storage jar kiln wasters', which might suggest local production of this vessel type (Bikai 1978: 13, 47, pl. III:7; see Figure 42a, and Appendix, Table A1: no. 29), and subsequent distribution through Phoenician trading networks.

Stager (in Ballard et al. 2002: 161–162) published a preliminary distribution of 'Crisp Ware Torpedo Jars' of the same type as those retrieved from the wrecks (i.e. 9B1), which revealed a strong coastal pattern in the central and southern Levant, with examples noted from Cyprus at Kition, and far distant

Carthage. Fragmentary remains of either 9B1 or 9B2 occur in the northern Levant at Al Mina (Lehmann 2005: fig. 9:1) and Tell Ta'yinat (Osborne 2011: pl. 22:14–16), which may have used Al Mina as its coastal port (discussed above, Chapter 2, under *Harbours*). Bikai (1987: pl. XXIII, no. 588) recorded a late eighth century BC example of 9B1 at Kition on Cyprus. Sagona (1982: 95–96) recorded two examples of 9B1 (his Type 2) in Cypriot tombs at Aphendrika and Tsambres, and other examples of 9B2 (his Type 3) in tombs at Kition, Marion and Tsambres. Examples of both Aznar Type 9B1 and 9B2 were catalogued in a survey of jars retrieved from the sea off the coast of Israel, near Dor (Zemer 1977: pl. 4.11) (Figure 42b). Regev (2004: 340) identified several examples of Type 9B jars in the west Mediterranean from the eighth century BC onwards. Here we simply note a few examples: (a) rims that can be attributed to 9B1 and/or 9B2 at Carthage (Vegas 1999: 430–431); (b) a 'miniature' example of 9B1 from Pithekoussai (Buchner 1982: fig. 4d; here Figure 41c) nearly identical to one from the *Elissa* shipwreck (Ballard et al. 2002: 160, fig. 9.4; here Figure 41b); and (c) a similar miniature example of 9B2 from Cumae, on the Tyrrhenian coast of Italy (Gàbrice 1913: 245; fig. 84). In Egypt, the Twenty-second Dynasty (c.943–716 BC) cemetery at Qurneh revealed both Aznar Type 9A and 9B1 examples (Petrie 1909: pl. L:794, 795). Bourriau (2004: 92) described 'the ubiquitous Phoenician wine amphorae' from the Third Intermediate Period at Buto, where their fabric stood apart, and overwhelmed the number of locally produced examples.

Singer-Avitz (2010: 188–190, fig. 1:1–5) published a corpus of Type 9B2 jars, notably 20 complete and many partly preserved examples and fragments from Tel Beersheba Stratum II (Iron IIB), in Israel. She notes that such jars were common during Iron Age IIB along the coasts of Lebanon and Israel, and inland mainly at Hazor and Megiddo. Because large assemblages of these jars were found at both Tyre and Hazor, Geva (1982) had suggested they might have been manufactured in the southern Levant (i.e. Israel) and exported to the coast (Tyre). Bikai (1985), however, felt that the Tyre corpus was manufactured locally and exported to Hazor. In turn, Gilboa (1995: 11) argued that the apparent typological differences in rim shapes suggest that the Hazor jars are different from those of Tyre, a conclusion later reinforced by computerised morphological analysis (Gilboa et al. 2004: 691–692).

Beyond the work by Aznar, the study by Singer-Avitz (2010: 188–190) offers one of the most comprehensive discussions of Type 9B2 forms and their production centres. Analysis of such jars from Tel Beersheba showed that they share a similar body type. Three examples of these vessels analysed by Goren and Halperin (2004: table 36.4:8–10) were shown to be compatible with the ferruginous clays of the Lebanese coast. Despite the notably wide distribution in the Mediterranean of Aznar Type 9B1–B2 jars, Raban (1980: 11) long ago noted that not a single example of these types has turned up in the Aegean; apart from the sherds excavated at Kommos, that picture persists to this day.

**Discussion and Conclusions**

With the transition to the EIA, many regional and palatial powers of the Levantine LBA went into decline or were reorganised (Knapp and Manning 2016), leaving a void that the Phoenician city-states would hasten to fill, undertaking maritime trading ventures and pottery manufacturing activities that show appreciable continuity with those of the preceding Bronze Age. By the Iron Age II period there is sound evidence for ships loaded with a large cargo of definitive MTCs and their contents (perhaps wine, based on the analyses available). Thus the transport by sea of bulk liquid commodities in specialised MTCs during Iron Age II is clear. During this period, the ‘Crisp Ware Torpedo Jar’ arguably became the standardised commercial jar used in maritime trade, with Aznar Type 9B1 emerging as the Iron II MTC par excellence. ‘Bullet-shaped’ jars (Type 9; Aznar 2005: 68–69) also emerge during the late eighth century BC at sites like Tyre, but would take longer to achieve the same exported frequency as an MTC (which happened later, during Iron III). Further refinement of the Iron II ‘Crisp Ware’ typology and study of production centres may reinvigorate Stager’s assertion (in Ballard et al. 2002: 159) that the vessels recovered from the *Tanit* and *Elissa* wrecks (Type 9B1) represent ‘purpose-built maritime containers’.

The production of some MTC forms has been associated, by means of petrography, with the Phoenician coast and specific coastal centres, such as Tell Keisan, Dor, Sarepta and Tyre, some with kilns (Sarepta) or kiln wasters (Tyre). Aznar’s (2005: 210) work indeed suggests that her Type 9B1 (variants 2–3) was produced at Sarepta, with variants 4a–c made at Tyre; the former are the variants (or sub-types) of the vessels recovered from the Iron II shipwrecks (Ballard et al. 2002; Stager 2003). Moreover, recent analytical work on the ninth–eighth century BC Phoenician assemblage at Kommos points to the emergence of MTC production centres in southern Lebanon (Gilboa et al. 2015).

Figure 43 presents a general diachronic overview of the Levantine MTCs examined in this section, adding to the work of earlier scholars such as Grace (1956), Amiran (1970), Raban (1980), Killebrew (2007), Pedrazzi (2007) and Gilboa et al. (2008). Even so, any seemingly uninterrupted continuity in development belies the appreciable diversity of forms that characterises all periods, and this illustration is not meant to impose an artificial ordering on the past. Lawall (2011b) has cautioned against establishing linear evolutionary typologies based on the identification of imitations. Neither do we mean to imply an uninterrupted evolution of forms as was the case with Amiran’s (1970: pl. 43) proposed development of the ‘angular shouldered’ Canaanite Jar during the LBA, which glosses over the continued use and maritime transport to Cyprus of globular Canaanite Jar forms throughout the Late Bronze Age and into the Early Iron Age (Pedrazzi 2010). Rather this figure attempts to depict, in very broad strokes, the morphological features of Levantine ‘commercial jars’ that would ultimately give rise to the even more explicitly articulated Phoenician MTCs.

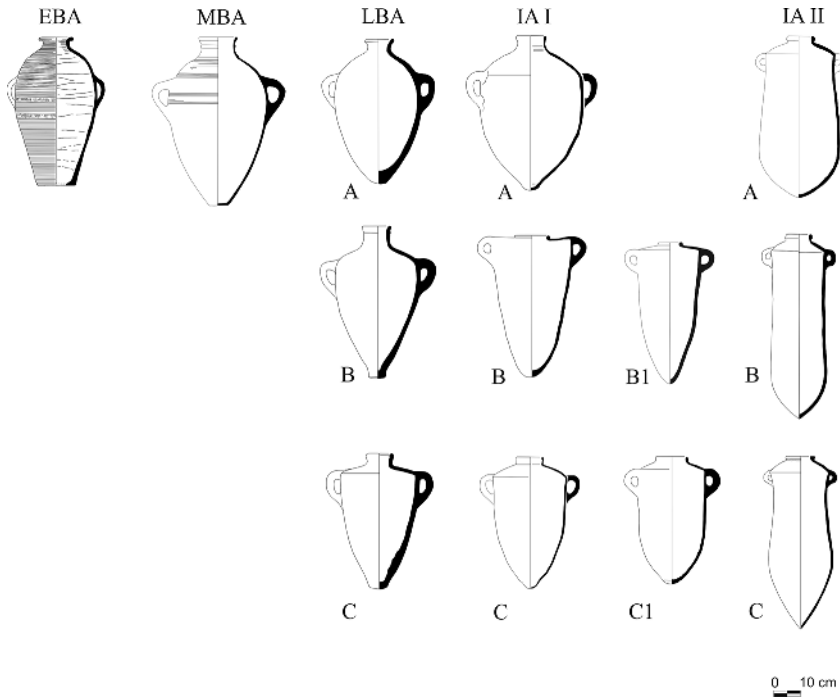


Figure 43 Diachronic Overview. Drawing by Rob Martin.

**EBA III:** Combed Ware Jar, Egypt (Knoblauch 2010: 249).

**MBA II:** Canaanite Jar, Egypt (Aston 2004: pl.169).

**LBA:** Canaanite Jars (Amiran 1970: pl. 43)

A. LB IA Canaanite Jar (Amiran 1970: pl. 43.2)

B. LB IIA Canaanite Jar (Amiran 1970: pl. 43.5)

C. LB IIB Canaanite Jar of Pedrazzi Type 5.4 (Amiran 1970: pl. 43.9).

**IA I:** Phoenician and other Levantine 'Commercial Jars'.

A. Type 4.1, Tell Kazel (Pedrazzi 2007: fig. 3.16:a)

B. Type 5.2, Palaipaphos *Skales* (Gilboa et al. 2008: fig. 9.6–10)

C. Type 5.5, Tell Keisan (Pedrazzi 2007: fig. 3.27:b)

B1. Type 5.2, Palaipaphos *Skales* (Gilboa et al. 2008: fig. 13.8)

C1. Type 5.5, Palaipaphos *Skales* (Bikai 1983: 397, T44/134).

**IA II:** Phoenician 'Crisp Ware' Commercial Jars and MTCs.

A. Aznar Type 9A, Hazor (Amiran 1970: pl. 81.5)

B. Aznar Type 9B1, Elissa shipwreck (Stager 2003: 160, fig. 9.5)

C. Aznar Type 9B2, Tyre (Bikai 1978: pl. 3.7).

The earliest, EBA precursors, with their high centres of gravity and flat bases, were surely prone to breakage, and the MBA version of the Canaanite Jar served as a major improvement upon this form. The LBA forms remain more or less comparable to their MBA counterpart until the thirteenth century BC, when a more triangular, carinated type of MTC (Killebrew form CA 22; Pedrazzi Type 5.4) became intimately associated with long-distance maritime trade. With some probable interruption during the transition to the Iron Age, these developments

seem to continue with the MTC industries of the Phoenicians, which show the same carination, and thus show concern with issues of stacking and/or breakage but also with an increasing tendency toward standardisation (as argued by Pedrazzi 2010 for the Late Bronze Age, and Finkelstein et al. 2011 for Iron Age II). Pedrazzi Type 5.5 as well as the ‘heavy’ Iron I prototypes of her Type 5.2, likely represent a continuation of such developments during the transitional Late Bronze–Early Iron Age periods. Other variants, which seem to emulate vessels of the LBA, may prove to represent an entirely different technique of ceramic production in the same tradition, rather than an imitation. In terms of provenance, still far from clarified, Pedrazzi Type 5.7 represents rather small-scale production whilst her Type 16 includes many variants—apparently from the southern and coastal central Levant—where it is related to Type 5.5. Pedrazzi Type 5.2 may be associated with the kilns of Sarepta, also in the central Levant, whereas only Pedrazzi Type 4 (dated to the transitional LBA/EIA) is associated with the northern Levant, possibly being produced in the region around Tell Kazel.

During the Iron Age, conical vessel forms proliferate, as well as some with a more bulbous shape. The reinforcement of the base in this manner likely relates to the stress that fell upon this common point of fracture. At least some of the Iron Age II ‘torpedo’ vessels assume a wholly cylindrical character for a time, but nonetheless also exhibit a widening at the base, which becomes more pronounced, especially approaching the seventh century BC. As these vessels developed a more conical shape, with a low centre of gravity (like the Iron II Aznar Type 9B2; Sagona Type 3), the pressure on the base of the vessel was greatly reduced, enhancing the vessel’s ability to distribute the weight when stacked, nested or slung in rope.

The production of MTCs during Iron I appears to be a regional phenomenon, especially after the disappearance of the LBA Canaanite Jar types associated with long-distance maritime trade. The distinctive morphology of carinated LBA forms has often been seen as a function of the MTC (e.g. Leonard 1996; Bevan 2014). The question remains, however, whether this was a result of production methods and/or of standardisation. Certainly there was some experimentation on the fast wheel during the LBA, which seems to have been carried forward into the Iron Age at Sarepta. Similarly, the distinctive Pedrazzi Type 5.2 jars may have been thick and ‘heavy’ not just for the rigors of maritime transport, but perhaps also because of their contents (murex dye? wine?). The morphology of these Type 5.2 containers is almost certainly related to the fact that they had to be stacked, whether in a ship’s hull or in large kilns, as Anderson (1989: 203–204) assumed for Sarepta.

Pedrazzi Type 5.2 was a Phoenician MTC that, unlike other exported types, is documented not only in a plausible LBA/Iron I wreck deposit (‘Shipwreck 13’ at Dor) but also in Iron I levels in Egypt, Cyprus and Cilicia. The presence of the earlier variant (Gilboa et al. 2008—Type C, Stage 2 commercial jars) in western Cyprus and at Tarsus may speak to continuity in the earlier maritime systems of trade that brought Canaanite Jars to these regions (also suggested by the continuing import of Type 4). The absence of the earliest variant of Type

5.2 in Egypt may suggest an initial disruption in trade connections that was re-established by Iron II, when the later form of Type 5.2 is documented at both the 'River Temple' in Amarna and Heracleopolis Magna (but note that the limited EIA material from Egypt remains difficult to assess).

During Iron II, we see the emergence of another standardised vessel type—the 'Crisp Ware Torpedo Jar' (Aznar Type 9B1)—closely associated with maritime exchange. From the time of the transition to Iron III, all the basic morphological characteristics are in place for the continued production of MTCs into the Persian Period (Bikai 1987: 49). Thus the Iron I–II periods represent a time when we can distinguish either purpose-built MTCs, or at least more standardised 'commercial jar' types that were primarily involved in maritime activities.

What can be said about the mechanisms of transport and the type of commerce involved in Early Iron Age Levantine trade? Whilst the Phoenician city-states certainly engaged in land-based trading and relied on transport from hinterland production centres (Stager 2001), their maritime activities were amongst the most extensive yet witnessed in Mediterranean prehistory and protohistory. The discovery of the *Tanit* and *Elissa* shipwrecks shows that, by Iron II, a system of supply and demand was in place for maritime transport and export on a bulk scale, involving apparently standardised containers of sophisticated manufacture that originated in major centres along the Phoenician coast. The appearance of these vessels on shipwrecks or in foreign markets like Egypt, Cyprus, Crete, Italy and Carthage makes their absence in mainland Greece conspicuous, as does the Phoenician material found at Lefkandi (on Euboea).

The broad overview presented here includes only those forms that in their documented contexts, or in their probable purpose at the point of manufacture, might be classified as MTCs. It would appear that the development of the Levantine MTC tradition was closely associated with the production and transport of certain liquid staples, principally wine, olive (or other types of) oil, resins and perhaps dyes. Local and especially foreign demand for such products must always have played a formative role in economic, technological and social developments in this region, from the EBA through the EIA.

By the Iron Age, the archaeological record reveals both purpose-built storage jars, clearly not designed for maritime transport, and MTCs like Aznar's Type 9B1, which filled the holds of the *Tanit* and *Elissa* ships. Perhaps through a better understanding of these Iron Age traditions we can begin to make sounder inferences about Bronze Age practices, when *ad hoc* and secondary usage is also evident in the material record. The underlying implication, however, is that at their point of origin, and in the context of their production and primary use, those vessels that we term MTCs seem to have been designed for maritime transport. Given the continuity of socioeconomic and technological developments associated with the continued production and use of MTCs in the Iron Age Levant, it would seem that the objectives of the Bronze Age Canaanites cannot have been so different from those of their Iron Age Phoenician successors. The evidence from both terrestrial and underwater excavation, and in particular that



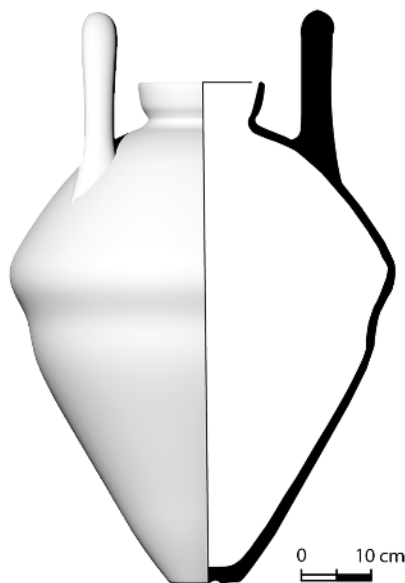
from the Uluburun, *Tanit* and *Elissa* shipwrecks, demonstrates well how single finds can change, skew or help to clarify our interpretations, and refine our understanding of MTCs, transport and trade, and Mediterranean connections.

### ***Cyprus (Stella Demesticha)***

#### *Cypriot Basket-handled Amphorae*

By the beginning of the Cypro-Archaic period (750–700 BC), a transport container with distinctive handles was being manufactured on Cyprus. Gjerstad (1960: 120–121) characterised it as a ‘pithoid amphora’ and classified it under Plain Ware Type IV (see also Winther Jacobsen 2002; Leidwanger 2005–06). The arched horizontal handles, rising from the shoulder to well above the rim, are the most characteristic feature of these MTCs, hence their name: basket-handled, loop-handled or basket storage jar (Sagona 1982: 88; Figure 44 here).

The type developed from a Cypro-Geometric amphora with horizontal raised handles (Gjerstad 1960: 120–121; Winther Jacobsen 2002: 170) and was most likely used for household storage or transport: this is indicated by two Cypro-Archaic clay figurines of women carrying such vessels on the top of their heads (Karageorghis 2006: 163, nos. 145–146). Another Cypro-Geometric figurine depicts a man carrying a basket-handled amphora (Karageorghis 2006: 161, no 142). Four types and subtypes have been distinguished thus far, covering a period of approximately four centuries, from the late eighth to the third century BC.



*Figure 44* Cypriot Basket-handled Amphora, from Salamis (after Karageorghis 1974: pl. 221). Drawing by Irini Katsouri.

The early type of Basket-handled Amphorae, classified as Type A (Leidwanger 2005–06: 25–26), has a large biconical body and a small flat base with vertical marks from shaving the clay before firing. Their largest and earliest known assemblage thus far, comprising 34 containers, was excavated in Tomb 79 of the necropolis of Salamis (Karageorghis 1973: 52), dated to the eighth century BC (Figure 44). As their production continued until the end of the sixth century BC, it is seldom possible to distinguish published examples of this type's starting phase; it seems that their distribution outside Cyprus began systematically during the seventh century BC, as evidenced by the three shipwreck assemblages found at Kekova Adası, Lycia, and at Kepçe Burnu and Çaycağız Koyu in Caria (Greene et al. 2013) (noted above, in Chapter 2, under 'Shipwrecks'). Earlier examples, however, are attested at Kelenderis, Cilicia (Zoroğlu 2013) and Tell Keisan, in the central Levant (Salles 1980).

Most scholars agree on the Cypriot origin, at least of the early types in the series. Petrographic (Courtois 1980: 358–360) and Neutron Activation Analysis (Gunneweg and Perlman 1991: 596–597) of the basket-handled jars from Tell Keisan distinguished two fabrics. For both, the suggested origin was southeastern Cyprus, in particular the area around Salamis (Leidwanger 2005–06: 28; Winther Jacobsen 2006: 307–308).

The Cypro-Syllabic word *e-la-i-wo* ('olive oil') was written in black paint on a Type A Basket-handled Amphora found in Tomb 2 at Salamis, dated around 600 BC (Karageorghis 1967: 38, no. 101, pl. 126; Masson 1967: 132). Puech (1980: 303) interpreted the Phoenician signs, inscribed after firing, on three Basket-handled Amphorae from Tell Keisan as abbreviations of Greek *elaion* ('olive oil'), written with Phoenician letter *lamed*, and, on one of the three vessels, accompanied by the numeric sign 'l, with the value 10 (perhaps 10 *hin*, equal to 72–75 litres). If this interpretation is correct, these inscriptions describe both the contents and the capacity of the containers.

Based on this evidence, it is assumed that olive oil formed the main contents of Basket-handled Amphorae. Although such inscriptions cannot be used as direct evidence for the main packaged product (they could just as easily signify the contents of the inscribed jars only), Basket-handled Amphorae found in association with an olive press in Nicosia (Cyprus), dated from the Archaic–Hellenistic periods (Hadjisavvas 1992: 27–32), add to the evidence for olive oil as the main contents. Humbert (1991: 576–577), by contrast, suggested that the amphorae found at Tell Keisan contained wine, interpreting a thick coating found on their interior as the residue from fermentation. A similar coating was found on the walls of the vessels found at Aradippou *Panagia Ematousa*, Cyprus (Winther Jacobsen 2002: 173–174). In the absence of further data and based on evidence from earlier periods, it seems plausible to assume that these amphorae could have held either wine or olive oil, depending on the specific exchange involved.

Basket-handled Amphorae were made on the slow turntable (Winther Jacobsen 2002: 171–173) and their size was large compared to most of the MTCs considered in this volume (see Appendix, Figure A1). Iconographic evidence also indicates the large size of these containers: a bronze bowl from

Salamis depicts two men carrying a Basket-handled Amphorae (Gjerstad 1946: 9, fig. 5a), as does a clay figurine dated to the Archaic period (Calvet 1986: 506, fig. 2). Although their height varies between 45–82 cm, the tallest ones are the commonest, with heights ranging between 60–70 cm. According to our volumetric analysis (see the Appendix, Table A1: no. 30), one Basket-handled Amphorae from Salamis Tomb 79 (Karageorghis 1973: 52, no. 720; 1974: pl. 221) held 64 litres, whereas the volume of 4 (out of 20) containers found at Tell Keisan (Salles 1980: pl. 23–24) ranged between 65–80 litres. One example from the Kekova Adası wreck falls within the same range, with a capacity of 69 litres (Greene et al. 2013: 24).

Exchange between Cyprus and the central and northern Levant remained active throughout the Cypro-Geometric period (Gilboa et al. 2008). During this time, Cyprus exported decorated pottery vessels of various types to the Levant, but no known commodity containers (Iacovou 2014b: 803–804; Georgiadou n.d.). Levantine imports to the island, however, were mainly MTCs (for wine?), as well as flasks and jugs, most likely for perfumed oils. Once production of the Basket-handled Amphorae began, their distribution seems to have been quite limited, especially in their early phase; thus we learn little from them that we didn't already know about the trading contacts of Iron Age Cyprus. The time of their emergence, however, marked a significant change in the trading mechanisms of the island, one that coincided with a historical turning point: at the end of the eighth century BC, Cyprus became tributary to Assyria and local political entities were recognised as 'kingdoms' by Sargon II (Iacovou 2002). Salamis, with its natural harbour, long pottery-producing tradition and uninterrupted connections with the Levant since the Late Bronze Age (Georgiadou n.d.), was one of the first Cypriot kingdoms to take advantage of the new conditions, as attested by its monumental tombs. Accordingly, the (presumed) production of Basket-handled Amphorae at Salamis provides further support for the idea that Cypriot mariners became closely involved in seaborne trade during the Cypro-Archaic period (Iacovou 2014b: 805–806, with further refs.).

### *The Aegean (Stella Demesticha and Catherine E. Pratt)*

During the four centuries that followed the Late Bronze Age 'crisis', significant sociopolitical and economic changes led to a transition from the Aegean palatial system to the early Greek *polis*. The lack of informative written sources and the fact that material evidence of these gradual and often inconspicuous changes has been hard to find led many earlier scholars to conclude that the period between the eleventh and eighth centuries BC in the Aegean was one of isolation and decline (e.g. Snodgrass 1971; Desborough 1972). The eleventh and tenth centuries BC are known as Protogeometric (Desborough 1952), followed by the Geometric of the ninth–eighth centuries BC, both named after styles of pottery decoration (Coldstream 1977). Such nomenclature is indicative of how thoroughly the pottery of this period has been studied, as it is the primary diagnostic and chronological evidence available. As Coldstream (1977: xiii–xiv) explained:

Pottery is by far the most abundant category of archaeological material, and has a special importance for the historian of early Greece. First, it offers the best means of measuring time in an age without contemporary written records. ... Secondly, because local Geometric styles are easily distinguishable, one can detect commercial and other contacts between various regions of Greece, either through exported pots, or through the 'invisible exports' implied by influences passing from one local style to another. Thirdly, Geometric pots are almost the only non-perishable Greek objects of their time which were exported to non-Greek lands.

Indeed, tomb assemblages of intact, distinctively decorated vessels have provided a rich background for the creation of the now well-established typologies of regional pottery production, which in turn have been used extensively for dating, analysis and interpretation of the archaeological record. The abundance of material evidence from grave goods, however, limits our ability to draw convincing conclusions about domestic life or, in our case, the seaborne exchange activities of the Protogeometric and Geometric periods.

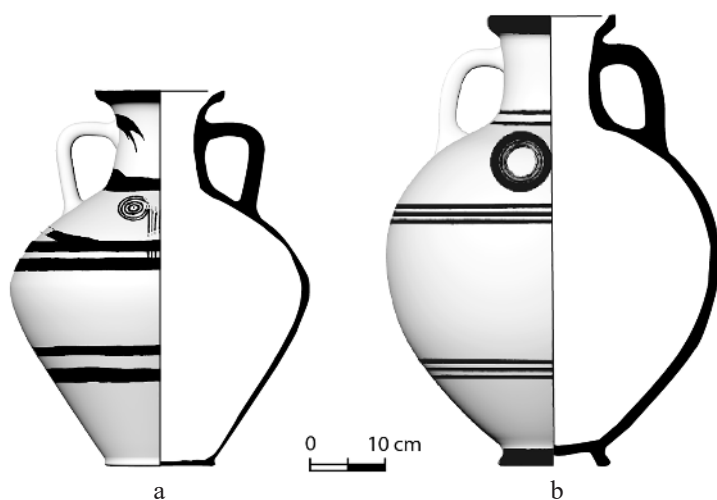
Some settlement sites have been excavated also, but in most cases they are small or rural ones; the most important centres seem to have been destroyed by successive occupations of later periods (Coldstream 1977: 303; Lemos 2002: 135). During the last two decades, fieldwork has provided significant new evidence, and fresh analyses of the data have led to a reassessment of earlier interpretations (for overviews, see Crielaard 1999a; Lemos 2002: 1; Dickinson 2006). Due emphasis has been given to the era itself as a historical phenomenon, not just as a dark period between two bright ones (Muhly 2011a: 45). Pottery remains a significant source of information but research focus has shifted to broader issues, such as contacts and trade within the Aegean as well as external relations, especially with the Levant. Thus at least two decades of 'revisiting' the 'dark age' (see e.g. Stampolides and Giannikouri 2004; Mazarakis-Ainian 2011) have led to further expansion of the already detailed pottery studies of the Geometric—refining typologies but at the same time creating distribution maps, and attempting to detect contact networks or to interpret the nature of exchange. In this respect, MTCs from the Protogeometric and Geometric Aegean certainly have not escaped the attention of scholars.

### *Protogeometric Amphorae*

During the Protogeometric period, various kinds of amphorae became common in both settlement and mortuary contexts. Desborough (1952: 5–19) distinguished four different types, mainly from Athens, based on the position of their handles: (1) the neck-handled, (2) the belly-handled, (3) the shoulder-handled and (4) the amphorae with handles from shoulder to lip (see also Lemos 2002: 56–63). The neck- and belly-handled amphorae were the commonest, the first deriving directly from Late Helladic IIIC (proto)types (see also Mountjoy 1986: 155). Their height normally varies between 40–45 cm, and they usually

have a ring foot. Their body is ovoid, tapering at the foot, with the point of greatest circumference placed relatively high; a tall, slightly concave neck springs vertically from the body.

The fact that Aegean neck-handled amphorae also served a maritime transport function in the Protogeometric period can be best demonstrated by their distribution outside the region(s) where they were produced. Courbin (1993: 104–105) first distinguished a type of necked amphora as the predominant Aegean vessel type imported to Ras al-Bassit, Syria, during the period between the end of the tenth and the beginning of the ninth centuries BC; he identified it as a transport container, most probably from Euboea. The transport function of this vessel is supported by the fact that it formed the only closed pottery type amongst imports at the site. Moreover, its very simple or non-existent decoration suggests that it was exported for its contents, not its value. The numbers of these vessels, however, remain quite low and they probably do not represent the transport of commodities in bulk: four or five were found at Ras al-Bassit and approximately seven at Tyre (see also Lemos 2005, who refers to parallels of these amphorae from the Toumba cemetery at Lefkandi). Courbin (1993) suggests that they held olive oil, not wine, and were brought to the Levant by the Phoenicians. Boardman (2006: 514), finally, posits that the small quantities of amphorae may indicate they were merely ‘in the baggage’ of early visitors. A similar group of neck-handled amphorae—the so-called Group I North Aegean amphorae (Catling 1998; Lenz et al. 1998; Gimatzidis 2010)—was found in large numbers (over 150 sherds attested) in the Protogeometric and sub-Protogeometric assemblages excavated at Troy (Aslan et al. 2014: 285).



*Figure 45* North Aegean Group 1 Amphorae. a) Protogeometric North Aegean amphora, from Troy (after Lenz et al. 1998: 215, pl. 4); b) Transitional type from Kapaklı, Volos (after Verdelis 1968: 6, fig. 2). Drawing by Irini Katsouri.

Catling (1998) first identified them as transport containers. These amphorae are coarse, wheelmade vessels with relatively flat bases and oval or biconical bodies. They stand around 50 cm high, with a maximum diameter of about 40 cm, thus enabling a likely capacity of 15–16 litres (Catling 1998: 153). A representative example comes from Troy where a complete profile is 48.6 cm high and 38.7 cm wide at the belly, with a rim diameter of 15.6 cm, and a flat 13.1 cm-wide base (Figure 45a; see also Appendix, Table A1: no. 19).

The earliest examples of this amphora in Troy (Level VIIb2) are dated to the early Protogeometric period, the end of which is placed in the late eleventh or early tenth century BC (Aslan 2002: 84, 97; Catling 1998: 155). The placement of the handles lower than the rim, as well as the amphora's particular decorative style—with compass-drawn motifs divided by vertical wavy lines—was interpreted as an innovation of 'specialist workshops' in central or northern Greece (see also Dickinson 2006: 130–131). Group I amphorae at Troy were further divided into subgroups IA, IB and IC on the basis of variations in paint and fabric, but it remains unclear whether these subgroups relate to differing producers or to chronological divisions (Lenz et al. 1998: 197–204).

Because detailed and extensive petrographic or chemical analyses have never been undertaken for Group I amphorae in the Aegean, it is impossible to say exactly where they were produced. There have been a number of suggestions, however, based on both stylistic and chemical analyses, that place their production either in central Greece (east Lokris; Catling 1998, 162), Thessaly (Catling 1998: 159, 162; Jones 1996: 199–200; Jacob-Felsch 1988: 198), Troy (Hertel 2003: 129; Aslan et al. 2014), Pergamon (Hertel 2011: 81; Mommsen and Japp 2009; Schneider and Japp 2009; Japp 2009), or Klazomenai (Aytaçlar 2004: 24). The most recent chemical analysis (NAA) of 11 samples of Group I amphorae from Troy suggests 'local' production (Aslan et al. 2014). Whilst the term 'local' needs to be defined better with respect to the general region of northwest Anatolia, the high number of possibilities may suggest that there were multiple production loci for this type of amphora.

North Aegean amphorae dated to the Protogeometric period have been found at sites in central Macedonia and the Chalkidike (Sindos, Kastanas, Assiros, Toumba, Mende, Sane and Torone); central Greece (Elateia, Kalapodi, Kynos, Agnanti, Atalanti, Mitrou, Lefkandi); Thessaly (Iolkos, Volos); Lemnos (Danile 2009: 323); Klazomenai (Aytaçlar 2004: 20–24); Pergamon and Ephesos (see Catling 1998: 155–162; see Gimatzidis 2010: 252–255 for discussion and references). Lemos (2001: 215–218) suggested that an 'Euboean koine' had developed during the Protogeometric period with 'a sophisticated network of contacts' within the Aegean, which included communities in central Greece, the coast of Thessaly and perhaps the Chalkidike and some Aegean islands (see also Mazarakis Ainian 2012). In her view, the function of this network involved the maritime transport of 'some kind of commodity' within these amphorae.

*Geometric Amphorae*

In his introduction to Geometric pottery, Coldstream (1991: 39) describes the amphora as ‘a necked jar with two handles’, the main closed shape designed for storage: ‘as a domestic chattel it usually contained wine or olive oil’. Indeed, neck-handled amphorae are one of the most common shapes found in settlement contexts throughout the Geometric Aegean (see, for example, Athens—Papadopoulos 1994: 441 no. A7; 2002: fig. 15; Euboea—Verdan et al. 2008: 100–103; Corinth—Pfaff 1988: 29–31, fig. 22). According to Snodgrass (1971: 55–105), amphorae were included in the repertoire of almost all regional pottery production centres (e.g. Attica, Euboea, Corinth, Thessaly, Cyclades, Crete and the Dodecanese), but were manufactured mainly for funerary use. For early ninth century BC Attica in particular, where these amphorae were extensively used for cremation, Coldstream (1977: 26) remarks that they follow on from Protogeometric types in an unbroken sequence. The placing of handles varies according to the sex of the deceased: for men, vertically from neck to shoulder and for women horizontally on the belly.

In discussing the function of the different shapes of Geometric pottery from Argos, Courbin (1966: 468–469) grouped amphorae into four categories: transport, storage, distribution and consumption. The use of amphorae for transportation on land is clearly depicted by clay figurines: e.g. a figurine of a mule loaded with four amphorae from an eighth century BC tomb at the Kerameikos in Athens (Kübler 1954: pl. 144, no. 1311); an animal figurine of unknown provenance in the National Museum in Athens (Boardman 1957: 15, pl. 3); a similar one exhibited in the British Museum (BM 1921, 1129.2) and another from Cyprus (Karageorghis 2006: 163, 178). Although we still lack direct evidence for maritime transport (i.e. Aegean shipwrecks dated to the Geometric period), we can nevertheless categorise a few types of Geometric amphorae as MTCs based on their distribution, size (capacity) and shape. The following discussion concentrates first on the problematic evidence available for MTCs in the Early and Middle Geometric periods, followed by a brief analysis of the three main Late Geometric MTCs: the so-called Group II North Aegean amphorae; SOS amphorae; and Corinthian A amphorae.

It is quite difficult to identify MTCs in the Early and Middle Geometric period. In general, as far as ninth century BC exports are concerned, this was a time of reduced exchange relations both within and beyond the Aegean: most pottery finds consist of drinking vessels, the main pottery marker being the Greek *skyphos*. The unimpressive quantity of amphorae, and the kraters and *pyxidae* found with them, suggests activities other than trade or exchange ventures, and there are no ‘known’ types of transport container (Crielaard 1999a: 60; Dickinson 2006: 215). For our purposes here, it is necessary to consider whether or how Group I North Aegean amphorae of the Protogeometric period make the transition into the Geometric period.

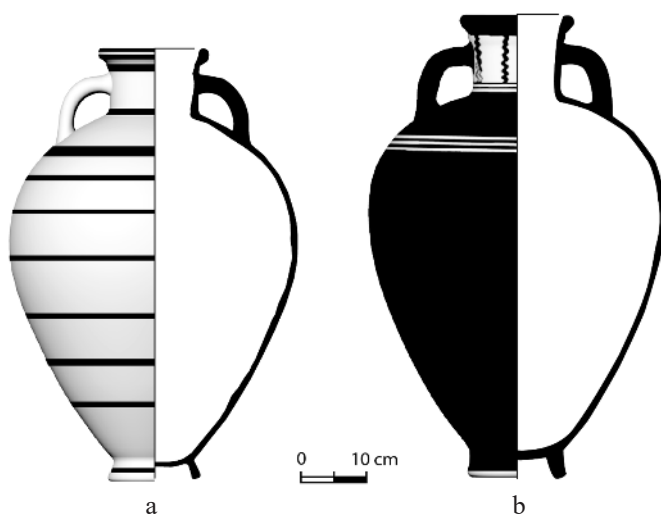
At Troy, at least, there seems to be a chronological ‘gap’ of about 200 years between the disappearance of Group I North Aegean amphorae and the appearance



of later Group II examples during phase VIII (Catling 1998: 153, 166–167). Catling (1998) proposed that this gap was filled—on the Greek mainland, at least—by a ‘transitional’ phase of the amphora type that continued the same diagnostic features of Group I amphorae (ridged, striped handles, tall neck with ridge, concentric circles), while the distinctive characteristics of Group II (three concentric circles on shoulder, wide band below shoulder, squat neck; see also Gimatzidis 2010: 254) were gradually added. The chronology of these amphorae, however, is far from clear as few examples found within central Greece stem from tightly sealed stratified contexts. Instead, many ‘transitional’ North Aegean amphorae are found in cemeteries (e.g. Torone—Papadopoulos 2005: 428–430; Kapaklı, Volos—Verdelis 1958: 6, fig. 1–2; and see Figure 45b above, and Appendix, Table A1: no. 18). Therefore, much of Catling’s chronology is based on style, and ultimately on Attic and Euboean styles. Consequently there is probably a greater chronological overlap between these three groups (Group I, Transitional, Group II) of North Aegean amphorae than the current data suggests. Recent examples from Sindos in northern Greece may provide clearer stratigraphic evidence for Group II predecessors, but whether this evolution can be identified at other sites remains uncertain (Gimatzidis 2010: 254–262). It is nevertheless the case that the North Aegean amphora shape continues to be remarkably consistent over a long period of time, a fact that also hinders a neat classification.

The exact date when Group II North Aegean amphorae were produced and shipped in sufficient numbers to be considered as MTCs is unclear. That the shape acquired all of its typical characteristics by the Middle Geometric (MG) II (mid-ninth century BC) at Sindos, at least, seems to be reasonably secure (Gimatzidis 2010: 254). The peak of its production, however, came in the middle of the eighth century BC when Group II amphorae reached their widest distribution. They differ from their Protogeometric counterparts in a number of ways. First, they seem to come in two ‘sizes’. The larger version is highly standardised with a height of about 60 cm and an estimated capacity of about 50 litres. The height of the smaller version varies between 35 and 40 cm. Smaller amphorae tend to be decorated with cross-hatched triangles, whereas larger versions continue to be decorated with concentric circles or semi-circles, normally in sets of three (Gimatzidis 2010: 259).

Recent discoveries have partly corroborated Catling’s suggestion that the Group II amphorae (also called ‘Thermaic’ amphorae; see Kotsonas 2012) originated in the region of the Thermaic Gulf. Specifically, examples from Methoni Pierias are petrographically similar to ones from Mende and suggest a common origin in the Thermaic Gulf region (Kotsonas 2012: 155; Kiriati et al. 2013). Kotsonas (2012) also distinguished a variant that most probably originated at Methoni Pierias, as petrographic analyses suggest (Figure 46a; see also Appendix, Table A1: no. 31). This type presents significant morphological similarities with some later east Aegean types, e.g. the Klazomenian and the Milesian. Additionally, recent chemical analyses of Group II amphorae from Troy would suggest a production locus within the region of the site (Aslan et al. 2014).



*Figure 46* Methonian and Attic SOS Amphorae. a) Methonian amphora (after Kotsonas 2012: 4124–13, no. MΘ 2461); b) SOS Amphora from Pithekoussai, tomb 719 (after Buchner and Ridgway: 689: table 210). Drawing by Irini Katsouri.

Group II amphorae were distributed widely, not only in Macedonia/Chalkidike (over 40 sites), but also more widely in the northern Aegean (Thasos, Troy, Lesbos, Samos). Additionally, Group II amphorae are found in central Greece (Eretria, Lefkandi), and even in Italy (e.g. Pithekoussai; see Kotsonas 2012: 154–162 with refs.; see also Gimatzidis 2010: 375).

At this point, it is interesting to note that some of the best-known Archaic ‘Greek amphora’ series began production during the eighth century BC as well, but slightly later than the Thermaic ones. Although Dupont (1998: 146 n. 37) expressed doubts about the possibility of Chian amphorae being found in layers of the second half of the eighth century BC at Old Smyrna (Cook 1958–59: 14) or Pithekoussai (Ridgway 1982; Di Sandro 1986; Luke 2003), Docter (2000: 69–70) identified Samian amphorae in eighth century BC contexts at Carthage. More recently, Fantalkin and Tal (2010) have published Lesbian amphorae from an Iron Age II context at Tell Qudadi in Israel. Until more examples of these eighth century BC versions are discovered or published, however, the scale of their production and distribution, at least during the Early Iron Age, remains unclear.

### *Athenian SOS Amphorae*

The MTCs attributed to the region of Attica present many morphological similarities with the group of Thermaic amphorae discussed above. These Proto-Attic vessels, designed for the ‘storage and carriage’ of liquids (oil or

wine) or solids, 'became important by the end of the Geometric period and a class of nearly spherical vessels with narrow mouths made in Athens and Euboea are important indicators of early trade in their contents' (Boardman 2001: 43). They are known in the literature as 'Attic SOS Amphorae' due to a decorative motif repeated on their necks. According to Johnston and Jones (1978: 132), they developed in the Late Geometric I period from the 'standard' decorated necked amphora. The form underwent several typological changes throughout the Archaic period. There is also a Chalcidian/Euboean version of this type, likewise dated to the end of the eighth century BC (Johnston and Jones 1978: 132–133).

In an attempt to determine the provenance of several SOS amphorae, Johnston and Jones (1978: 122–128) conducted chemical analysis (OES—optical emission spectroscopy), which was followed up by Jones (1986: 706–712), who added to the number and breadth of samples. The results of both projects proved to be conclusive and complementary: SOS amphorae were produced in Attica, on Euboea (perhaps Chalcis) and within a number of western colonial settings ('local' versions have been identified at Pithekoussai, Metaponto, Sybaris and Megara Hyblaea; Jones 1986: 711) (see Figure 46b above; see also Appendix, Table A1: no. 32). Stylistic classifications of SOS amphorae seem to match their chemical divisions very well. For example, on the one hand, early Athenian versions tend to have cross-hatched triangle decoration instead of the typical 'O' motif, and the 'S' is more like a vertical wavy line. Early Chalcidian versions, on the other hand, have a dark-glazed neck interior and a light-glazed neck exterior, over which the vertical wavy lines framing a five-ring concentric circle were drawn.

Over the course of 150 years, the SOS amphora varied in height between 58–75 cm, with an average of 68 cm. Maximum diameter was more stable over time and ranged between 43–49 cm (Johnston and Jones 1978: 132–135). Because of the great variety in size, capacity could never be consistent. Johnston, however, postulated some loose level standardisation by potters based on simple dimensions including maximum diameter (44 cm/22 Attic fingers), height (64 cm/2 Attic feet), and neck diameter (14 cm/7 Attic fingers), as well as the body and neck diameters being related by the factor  $\pi$  (Johnston and Jones 1978: 134 n. 50, 135 n. 53; Jones 1986: 706–707). This gives a capacity of 144.4 Attic *kotylai* or just over one Attic *metretres*, equivalent to about 39 litres (Johnston and Jones 1978: 135); our own analysis of one example indicates an average capacity of 47.4 litres (Appendix, Table A1: no. 32). Early examples seem to fall into this schema, but it is unclear whether the eighth century BC examples follow metrical standardisation.

Some of the earliest examples of the SOS Amphorae appeared during the late eighth century BC in the Athenian Agora, where they are considered to have been used as transport or storage containers or, as Burr (1933: 571) put it: 'the first Athenian pots to be exported, doubtless filled with oil, or earlier, with wine'. Soon afterwards, various scholars associated them with the export of olive oil from Athens, primarily based on the knowledge that the city was not a large wine

producer, but also on a later decree by Solon, which allowed only Athenians to export oil (Brann 1962: 32; Vallet 1962: 1558–1560; Johnston and Jones 1978: 73; Hopper 1979: 93; Shefton 1982: 341). Wine, however, has also been suggested, especially for the early phase of their trade, based both on excavation and iconographic evidence (Niemeyer 1984: 216; Docter 1991: 46). For example, SOS Amphorae were found in western Mediterranean sites in association with Corinthian drinking cups (*kotylai*); an SOS Amphora is also depicted on a Proto-Attic *oinochoe* (Young 1938: 417, fig. 5) and on the Francois Krater, a well-known vessel dated to approximately 570 BC, carried by Dionysus.

The use of SOS Amphorae as MTCs has been discussed extensively in the literature (Johnston 1984); their ring base, for example, does not seem convenient for a transport container. Even so, such a question only arises when comparisons are made with later types of MTCs or with contemporary or earlier Levantine and Cypriot types. In fact, most contemporary, Late Geometric Aegean transport containers share this morphological feature (i.e. the ring base). Furthermore, neither the lack of clear representational evidence on the vessels (Johnston 1984: 211) nor the written sources (i.e. Solon's decree) form valid arguments against SOS amphorae as MTCs, as such factors hold true for most MTCs. Most important for their designation as MTCs is the considerable number found outside the Aegean, at over 140 sites from the Iberian peninsula to the Black Sea (Vallet 1962: 1558; Pratt 2015). To date, SOS amphorae belonging to the Late Geometric period have been identified at 37 different sites.

The only regions that have thus far failed to produce early Attic SOS amphorae are Asia Minor and the Black Sea, as well as the non-Saronic regions of the Peloponnese. The presence and quantity of early SOS amphorae in the west, at least, seems to coincide with the distance of the site from their locus of production, i.e. Attica and Euboea. Early SOS amphorae are found at seven sites on the Italian peninsula, six sites on Sicily, and five sites in the western Mediterranean (Pratt 2015). In contrast, only four sites from the Levant, Egypt and the north coast of Africa have produced early versions of SOS amphorae. The limited number of SOS amphorae that reached the Iberian peninsula (Dominguez and Sánchez 2001), along with Corinthian drinking cups and other types of 'popular' pottery, suggests that they may have been transported by Phoenicians, having been loaded onto ships 'somewhere between Pitheculasae and Sicily' (Shefton 1982: 342). This suggestion is supported by the presence of early SOS amphorae at several Phoenician colonies (e.g. Carthage, Motya and in Iberia at Toscanos, Guadalhorce, Aljaraque, Gadir, Málaga, Algarroba and Cerro del Villar).

### *Corinthian Amphorae*

Transport amphora production in Corinth was also one of the earliest in the Iron Age Aegean. The first containers of this series, known as 'Corinthian A', present several morphological variations and are characterised by a broad, flat rim (which grew heavier during the Protocorinthian period), heavy vertical handles and a roughly spherical body with a cylindrical toe (Koehler 1978a; 1992; Pfaff 1988:

29, no. C-37-935, fig. 22; Whitbread 1995: 255–257) (Figure 47a; see also Appendix, Table A1: no. 34). The development of the common, local, handmade storage amphora into the so-called Corinthian A amphora began toward the end of Geometric period, in the second half of the eighth century BC (Koehler 1981: 451). Corinthian amphorae were rather bulky, holding up to 75 litres, although smaller versions holding between 18–40 litres exist (Koehler 1986: 56). Our own analysis of one example indicates an average capacity of 46.2 litres (Appendix, Table A1: no. 33). Significantly, Corinthian amphorae were made by hand on a slow wheel (Vandiver and Koehler 1986), as was the case with other large jars (*hydria*, jugs; Strack 2007: 142–143) and *pithoi*. Although it is difficult to assess how early this type of production began, some elements characteristic of later, large-scale production, such as the capped toes, may be observed during the early Protogeometric. This suggests that the production of Corinthian A amphorae rested on a long-standing local potting tradition (Strack 2007: 143). Nevertheless, most Middle Geometric Corinthian amphorae continued to have small, flat bases, perhaps signalling a storage function.

In this light, it is worth reiterating the close association between storage jars and transport containers, both functional and typological (see above under *Maritime Transport Containers, Shape and Function*). A distinctive type of Iron Age decorated storage jar—the Cycladic ‘relief *pithoi*’—is interesting in this respect; they have the form of an amphora but have been found in sanctuaries as well as in settlements (Caskey 1998: 478). Moreover, they co-existed with several types of handleless *pithoi* that had different kinds of decoration

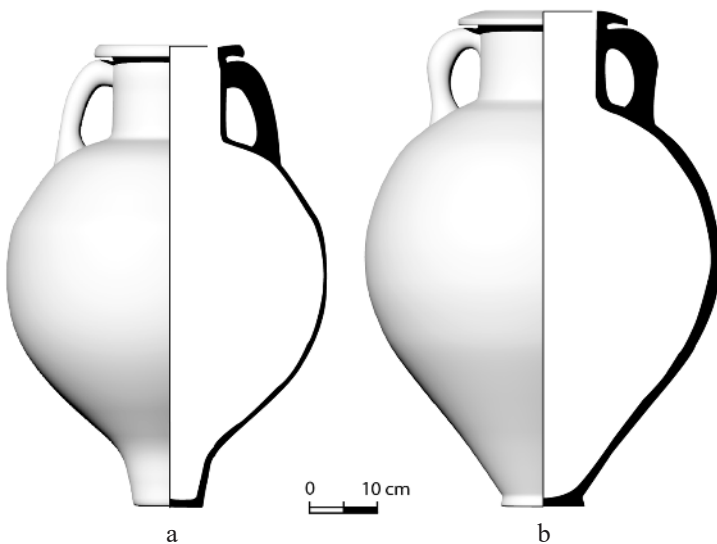


Figure 47 Corinthian Amphorae. a) Type A (after Vandiver and Koehler 1986: fig. 7B); b) Transitional type, from Incoronata, Metaponto (after Scioli and Sacchi 1992, 63, fig. 104). Drawing by Irini Katsouri.

and were very common throughout the Aegean (Simantoni-Bournia 1998: 500). Based on their morphology (large size, restricted neck), fabrication (harder, less porous fabric, higher quantity of inclusions producing a cooling effect) and ornate decoration, McLoughlin (2011: 919–920) suggests that relief *pithoi* most likely held wine, or even coveted ‘aged wines’.

In any case, Corinth was already beginning to export locally made MTCs (or the products within them) to Greek colonies such as Sicily and Magna Graecia during the second half of the eighth century BC (Koehler 1978b), as excavations there have attested: Pithekoussai (Di Sandro 1986: 24–27, nos. 48–56; Buchner and Ridgway 1993: 414, nos. 368.1, 674–675, no. 702.1; Kotsonas 2012: 187); Incoronata, near Metaponto (Scioli and Sacchi 1992; Stea 1997: 35, 37, no. 1); Siris (Berlingo 1993); Otranto (D’Andria 1985: 347); and Naxos and Megara Hyblaea on Sicily (Gras 2010: 113). In fact, the chronology of the beginning stages of Corinthian A amphorae depends chiefly upon examples excavated at coastal settlements around southeast and central Sicily and in Magna Graecia. Most of these have been recovered from cemeteries, where such containers were frequently reused as cinerary urns or as coffins for infants. Jars found with grave offerings of Protocorinthian pottery at Schirone near Metaponto and at Gela establish the Corinthian A amphora series as one of the first produced in Greece (Koehler 1981: 451; 1992). It is worth noting that many of these early examples outside of Corinth have the characteristics of pre-Corinthian A amphorae: flared rim instead of thick square rim; flat base instead of toe (see Figure 47b, above, and Appendix, Table A1: no. 33).

Within the Aegean, their distribution in the eighth century BC is limited to a few pieces from Sindos, Methoni Pierias and Abdera (Kotsonas 2012: 187). The early eighth century BC Corinthian amphora from the Athenian Agora mentioned by Kotsonas (Brann 1962: 59, no. 242) seems more like a table amphora than a transport amphora (Dupont and Skarlatidou 2012: 261, fig. 27). From the earliest, relevant studies in the literature, it has been assumed that olive oil formed their principle contents; this assumption is based on the absence of pitching on their interior and the similarity of their fabric (‘blisterware’) with other Corinthian vessels associated with oil (e.g. lamps and *lekythoi*) (Vallet 1962; Koehler 1978a; 1981; Whitbread 1995: 257). Gras (2010: 113) has suggested that olive oil was exported from Corinth to the Greek colonies of Sicily and south Italy at a very early date, mainly because of the lack of systematic agriculture in the first colonies.

### *Geometric Amphorae Trade*

External Aegean contacts are documented by exports of Protogeometric pottery found in the Levant and Cyprus. According to Coldstream (1977: 20–26, 103; 2003: 18), the points of contact, mainly with Euboea (Lefkandi) and Attica, must have been in the Aegean, not in the Levant (see also Dickinson 2006: 213–214). Lemos (2005: 56), following Coldstream and Boardman, discussed changes in the Euboeans’ relations with the east during the first half of the ninth

century BC, and suggested that—because of political changes in the Levant—the Phoenicians became more active in trade with the Aegean. In the century that followed (850–750 BC), however, a two-way system of exchange developed once again. The networks of Greek maritime activity, limited mainly to the Aegean, were steadily developing during the late ninth and early eighth centuries BC, thus serving to consolidate the unity of the Greek world. Most scholars (e.g. Dickinson 2006: 216–217; Coldstream 1977: 20, 109–110) agree that maritime activity intensified after 770 BC, the period of the first Greek settlements beyond the Aegean, with the Euboean presence at Pithekoussai by 750 BC being the first substantial case.

There, new networks of exchange and redistribution were developed, the detailed discussion of which is beyond the scope of this study. Still, it may be worth mentioning two cases of inscribed Aegean MTCs, indicative of the complexity of these connections during the Late Geometric period, within and beyond the Aegean. Both amphorae had inscriptions written in a non-Greek alphabet and were found in cemeteries used for infant burials (*εκχυτρισμός*). One of them, not yet attributed safely to any of the established types, was found in a Late Geometric I tomb (no. 575) at Pithekoussai; three separate Semitic inscriptions (two in Aramaic) were inscribed on its handle and shoulders (Durando 1989: 81–84, fig. A; Ridgway 1992: 111–113). The other was an SOS Amphora, dated to the last quarter of the eighth century BC, found at Mende, Chalkidike; a Cypro-Syllabic graffito, probably a name, was inscribed on its shoulder (Vokotopoulou and Christidis 1995).

Dickinson (2006: 209–210) makes special reference to the fact that the ceramic material exported from the Aegean during the Protogeometric period includes not only shapes that could be considered as prestige items (drinking and pouring vessels) but also amphorae, which reflect the exchange of commodities available for trade in the Aegean. He acknowledges, however, that the limited quantities indicate small-scale and irregular exchanges. For example, at Al Mina in Syria, although the pottery was not originally recorded and published in detail (Woolley 1938: 154), later classification attempts have been much more informative (e.g. Kearsley 1995; Luke 2003): they have correlated Woolley's 'Type 11' amphorae with the necked amphorae of the Aegean. From the informative table published by Luke (2003: 32–35 and 42, with refs.), it is clear that Attic and east Greek amphorae were indeed exported to the site, albeit in very limited numbers. Of 192 Greek vessels (mostly drinking types) found in Levantine sites and dated to the entire Geometric period, only ten amphorae (and *amphoriskoi*) have been identified (for eastern imports at the site, including transport amphorae, see Lehmann 2005). The picture is similar on Cyprus: of 170 Greek Geometric vessels identified on the island, only two amphorae were found (Coldstream 1986: 321; 1988: 42, fig. 1; Crielaard 1999b: 266). In Luke's (2003: 54) view, these vessels should be associated with ritual, not commercial use.

Although most excavated pottery assemblages from Aegean sites dated to the Geometric period continue to derive mainly from funerary contexts,



fieldwork over the last two decades has brought to light several settlement sites as well (see e.g. Stampolides and Giannikouri 2004; Gimatzidis 2010; Mazarakis Ainian 2011). This development has expanded considerably our knowledge concerning the types of pottery used for domestic or commercial use. Much earlier, based on decorative styles, Coldstream (1968) had demonstrated the development of key Greek pottery centres during the Geometric period: Attica, Corinth, Argos, Thessaly, the Cyclades, Boeotia, Laconia, Crete, the east Aegean islands and the coast of Asia Minor. Thus, despite the generally accepted decline in the level of trade, it is evident that potters continued to work and produce a rich variety of vessels (both large and small) throughout these two centuries (950–750 BC).

Moreover, it is unlikely that seaborne trade was ever completely interrupted within the Aegean, with Attic wares forming the most prominent exports, at least during the ninth century BC. Even so, the distribution patterns suggest that ‘much of the material may relate to the exchange of gifts rather than commodities’ (Dickinson 2006: 215–216). Furthermore, it is still difficult to distinguish the agents who were involved in this activity; Coldstream (1977: 103), for example, observed a ‘lack of Attic maritime enterprise’, which is interesting given the significant distribution of Attic pottery during the same period. Crete and the Cyclades, namely the areas whence the MTCs of the Aegean Bronze Age originated, no longer seem to play an important role, whether in production or trade. No examples of Cycladic or Cretan amphorae (not even Cretan pottery—see Dickinson 2006: 218) have been found beyond their homelands, suggesting a considerable change in trade networks and/or social relations. Dickinson’s (2006: 218) suggestion that this may be attributed to a change of taste, namely that Cretan pottery ‘was not so attractive as that of the other regions’, would not hold true for MTCs, which by this time were certainly traded more for their contents than their decorative value.

### *Geometric Amphorae: Contexts of Use*

Literary evidence, in the form of the Homeric epics, may help provide an emic point of view regarding amphora use and trade. These narrative works were shaped within a Greek oral-poetic tradition and cannot necessarily be used as historical evidence. Nevertheless they encompass important, albeit somewhat distorted, reflections of social, economic and political situations within the Aegean world; they may also reflect concepts of ‘containerization’ (Bevan 2014), including the use of amphorae. By the time of the textualisation (or text-fixation) of the *Iliad* and *Odyssey* (arguments range from the eighth to sixth, or even fifth, centuries BC—most recently Janko 2012; Andersen and Haug 2012: 7; West 2012: 235–237), a number of passages include references to a certain type of container: the *αμφιφορεύς*.

In the *Iliad*, the word *αμφιφορεύς* is mentioned only once (23.92), describing a golden vessel. Interestingly, however, in the *Odyssey*, this term is mentioned seven times:

- Odyssey 2.290. The goddess Athena advises Telemachus on preparing his journey to Pylos: *But go thou now to the house and join the company of the wooers; make ready stores, and bestow all in vessels—wine in jars* [οἶνον ἐν ἀμφοροεῦσι], *and barley meal, the marrow of men, in stout skins.*
- Odyssey 2.349. Telemachus asks Eurycleia to provide him with the special wine she keeps in her cellar for the day that Odysseus will return: *Nurse, draw me off wine in jars* [οἶνον ἐν ἀμφοροεῦσι], *sweet wine that is the choicest next to that which thou guardest ever thinking upon that ill-fated one, if haply Zeus-born Odysseus may come I know not whence, having escaped from death and the fates. Fill twelve jars and fit them all with covers* [πώμασιν ἄρσον ἅπαντας], *and pour me barley meal into well-sewn skins, and let there be twenty measures of ground barley meal.*
- Odyssey 9.164–165. Odysseus narrates how he and his men feasted over the meat they stole from Cyclops and the wine they had taken from the land of Cicones: *So then all day long till set of sun we sat feasting on abundant flesh and sweet wine. For not yet was the red wine spent from out our ships, but some was still left; for abundant store had we drawn in jars* [ἀμφοροεῦσι] *for each crew when we took the sacred citadel of the Cicones.*
- Odyssey 9.195–205. In the same narrative, Odysseus explains the provisions he took when exploring the Cyclops island, with only his own ship and 12 of his best men: *With me I had a goat-skin* (αἶγρον ἄσκρον) *of the dark, sweet wine, which Maro, son of Euanthes, had given me, the priest of Apollo, the god who used to watch over Ismarus. And he had given it [to] me because we had protected him with his child and wife out of reverence; for he dwelt in a wooded grove of Phoebus Apollo. And he gave me splendid gifts: of well-wrought gold he gave me seven talents, and he gave me a mixing-bowl all of silver; and besides these, wine, wherewith he filled twelve jars* [ἀμφοροεῦσι δωδέκα] *in all, wine sweet and unmixed, a drink divine.*
- Odyssey 13.105–110. A description of the harbour of Phorcys in Ithaca: *At the head of the harbor is a long-leafed olive tree, and near it a pleasant, shadowy cave sacred to the nymphs that are called Naiads. Therein are mixing bowls and jars* [ἀμφοροῖς] *of stone, and there too the bees store honey.*
- Odyssey 24.74. The Greeks put Achilles' ashes and bones in a golden amphora: *But when the flame of Hephaestus had made an end of thee, in the morning we gathered thy white bones, Achilles, and laid them in unmixed wine and unguents. Thy mother had given a two-handled, golden urn* [χρύσειον ἀμφοροῖς] *, and said that it was the gift of Dionysus, and the handiwork of famed Hephaestus.*

These references help us to understand better the function of amphorae within Geometric Greece. Apart from the references to the golden (24.74) and stone amphorae (13.105–110) related to funerary usage, the remaining five are

associated with the transportation of wine on ships: Telemachus' provisions (2.290 and 2.349) include wine from the house cellar, bottled in amphorae for the occasion. This may indicate a secondary function of table amphorae, or the use of intentionally kept (and pitched?) transport amphorae, which were employed whenever the transport of wine was necessary, by land or sea. The fact that the aged Eurycleia was supposed to find the necessary means for stoppering (stoppers and sealant material) within the house also indicates that packaging in the palace may have been a common practice.

Odysseus' (9.205) narration corroborates the practice of wine being bottled in amphorae to be offered as a gift when it had to travel long distances: for example, from Ismarus, Thrace to Ithaca. Even when he and his men were stealing Cicones's wine, they had to pour it from the *pithoi* into amphorae, so that it could be transported. When Odysseus chose to take some of the Ismarus wine for his short exploration of the Cyclops' Island, he decanted it into a goatskin, since the amphorae were probably too big. If we assume the wine was bottled in known MTC types of the Late Geometric period, then they were probably too big to carry on a small boat: according to our analyses, the capacities of the SOS, Methonian and Corinthian amphorae ranged between 41.3–47.4 litres. The Protogeometric MTCs, however, were slightly smaller, with capacities between 22.4–36 litres, but maybe still too heavy to carry on a short trip.

Although we should be cautious with the epic narratives, in this case archaeology corroborates the information provided: the small numbers of Geometric transport amphorae dated before the middle of the eighth century BC would have served for exchanging products on a limited, quite small scale. For this purpose, a very common transport vessel was used, namely the amphora. In other words, the Protogeometric amphorae (Catling's Group I) and any possible Middle Geometric descendants must have had a domestic as well as an occasional transport use.

*Summary* Although both Catling (1998) and Kotsonas (2012) see a linear evolution of the North Aegean transport amphora shape, from the Protogeometric throughout the Geometric period, from Phocis or Lokris to Thessaly and Macedonia, we would suggest that more complex processes are involved. The Aegean transport amphorae that appear in the Late Geometric period, i.e. at the end of eighth century BC, in northern Greece (Thermaic Gulf), the islands of the east Aegean (Samos, Lesbos), Attica (SOS Amphorae) and Corinth clearly belong to a different socioeconomic horizon than the Protogeometric examples. They have a distinctive transport character, with minimal decoration, large volume and, most importantly, distribution in large quantities. Moreover, the Late Geometric Aegean MTCs seem to have been produced in regions different from that of the Protogeometric Group I North Aegean amphorae (although it is unclear where exactly this took place).

There is, however, a common denominator in the Protogeometric and Late Geometric groups of amphorae. They both seem to derive from the domestic

amphora, a common pottery vessel in the Greek Geometric Aegean, as both archaeology and the epic poems indicate. But which is the Middle Geometric amphora that Eurycleia was supposed to fill with wine? Or should we search amongst the Late Geometric types for it? Whatever the answer may be, the two amphora groups should not, in our opinion, be considered as the two ends of a linear evolution of a specific pottery type. It is more likely that they represent two different adaptations to a need for a maritime transport container. Such a demand was occasional in the Protogeometric period, and thus Group I amphorae have a non-standardised style. Group II amphorae, on the other hand, were developed as a response to increasingly dense maritime trade, regional or inter-regional, in which the northern Aegean and Attica were directly involved during the eighth century BC (e.g. see Kotsonas's [2012: 161] appropriate association of Thermaic amphorae production primarily with regional trade activity). Corinthian Late Geometric MTCs also appeared in the same period but through a different tradition, one that adapted the domestic *storage*, not (local) *transport* amphora into an MTC.

In conclusion, we would suggest that the distinctive phases of Geometric amphorae are typical for the genesis of MTCs. Their production, short or long term, may be initiated, interrupted or continued, depending on the nature, intensity and length of the exchange systems in which they are involved. Their form, however, is not so sensitive to economic fluctuations; it evolves from the existing local pottery traditions and usually represents a development either from storage (like the Corinthian amphorae) or domestic transport vessels (like the north Aegean-Attic ones) associated with established local pottery repertoires.

## 5 Maritime Transport Containers, Bulk Transport and Mediterranean Trade

### Discussion

In order to consider the extent to which MTCs offer insights into patterns of seaborne connections and trade in the Aegean and eastern Mediterranean, it is important first to distinguish between their development in what seem to be two, if not four prominent places of production: the Levant and the Aegean, and possibly Egypt and Cyprus. Based on the evidence presented in this study, it seems clear that (1) the earliest MTCs developed during the Early Bronze Age, first in the Levant and then in the Aegean, and (2) the Levantine type continued almost without interruption into the Iron Age, preserving its characteristic morphological features. In contrast, at least three distinctively different types of MTC were produced in the Bronze Age Aegean, one possibly on Late Bronze Age Cyprus, three more in the early Iron Age Aegean, and one on early Iron Age Cyprus.

Archaeological evidence demonstrates that Cyprus imported and used MTCs (Canaanite Jars, TSJs) during the Bronze and early Iron Ages, and textual evidence has been taken to corroborate this: Ugaritic text RS 18.042 (=KTU 4.352) indicates that ‘660 [jars/measures] total of oil’ were sent from Ugarit to ‘Abiramu the Cypriot’ (Walls in Knapp 1996: 38; Monroe 2009: 87, 114; note, however, that ‘jars/measures’ is inserted in the text to make it intelligible). At some point in the Late Bronze Age, potters on the island produced a vessel that occasionally *could* have served for the transport of liquids or other organic materials by sea (i.e. to Crete, the Levant and Egypt; Sardinia and Sicily; also found on the Point Iria and Uluburun shipwrecks). This was the medium-sized Group II (and IB1) *pithos*, whose primary purpose—in particular that of the larger vessels—was for storage. Such provenance work as has been conducted on Cypriot *pithoi* indicates that they were produced at various sites on the island. Some *pithoi* found on the Uluburun shipwreck were used to transport pomegranates and possibly figs, less certainly any liquids, but again there has been no systematic study of their contents. By the beginning of the Cypro-Archaic period (750–700 BC), a transport container with distinctive handles—the Basket-handled Amphora—was being produced on Cyprus.

The earliest vessel type from the Aegean that we would define as an MTC was the Cycladic Collar-necked (or, Narrow-necked) Jar. Beginning in EM IIA (c.2650–2450 BC), these jars are found in varying amounts throughout the

Cyclades, on the Greek mainland, at Poros-Katsambas on Crete and in some quantity on the EH II shipwreck from Dokos. Petrographic analyses suggest that these jars were produced in the central and western Cyclades, and most likely along the north central coast of Crete itself. As to their likely contents, despite the lack of any analytical work, it has been suggested that they were well suited for transporting liquids, perhaps alcoholic beverages (Broodbank 2000: 305–306).

Crete first developed its own distinctive MTC, the Oval-Mouthed Amphora (OMA), during the Protopalatial period (c.1925/1900–1750 BC). Examples have been found throughout Crete, in the Cyclades and on the Greek mainland, and at ‘Ezbet Rushdi (Tell ed-Dab’a) in Egypt. While the numbers found outside the island are not large, they certainly demonstrate a long-distance trade involving these vessels. Equally significant for our purposes, they have been found on the wreck deposits off Pseira (Crete) and off the Laconian coast in the Peloponnese (further discussion below). Based on other Bronze Age parallels, it has been suggested—but not demonstrated—that OMAs contained products such as olive oil, wine, ointments or resins.

Within the wider Aegean world of the Late Bronze Age, stirrup jars generally were produced in shapes that we regard as being too small to function as an MTC. Although they were surely traded for their contents (arguably perfumed or other precious oils, wine, fermented beverages), the capacity of ordinary stirrup jars was too limited for a long-distance exchange in bulk commodities. Despite the significant numbers found beyond the Aegean world (Haskell 1985; Shelmerdine 1985; French 2011: 70–71, table 1; Graziadio 2011), perfumed oils and the like were probably never shipped in bulk.

On Crete, however, at the time of the transition to the Late Minoan I period (c.1700/1650 BC), the Transport Stirrup Jar (TSJ) began to play a major role in the maritime shipment of liquid commodities (olive oil, if not other products). Archaeological and Linear B evidence suggests that TSJs contained (perfumed) oil, olive oil and wine, perhaps also beer and honey mead. Two analysed TSJs from Khania on Crete may have contained resinated wine; the one from the Uluburun shipwreck that held a mixture of seeds, stone beads, faience and orpiment probably cannot be regarded as representative. Thus far, however, no systematic organic residues study has been conducted on TSJs. TSJs continued an earlier tradition (OMAs) in bulk trade, one that now covered much greater distances, from the Levantine coast to north Africa (Marsa Matruh, Zawiyet um el-Rakham) and beyond (albeit in small numbers) to Sardinia, Sicily and the Aeolian island of Filicudi. Here we have an excellent example of how the study of MTCs can provide markers of trade mechanisms of different scale (i.e. stirrup jars for a trade in ‘luxury’ goods; OMAs and TSJs for a bulk trade in ‘semi-luxury’ commodities).

Another, more conjectural example is provided by Rutter’s (2014: 64–65) study of ‘Canaanite transport amphore’ (Canaanite Jars–CJs) within the Late Bronze Age Aegean, and his suggestions concerning the merchants or traders involved. During the sixteenth and early fifteenth centuries BC, the few CJs that

appear in the Aegean—perhaps brought by Levantine merchants—are confined to Crete and the Cycladic islands (Santorini), and mainly to coastal settlements. By the late fifteenth century BC, most CJs seem to have arrived in the Aegean on Crete, at Mochlos in the east but especially at Kommos on the south coast. In Rutter's view, they came either on Minoan ships or via 'royal gift exchange' with Levantine dynasts; the few that wound up on the mainland in Mycenaean chamber tombs may have been 'royal gifts' from the rulers at Knossos. The destruction of Knossos early in the fourteenth century BC disrupted this pattern, and after the mid-fourteenth century BC the bulk of CJs that appear in the Aegean—perhaps now brought by Cypriot intermediaries—stem from the Argolid, and are found mainly in Mycenae and Tiryns.

The shape of the CJ continued to evolve ('Phoenician transport amphorae', together with an elongated 'torpedo-shaped' version) throughout the early Iron Age. While the earliest Egyptian Jars (Middle Bronze Age) were likely modelled on imported CJs, by the Late Bronze Age locally manufactured examples quite homogeneous in their composition (probably produced in or around Memphis) began to appear. With a pointed base, two loop handles, and an increasingly narrow and angular body, these vessels were well suited for sea transport. They have been found at sites throughout the southern Levant and at Kommos in Crete. The contents of New Kingdom Egyptian Jars are known only from tomb paintings and the hieratic inscriptions found on them: wine was the most common, but other liquids (beer, honey, milk), incense, meat and game, grains and fruit are also indicated. Chemical and organic residues analyses of various CJs found in Egypt (Amarna)—mainly produced in the central-northern Levant—demonstrate that they held wine, oil and pistacia resin, while the majority of those recovered from the Uluburun wreck contained terebinth resin (*Pistacia atlantica*) or wine (as well as olives and glass beads).

During the Postpalatial period (beginning in the fifteenth century BC), the Short-necked Amphora (SNA) was introduced: this was a product of workshops at Kommos on Crete, or nearby. Although Rutter (2006a: 663) regards this vessel as a counterpart to the CJ, the only example found beyond Kommos itself was recovered at Knossos (and the only known content is haematite). While the jury is still out, the maritime function of the SNA remains in doubt.

Within the Aegean, the evidence of MTCs at least suggests a change in the mechanisms or in the scale of trade between the Late Bronze Age and the early Iron Age. Thus the Minoan TSJ never developed further as an MTC. Throughout the Aegean, new types of MTCs had developed by the late eighth century BC in Corinth (Corinthian Type A amphorae), the North Aegean (Thermaic Gulf, Samos, and possibly Lesbos) and Attica (the SOS Amphorae); several other regional or local styles emerged during the Archaic period. Thus, in a pattern quite different from that seen in the Levant, the shape of the amphora with two vertical handles and a narrow base was adapted to become an MTC with many different regional styles and variants. These developments took place in those areas of the Aegean that were involved in maritime activity. Because of their differing pottery traditions, each area in the Aegean created different types of



transport amphorae, which never lost their regional characteristics. Despite entering mid- to long-range trading networks, they never evolved to a standard type or size.

## The Organisation and Mechanisms of Trade in MTCs

Did the trade in MTCs and their contents take place primarily through well-organised, long-distance maritime expeditions ('grand cabotage') or via regular, small-scale, coastal oriented trade between a succession of ports (cabotage), or both? Or should we consider even more vectors of trade, as for example Tartaron's (2013: 186, table 6.1) local ('coastscape'), small worlds, regional and interregional spheres of interaction? Can we discern any differences through time between such possible parameters of trade?

First of all, there is a matter of terminology to settle. Arnaud (2011: 62–63) maintains that the English definition of 'cabotage' (sailing from cape to cape seeking profits) is too reductive, and confuses French *capotage* with *commerce forain*. In discussing the term 'cabotage', Arnaud (2005: 108–109; 2011: 62–63) stressed that it is important to distinguish between (a) different kinds of seafaring or navigation, and (b) the structure of exchanges. The term cabotage describes a way of coastal navigation, from cape to cape, either short- or long-distance, within or beyond territorial waters, typically involving technical (for repairs, provisions, etc.) as well as commercial stops. Thus cabotage is not a homogeneous sailing practice like open sea navigation. Because the orientation of Mediterranean coasts is, generally speaking, favourable for cabotage, most types of exchange could be conducted in that manner. Accordingly, as a way of navigation, cabotage might be confused with tramping, i.e. trading from port to port, if only because tramping usually presupposes cabotage.

Here we regard tramping as a type of sailing or trading that is local in scale but indeterminate, i.e. the ship's captain went wherever a profit was to be made (equivalent, perhaps, to Tartaron's 'small worlds') (Table 5). With cabotage (coastal sailing, equivalent to Tartaron's 'coastscales'), the scale may be local or long distance but the ships usually travelled between known ports or anchorages. In the case of regional maritime trade (Tartaron's 'intracultural'), the scale is beyond the realm of the habitual and the everyday, but still involves a recognisable cultural area—for example, the Aegean basin or the Levantine coast (more than one?) during the Late Bronze Age; such areas tend not to be delimited by hard boundaries and they may be discontinuous in space. In the case of long-distance trade (Tartaron's 'intercultural') in certain high-demand products, the routes of travel transcend known economic, political or spatial boundaries, and the destination ports are typically predetermined; in this case, the level of profits would have been high, whenever the venture was completed successfully. Such interaction spheres call into question notions of an 'unchanged' or 'unchallenged' maritime (trading) landscape—i.e. direct long-distance sailing vs localised cabotage or tramping—throughout the Mediterranean, or even in its eastern sector throughout the Bronze and early Iron Ages (Arnaud 2011: 61).

Table 5 Maritime Transport Containers—Trade Mechanisms

Cabotage	Local or long distance: coastal navigation	Tartaron: coastscapes
Tramping	Local: indeterminate	Tartaron: small worlds
Regional	Recognisable cultural area (Aegean, Levant)	Tartaron: intracultural
Interregional	Long distance	Tartaron: intercultural

It should be noted that Tartaron has distinguished four different scales of exchange, not sailing patterns. In both cases, of course, distance is important, but as Arnaud (2005: 61–92) has argued at length, distance was directly connected to time, at least in classical antiquity (as we know from ancient geographers). For example, trips that could be completed with a single day's sail ('cabotage diurne'), as is the case in many parts of the Aegean, were never seen as a daunting nautical task in antiquity (Arnaud 2005: 118). In cases where the distance was greater, however, as for example between Rhodes and Lycia on the Anatolian coast, a choice had to be made between cabotage and direct sail. Arnaud (2005: 118–121) thus argues that we should not only distinguish between long-distance trade and cabotage, but also bear in mind that the rule was to combine the two. Cabotage was not the only standard way to sail, because the routes of travel were composite and segmented: in ancient sources they are not described as being from port to port, but rather from landmark to landmark (capes, estuaries, islands). Arnaud (2005: 50–51) also discusses navigating without instruments, a practice based on spatial memory, which is also a memory of space–time. Because any sailing venture in the ancient Mediterranean without landmarks for more than four days would have been extremely rare, mariners would commit to memory certain routes, combining landmarks for daytime with constellations for the night. Thus, although we might profitably pay more attention to the different Mediterranean maritime regions/spaces described by ancient geographers, it is beyond the scope of this study (see, however, the brief discussion in Chapter 3, under *Connectivity, Seaborne Trade and Maritime Transport Containers*).

Tartaron's first two levels of exchange (small worlds and coastscapes) have survived throughout the ages along the Mediterranean's coasts, involving connectivity on multiple levels (trade, fishing, social relations, etc.). These levels may well be involved in the occasional maritime use of transport or storage vessels that are often found in small numbers within the immediate vicinity of their production centres—e.g. the Early Cycladic Collar-necked Jars. The other two (intracultural, intercultural), which require nautical expertise and larger ships, would have been associated with more systematically used and traded MTCs (e.g. CJs, TSJs, Crisp Ware Torpedo Jars), because these vessels moved through more targeted or organised systems of trade, and also because they might not have survived periods of economic decline or turbulence, for example, the severely restricted use of the OMA by end of Middle Minoan III (Thera

eruption?); the disappearance of TSJs and the cessation of Canaanite Jar imports into the Aegean by Late Helladic IIIB 2 (Rutter 2014: 63) (collapse of ‘palatial’ regimes?). Because MTCs were linked mainly with regional and interregional trade, their provenance may tell us something about the identity of those who carried out these more demanding ventures. The occasional transport of goods packaged in closed vessels like storage jars or *pithoi*, however, most likely took place on all levels of exchange delineated by Tartaron. Given that mariners persistently (if not always easily) were able to navigate the Mediterranean’s ‘coastsapes’, it is more difficult to draw conclusions about maritime commerce based on the production and distribution of those ceramic vessels.

Arnaud (2005: 114) also stresses the important difference between institutional commerce, which had limited economic risk (e.g. gift-giving between the rulers of LBA polities; aristocratic Homeric commerce), and independent, small-scale commerce. Monroe (2011) has discussed eloquently another kind of risk that was inherent in the ‘liminal’ zones of water–land interfaces (i.e. ports, harbours), with special reference to Late Bronze Age maritime trade. In considering the economics of Roman trade, Bang (2008: 194–195) has argued that it should be modelled not as a ‘generalized market sphere’, but as a patchy, weakly integrated space where trading ‘circuits’ were segmented at different scales: ‘It was a high-risk, high transaction-cost environment’. Others argue that, at the very least, a more organised and directed level of trade was essential to supply the major urban centres of the Roman Empire (Wilson 2011: 53–54; see also Temin 2012). These contrasting views concern the *scale* of interaction, and even if Wilson is correct concerning the Mediterranean-wide scale, local systems and even individual sites may have contrasting dynamics that would not be apparent at the larger scale (Galaty et al. 2009: 43). In light of the longer-term and eastern-Mediterranean-wide data on MTCs presented in this study, and as we argue further below, it seems clear that interregional patterns of trade existed, with certain Levantine coastal towns and Aegean islands (the Cyclades, Crete) or regions (during the Iron Age), as well as Egypt (Memphis?) if not Cyprus, being primary production centres. From these centres, however, specific types of MTCs with varied contents moved forth into both local and regional systems of seaborne communications, connections and consumption.

Braudel (1972: 108) observed that ‘Everyday coastal shipping has untiringly spun threads connecting the different areas of the sea which may pass unnoticed in the great movements of history’. Fishermen and small-time traders plied the coasts between anchorages or safe havens in the course of their everyday lives: visiting coastal communities, turning over cargo, connecting people and products. The ‘opportunistic’ ports they used are not easily recognised archaeologically: the routine loading and unloading of goods (or people) might have occurred along any part of a coast or unadorned beach accessible by land or sea (Leidwanger 2013: 223; for such an anchorage on Roman Cyprus, see Leonard 1995). Although the fragmentation of Mediterranean islands and coasts typically supports intensive local trading, when politico-economic and environmental conditions permit, the ease of maritime communications enables

trade to expand into wider networks of exchange (Tartaron 2013: 203). Broodbank (2013a: 466, 472–473), for example, suggests that Braudel's *caboteurs*, tramps and 'travelling bazaars'—perhaps originating in the port towns of Cyprus—came of age during the unsettled conditions following the collapse of several 'palatial' polities in the eastern Mediterranean during the twelfth century BC, spreading as far west as Sardinia. In turn, this signals another potentially crucial change between Bronze and Iron Age trade mechanisms (discussed further below).

As the economic productivity and political influence (or territorial control) of various coastal or island polities grew during the Middle and especially the Late Bronze Ages, some increasingly became involved in moving both 'luxury' and bulk goods over long distances, or at least controlling the means of doing so (Sherratt and Sherratt 1991: 372–373). Indeed, maritime mobility and the demand for luxury goods may be seen as two prime movers in the emergent long-distance exchange systems of the Bronze Age, if not the early Iron Age (Sherratt and Sherratt 1993). Those polities that possessed the demographic capacity and seafaring knowledge to mount trading expeditions may well have gained a dominant position amongst their neighbours (Broodbank 1993: 323; Ivanova 2012: 360). Bernal (1991: 491) went so far as to suggest that the Canaanite Jar was 'the clearest archaeological indicator of Levantine economic penetration into the Aegean'.

Be that as it may, the fact that seafaring was a 'normal', everyday activity in which large numbers of people were engaged, off and on, with the sea, at least on a local basis, meant that any level of political or social control was difficult (Purcell 2014: 67). Close reading of a very broad selection of studies related to the politico-economic aspects of trade suggests that overt attempts by elites to control trade typically are subverted through resistance, corruption or simply shifting the centre of trade to another place. At the same time, excessive freedom of trade is often subjected to regulation, whether social, political or ideological (Oka and Kusimba 2008: 366–367). With respect to Bronze Age trade in the Mediterranean, Artzy (1994: 134) argued that when the economic infrastructure (or the political base) of trading centres became destabilised (as they did at the end of the Late Bronze Age), mariners may have turned on the powers that had provided security and meaning to long-distance trade, developing a more predatory means of living that opposed terrestrial authority.

Most such Bronze Age polities that concern us here had a 'palatial' configuration, from the city-states of the Levant or the Aegean kingdoms to the centralised authority on Cyprus or the imperial regimes that often dominated the Egyptian delta. They were organised and dedicated not only to large-scale technological development, production and storage but also to generating wealth. This they did by importing luxurious things from afar or exporting their own high-value products that were in demand—including olive oil, wine and grain. Here we may note that the Linear B texts of the Aegean world are notoriously silent on external trade (Killen 1985; Bennet 2007: 182; Monroe 2009: 196–197). Nonetheless, the expansion of maritime trade and the resulting accumulation

of wealth must have coincided with (if they did not underlie) other, social changes, not least the sharpening of status inequalities (as Ivanova [2012: 361] argues for early maritime trade along the west coast of the Black Sea).

Even so, taking the larger view over the long term, there is no indisputable evidence for any maritime ‘thalassocracies’ in the Late Bronze Age Mediterranean (Knapp 1993); the notion of Aegean, Levantine, Cypriot or Egyptian trading monopolies has little to do with Bronze Age reality (Wachsmann 1998: 332; for discussion of a comparable situation in eastern Arabian maritime trade during the Bronze Age, see Boivin and Fuller 2009: 164–165). As far as we can tell, much of the maritime mobility and connectivity at work in the prehistoric and early historic Mediterranean lay in the hands of coastal polities that were beyond the control of the major, land-based powers such as New Kingdom Egypt, the Hittites and the Assyrians, or even the sea-minded Minoans (similarly, Wachsmann 1998: 10). Indeed, as Purcell (2014: 67) recently emphasised: ‘If the sea was to be controlled more generally, it had to be through the supervision of landing places, rather than through engagement between ships at sea’.

Rather than attempting to develop a state-run system of transportation, the rulers of some Bronze Age coastal polities, like Ugarit in Syria, turned to independent merchants within their realm (Monroe 2009: 181–189; cf. Sauvage 2012: 156, 161). Such transport-based economies—whether state-run, private or somewhere in between—responded to increased foreign demand by scaling up the level of commerce and undertaking longer journeys: e.g. Egyptian missions to Byblos for cedar in the Middle if not the Early Bronze Age; medium- to long-range shipments of grain between the Levant, the Aegean, Egypt and Anatolia in the Late Bronze Age; Cypriot copper to the Aegean, Levant or Egypt in the Late Bronze Age; Phoenician forays for metals and minerals to the central and western Mediterranean in the Iron Age.

The increased demand for bulk raw materials and other goods obtained from afar, and spiralling economies of scale spurred on by merchants as well as the heads of complex Bronze Age polities, developed alongside refinements in the technology of sailing ships (Broodbank 2010: 258; Monroe 2007: 14). Maritime enterprises that involved seafaring under sail had clear advantages over oared ships (Broodbank 2010: 258–260): (1) optimising travel time within the Mediterranean, thus expanding the margins of the known as well as the unknown; (2) lowering transport costs that may have promoted the specialised production of goods in some key centres; (3) bringing different peoples and cultures as well as their social and economic practices into more consistent contact in the main ports or harbours; and, not least, (4) facilitating the bulk transportation (up to a maximum of 20 tons in the view of Monroe 2007) of an increasingly diverse range of goods—metals, MTCs and their contents (oils, resins, wine), grain and other staples.

At least some goods in transport would have been transhipped, i.e. taken from one port to another by different ships, merchants or individuals, or offloaded at nodal ports for transport to inland centres or other coastal sites

lacking suitable harbours or anchorages (Artzy 2006a). One intriguing example involves the ‘sheer quantities’ of Aegean pottery vessels found in the eastern Mediterranean (van Wijngaarden 2002: 24). East of Cyprus, these quantities dropped markedly, while Cypriot pottery found in Levantine sites outnumbered Aegean examples by a 3:1 margin (Manning and Hulin 2005: 284). Were all these Aegean pottery vessels transhipped from Cyprus to the Levant? If so, were they transported on Aegean or on Cypriot carriers? Or were they exported directly from the Argolid to the Levant, as Jung (2015) has recently argued?

When it comes to transporting liquid or other commodities in MTCs over the short haul or far across the open sea, in bulk or as part of more ‘general’ cargoes, our main source of evidence is the shipwrecks that carried these containers. The evidence from shipwrecks for the Bronze and early Iron Ages, however, is limited and very uneven: the Uluburun ship carried some 150 Canaanite jars (the majority manufactured in the southern Levant), 9 or 10 Cypriot *pithoi* (most analysed *pithoi* were produced in southern or eastern Cyprus), and 12 or so TSJs (mainly from central or western Crete). In contrast, the Cape Gelidonya shipwreck carried only five (pieces of) Canaanite Jars, four or more TSJs (one of two analysed was possibly produced on Crete) and at least one Cypriot *pithos*. From the Point Iria shipwreck came eight coarse ware TSJs (from central Crete), and four or five (Group II) Cypriot *pithoi*. The published contents of other Bronze Age shipwrecks have little to add to this picture: Dokos, Laconia and Pseira (Oval-Mouthed Amphorae; the last also possibly one Canaanite Jar—Rutter 1999: 143, 153 n. 34); Sheytan Deresi (three ‘piriform amphorae’ that may well be MTCs, but are not considered further in this study, but see Catsambis 2008: 22–26, figs. 9–11; 51–54).

Still within the early Iron Age but towards its end (and thus on the boundary of material covered in the present study), the *Tanit* and *Elissa* shipwrecks each carried nearly 400 highly standardised, ‘torpedo-shaped’ Phoenician transport amphorae, while the Kekova Adası wreck held some 130 amphorae in its cargo, including 90–100 Cypriot Basket-handled Amphorae (likely origin in eastern Cyprus), as well as 20 fragmentary examples of ‘southeast Aegean’ type amphorae and 7–10 examples of Corinthian Type A amphorae (Greene et al. 2011; 2013: 23–28). The Kekova Adası wreck’s (bulk?) cargo thus consisted of nearly 7000 liquid litres of commodities from Cyprus, Corinth and the southeast Aegean. Some other goods found on the seabed—two *mortaria*, a cooking pot, some roof tiles, 80 diabase ballast stones—led the excavators to suggest a possible Cypriot origin for the ship (Greene et al. 2013: 28). Consideration of a wide range of comparative evidence as well as close examination of all the amphorae on the Kekova Adası wreck indicate an early or mid-seventh century BC date for this wreck (Greene et al. 2013: 27).

Trying to determine the ultimate origin, or even the political or economic status of the four ships (Uluburun, the *Tanit* and *Elissa*, Kekova Adası) involved in long-distance trade (albeit surely under different mechanisms of exchange) is problematic on several grounds (for an opposing but somewhat confusing view, see Bass 1991: 69–71). Stager (2003: 238–244) argues convincingly for the



origin of the *Tanit* and *Elissa* wrecks, but concedes that their destination is unknown (although he favours Egypt). Harpster (2013) is more sceptical, and points out that existing interpretations of the Uluburun wreck, and by extension those of the Cape Gelidonya, *Tanit* and *Elissa* wrecks, represent artificial, modern constructs developed to suggest not only the identities of the ships ('Canaanite', 'Phoenician') but also their likely destinations (the Aegean, Egypt or Carthage).

We are on firmer ground with a widely cited, early fifth century BC Aramaic papyrus from Elephantine that records the duty collected from ships bringing goods to Egypt over a period of ten months (Yardeni 1994: 69–70). Here, 'Phoenician' ships and 'Sidonian' and 'Ionian' wines are listed in an unambiguous manner, what Malkin (1998: 17–19) terms 'oppositional ethnicity' (see also Monroe 2009: 228–229). Moreover, and more importantly, Stager's (2003: 24–244, table 3) analysis indicates that during a three-month period, these ships transported (to Egypt?) 6170 wine-filled amphorae, along with empty amphorae and other goods including copper, tin, wood, wool and clay. Nonetheless, the point remains that for prehistoric and even protohistoric shipping, we simply do not know the majority of the possible permutations of ownership, sponsorship or 'nationality'. From such documentary evidence as we do have, one could imagine that a Bronze Age ship built on Cyprus was captained by a Canaanite or a Minoan, while the goods on board (olive oil, wine, pottery from Crete) were 'owned' by an Ugaritic merchant and were being shipped to Egypt under royal sanction.

Certainly the Uluburun wreck, on its final journey, must have made stops (1) in the Levant (the clays of the Canaanite Jars suggest production somewhere around the Bay of Haifa; the mandible of a house mouse came from somewhere farther north) and (2) on Cyprus (the ten tons of copper ingots; the Cypriot fine wares stacked in the *pithoi*). While the excavator and others argue for a Levantine origin (i.e. a Levantine 'nationality') for the ship and an Aegean destination (e.g. Pulak 2008; Bachhuber 2006), others reasonably maintain that a Cypriot origin, if also an Aegean destination, is equally plausible (e.g. Hulin, in White 2002: 173–174; Muhly 2011b: 44; Monroe 2011: 92; Broodbank 2013a: 402). In Goren's (2013: 60) imaginative scenario, the Uluburun ship, Canaanite in origin, was loaded in Egypt with precious raw materials and sent to the Aegean in order to form an Egypto-Aegean alliance against the Hittites. Ward (2010: 155–156), more soberly, observes that nine or ten cultures are represented by the finds: a substantial Cypriot cargo, 24 anchors of Levantine type, a variety of raw materials and 'high status' finished products (gold, silver, ivory, cobalt, tin, amber, ostrich eggs) with multiple origins, and much more. She concludes that the Uluburun ship exemplifies 'directional trade' by some of the most 'conspicuous consumers' of the LBA, and that 'definitive proof of who operated the ship, how the ship's cargo was financed, or where it was going is tenuous at best'. Monroe (2011: 94) suggests that this kind of ambiguity may relate less to interpretation (or preservation for that matter) than to 'accurate readings of a maritime past lived in maritime, liminal, and semi-peripheral conditions'.



The Uluburun shipwreck holds the largest concentration of Canaanite Jars as cargo from the LBA, corroborating their role as *the* Levantine MTC of the period but also as a multi-purpose container, since they carried more than one kind of good. Unlike the *Tanit* and *Elissa* wrecks, the heterogeneity of the Uluburun cargo impedes any direct connection of its MTCs with a maritime centre, and precludes any definitive understanding of the ship's 'identity' or even its itinerary. Moreover, the ten TSJs found in the ship may not have been cargo items: they have more than one provenance and four of them had Cypro-Minoan signs on their handles (indicating, perhaps, that they were either shipped to or *via* Cyprus?). If these TSJs were in the 're-use phase' of their life, are they better indicators than the Canaanite Jars of the identity of their owners (mariners, or just passengers on the ship)? Such questions are easier to pose than to answer.

Moving from shipwrecks and MTCs to their destinations, the development of (natural) 'proto-harbours' in the Middle–Late Bronze Ages, and thereafter of purpose-built harbours, enabled many coastal polities to intensify their efforts and/or to solidify their economic bases. The ports themselves became key locational centres in the expansion of long-distance trade; they were gateways for goods coming into or through the Mediterranean from afar, and places of encounter that brought together dissimilar peoples and unfamiliar ideas. Here it must be qualified that coastal ports need not necessarily be, and indeed often are not, terrestrial urban centres in their own right, mainly because of their essentially transport-related nature (exceptions include ancient Levantine ports like Tyre, or classical Piraeus vis-à-vis Athens) (Sawicky 2007: 47). Moreover, as was the case with the Late Bronze Age port at Minet al-Beidha, the palatial centre of Ugarit lay not on the coast but (in this case) one km inland.

These ports and urban centres, together with their surrounding villages, farms or estates, formed the basis for 'palatial', regional or state-level polities with their attendant power structures (Broodbank 2013a: 358). Based on the amounts of Late Bronze Age Aegean painted pottery found in different places throughout the Aegean and eastern Mediterranean, Broodbank (2013a: 413) calculates that there was a network of some 40–50 main production, trade and consumption centres, mostly palatial and 'urban' in organisation, stretching from the Nile Delta to the Aegean. In addition, countless further communities, many of them smaller ports or havens, made up the broader system of interconnections that typified the eastern Mediterranean at this time.

Beyond any concept that archaeologists hold regarding Levantine, Aegean, Cypriot or Egyptian traders or trading systems, we would suggest that Late Bronze Age (and probably early Iron Age) trade in the eastern Mediterranean existed on at least two basic levels, with myriad other possibilities or combinations. Perhaps built on similar systems of contact, one involved local types of exchange between individuals via tramping or by coastal sailing between known ports (cabotage, 'coastscares', 'small worlds'); the other was based on regional and interregional exchange, which involved independent entrepreneurs, state or regional powers, as well as gift-giving between the rulers

of the major powers (Egyptians, Hittites and Assyrians). The actual networks of trade probably involved all levels, and certainly would have overlapped or intersected, providing a crucial level of stability to supply and demand.

The stability of trading networks was an essential factor in maintaining patterns of trade: the less certain the market for any given product, or the more variable the value of specific goods through space and time, the greater the likelihood of tramping or cabotage, in search of higher selling prices (Arnaud 2011: 72–73). One main difference between the two levels was politico-economic if not spatial in scale, and depended on the extent to which the destination was pre-determined (Sawicky 2007: 46). In the case of tramping, the scale was local and indeterminate; in the case of cabotage (coastal sailing), the scale was also local but not entirely indeterminate as typically it was directed to known ports or anchorages, and concerned in large part with all manner of products (e.g. subsistence goods, pottery). In the case of longer distance (regional or interregional) trade and the bulk exchange of certain products in demand (metals, agricultural and ‘luxury’ goods, aromatic resins), whether on behalf of state-level polities or individual merchants, the routes of travel and the destination ports were nearly always set within diplomatic, economic or even military parameters. Given the costs associated with such ventures (import or export duties, travel expenses, possible interest on loans), merchants probably sought to make a substantial profit from the sale of their cargo (in classical Athens, the value of an imported cargo was approximately twice that of the original investment—Arnaud 2011: 71).

Panagiotopoulos (2011: 40–41) attempted to refine further the mechanisms of trade on the long-distance level, between (1) ‘closed networks’ of ceremonial gift exchanges that characterised interactions amongst the rulers of most major states during the Late Bronze Age (i.e. Egypt, Babylonia, Assyria, Mitanni, the Hittites), which he sees as diplomatic and sociopolitical in nature, and (2) ‘open networks’ of long-distance trade between and amongst these and other, smaller states, which he sees as largely economic in nature (also Zaccagnini 1987). Closed networks mainly involved centralised control and typically were managed by rulers and elites; they were thus highly restricted and characterised by intricate, inter-polity ties. Open networks also involved reciprocal exchanges but were more flexible, operating in multiple modes of exchange with a wider array of partners or polities; overall, they were characterised by weaker ties between members. Modern-day polities or social systems with weak ties seem to have easier access to a wider range of goods and ideas than those with closer ties (Csermely 2006: 1–3).

Projecting this notion back onto the Late Bronze Age, Panagiotopoulos (2011: 40) suggests that the (smaller scale) Late Bronze Age polities of the Aegean and the Levant (and presumably Cyprus?) contributed more to the cosmopolitanism of this era than did the ‘great kings’ of Egypt and the Near East, with their more formal exchange relationships. Yet even a glance at the extensive array of material things, raw materials, and organic and inorganic goods mentioned in the cuneiform documentary evidence of the ‘great kings’ (e.g. Liverani 1990; Knapp 1991; Van De Mieroop 2007) calls any wide

application of Panagiotopoulos's point into question. Arnaud (2005:114), moreover, suggests that institutional trade (i.e. closed networks) was of low financial risk, and if that were the case we can assume that long-distance trade, which required a bigger investment, was more likely to happen within closed rather than open networks. During the classical era, the overall weight of goods carried by 'smaller' ships (20–50 tons) was less than that carried by large ships (Arnaud 2005: 34–38). During the Bronze Age, the lower cost of goods that were transported in bulk by sea would have made it possible for a few centres to specialise in the production of specific goods or raw materials (e.g. copper on Cyprus, gold in Egypt, cedar wood in the central Levant), while other centres relied mainly on imports, even for locally available goods and materials (e.g. wine, olives, wool, clay) (Sherratt and Sherratt 2001; Broodbank 2010: 259). We discuss this point in more detail in the conclusion.

In the Bronze and early Iron Ages, even if we remain largely uncertain about who actually carried the products that travelled in maritime transport containers, it is clear that such goods—wine or other intoxicants, olive oil, fruits and grain, resins, dyes, exotic or otherwise—were consumed on a significant level and must have been in high demand. While the Bronze Age cargoes of which we are aware (eight shipwrecks) were clearly compound in nature (i.e. they consisted of more than a single component/product), from the mid–late first millennium BC onward, this pattern changed dramatically: the majority of ships' cargoes were characterised by a single, bulk component, in particular transport amphorae (Parker 1992: 20–21); *prima facie*, this is the case with the Iron Age wrecks of the *Tanit* and *Elissa*. These two wrecks provide sound evidence for the *bulk transportation of MTCs*: indeed the eighth century BC represents a turning point in the history of MTCs. Phoenician and Greek involvement in the central and western Mediterranean marked a major change in the scale of maritime trade, in terms of its mechanisms, its technologies and the space traversed. Thus our study—which focuses on the different contexts of the MTCs' emergence, not their further development in the different parts of the eastern Mediterranean—terminates at this crucial point.

### **The Political Setting of Late Bronze–Early Iron Age Trade in MTCs**

In light of the foregoing discussion, we need to consider the extent to which seaborne trade mechanisms may have changed between the Late Bronze and early Iron Ages. In order to do so, however, it is necessary first to summarise the wider politico-economic setting in which such changes took place. Many of the state-level polities of the Late Bronze Age—from the Aegean to the Levant, and from Anatolia in the north to Egypt in the south—went into decline within a few decades either side of 1200 BC (Gitin et al. 1998; Oren 2000; Killebrew and Lehmann 2013). After this 'collapse' of several politico-economic regimes that had been dynamically involved in the transport and exchange systems which characterised the previous 300–400 years, several smaller, regional

polities emerged (e.g. Artzy 1997; Iacovou 2002; 2012b; Gilboa 2006–07; Bachhuber and Roberts 2009; Pedrazzi 2010; Sherratt 2010; Genz 2013; Aslan et al. 2014; Bunimovitz and Lederman 2014). Although multiple and even contradictory causes for these developments have been suggested (e.g. migrations, Sea Peoples' destruction, political inequalities between centres and peripheries, climatic change, internal disruptions, system collapse), there is no coherent, overarching explanation that might account for all the economic, sociocultural and political changes that seem evident between about 1250–1150 BC (Knapp and Manning 2016).

The most commonly cited cause stems from the account by Ramesses III (Kitchen 1983: 39–40) of Egypt's defeat of the 'Sea Peoples'. There the villains are portrayed as a group of wayward warriors—mariners, pirates and brigands—whose accompanying ships are depicted only once in any detail, in reliefs on the outer walls of Ramesses III's temple at Medinet Habu (Wachsmann 2000: 105–106, fig. 6.1). These ships look suspiciously similar to the smaller-capacity, independent vessels that came to characterise much of Iron Age shipping. As to the Sea Peoples themselves, certain of their element were known from documentary evidence as early as the fourteenth century BC, and they persisted as late as the eleventh century BC. Whoever they were and wherever they came from, they were not really a cause but rather a symptom of the 'collapse' at the end of the Late Bronze Age. No doubt external factors like the Sea Peoples, and intractable factors like climate change, played a part in these disruptive times, but so too did internal troubles—social, political, economic—throughout the eastern Mediterranean.

Sherratt and Sherratt (1993: 361–363) have presented an eminently plausible scenario of several major changes in the trading patterns that accompanied the transition to the early Iron Age. Although we don't really know if Phoenician ports like Tyre, Sidon or Arwad were organised on a 'palatial' model similar to that of Canaanite Ugarit, it is assumed that Iron Age mercantile towns and centres replaced the palace-centred diplomatic and trading networks of the Bronze Age, and that merchant enterprise became the dominant mode of trading activity. The production of iron formed part of this progressive commercialisation in the eastern Mediterranean, and the spread of ironworking undermined Bronze Age polities that had been based on acquiring and circulating bronze. The erosion of this centralised, Bronze Age control over economic activities led to new forms of political power and new territorial boundaries, from city-states to (eventually) empires, which in turn led to new forms of surplus production and consumption in various regions of the Mediterranean. Routledge and McGeough (2009: 29) present a somewhat different view: while agreeing that the networks and agents involved in Late Bronze Age trade were 'diverse and dispersed' and that some segments of this overall system remained active during the early Iron Age, they insist that palace economies such as those evident at Ugarit were dominating rather than controlling institutions, and that—accordingly—decentralised, entrepreneurial trade never threatened the politico-economic foundations of the palaces.

In either case, it is likely that tensions arose between agricultural and commercial interests, whether in the relationship between territorial states and mercantile city-states on their boundaries (especially on islands or coasts through which foreign trade was channelled), or within independent city-states, where mercantile activity was often separated from political power. These and several other features—overseas trading stations that often developed into formal colonies; the increasing scale of commercial competition and rival movements of colonisation or imperial expansion; a growing volume of maritime traffic and the concomitant requirements of commerce, tribute and military expenditure (e.g. mercenaries)—appeared only gradually during the early first millennium BC, taking different forms in different areas of the Mediterranean (generally earlier in the east). Together, however, they led to a progressive increase in scale, both in the volumes of material and in the expansion of Mediterranean maritime routes, which ultimately surpassed anything achieved during the Bronze Age under systems of palatial control.

As emphasised already, the stability of trading networks can have a major impact on the long-term maintenance of specific patterns of trade: less stability in supply or demand on any level will increase the likelihood of tramping or cabotage (Arnaud 2011: 72–73). At the end of the Bronze Age, on land and at sea, brigandage and piracy accelerated the demise of a well-established system (or systems) of international trade. Once many of the previously key ports and harbours throughout the eastern Mediterranean were destabilised or devastated, there were few secure or dependable places left for merchants, mariners or even pirates to conduct their business. Even so, some coastal towns and island ports survived these destructions (e.g. Kition and Palaipaphos on Cyprus, Beirut and Byblos in the Levant), whilst other, now purpose-built harbours emerged (e.g. Amathus and Salamis on Cyprus; Sidon, Tyre, Dor and Atlit on the Levantine coast) as new commercial centres, instigating or developing new contacts overseas, from the Levant to the central Mediterranean. Such centres thus made tactical as well as commercial adjustments to the coming Age of Iron, engaging with a new type of economy that became integral to Mediterranean connections.

The end of the Bronze Age thus brought about notable changes not only in stability, supply and demand, but also in the mechanisms of trade and equally in the production methods, even the manufacturing loci of MTCs. Early Iron Age forms of trade had different standards, circumscribed by smaller polities and arguably driven by profit. Tramping, or coastal sailing (cabotage), with smaller volume flows of (higher value?) goods, is eminently suited to such periods of crisis (Arnaud 2011: 76). Only one Bronze Age shipwreck (Uluburun) could be regarded as a bulk transport carrier involved in long-distance trade. By the early Iron Age, however, our (still limited) shipwreck evidence tells quite another story. The *Tanit* and *Elissa* wrecks both seem to have carried bulk cargoes of transport amphorae, although their destinations—and thus the likelihood of determining whether they represent local, regional or long-distance trade—remain a matter of guesswork. In the Aegean, while there are no published shipwrecks dating to the Early Iron Age, we can see from the

distribution of so-called North Aegean amphorae that the trade in bulk commodities, and at least some *maritime* trade, continued after the end of the Bronze Age. Certainly by the eighth century BC, there was a significant rise in MTC use throughout the Aegean basin as ‘Thermaic Gulf/North Aegean Type II’ amphorae were mass-produced and widely distributed. Shortly after, southern Greece started producing large numbers of both SOS and Corinthian amphorae, both of which have been found throughout the western, central and eastern Mediterranean.

Within the early Iron Age, the eleventh century BC Egyptian Tale of Wenamun sheds some light on what happened when two levels of trade—local and long-distance—collided (Sawicky (2007: 46–47). After some of his goods were stolen at the port of Dor, Wenamun made a legal appeal for their return (Brinker 2011), but grew impatient at the lack of recompense and departed for Byblos, his final destination, where he was to pick up timber on behalf of the Egyptian pharaoh. On the way he confronted a ship from Dor, and seized some goods to replace what he had lost. Upon arrival in Byblos, however, its ruler received him with hostility, asking why the Egyptians had sent ships all the way to Byblos when there were so many local ships involved in trade with Egypt, all of them from ports closer to Egypt than Byblos? Wenamun responded that there had long been a tradition of exchange between Byblos and Egypt, insinuating that it had been—and still was—an ‘Egyptian’ enterprise. The ruler of Byblos, acknowledging such an earlier tradition (of royal gift exchange), nonetheless demanded payment. Thus Wenamun was forced to send to Egypt for the commodities demanded by the ruler of Byblos, before he could obtain his cedars. Wenamun (or any notion of an Egyptian official who could control the delivery of goods) and ‘Egyptian’ trade, along with the concept of long-distance gift exchange, were things of the past. In the new, early Iron Age system of exchange, Wenamun and others like him would have to come to terms with different standards, motivated by profit and circumscribed by a more localised outlook—economic and legal—now embedded in mechanisms of Levantine coastal polities.

## 6 Conclusions

### MTCs and Mediterranean Connectivity

Syro-Palestinian jugs and flasks suitable for oil, syrups and resins had reached Egypt in some quantity during the third millennium, and the proliferation of standardised forms of packaging after 2000 BC is indicative of the degree of regional specialisation in organic production made possible by sea transport. (Sherratt and Sherratt 1991: 362)

With these few words written over two decades ago, it is clear that Andrew and Susan Sherratt had already seen the potential and importance of what we term MTCs; our attempt to disentangle the implications of what they said has taken us a far greater number of words. In general, they argued that the appearance of two forms of bulk commodity units—oxhide ingots for metals and Canaanite Jars for organic goods—demonstrates that certain regions (respectively, Cyprus and the Levant) were able to specialise in the production of bulk commodities that were transported by sea. The quantity of goods moving long distance by sea may have been small in relation to overall production, but its importance in motivating intensified surplus production to provide goods for exchange was out of all proportion to its bulk (Sherratt and Sherratt 1991: 354). Moreover, because the equivalent volume or weight of organic goods was of lower value than that for metals, the Canaanite Jars and their liquid contents—mainly wine and olive oil—must represent a high level of specialised production (Sherratt and Sherratt 1991: 363–364).

The increasing proliferation through time of MTCs, both in their numbers and their types, went hand in hand with the increasingly widespread production of wine and olive oil throughout the Bronze and early Iron Age Mediterranean (see papers in Amouretti and Brun 1993; Brun 2004). The olive (or other) oil and wine stored and shipped in MTCs represent the surplus production, organised export and ultimate consumption of commodities that had not only extrinsic value but also a certain social cachet related to the nature of their transport and the ‘semi-luxury’ status attached to it (Foxhall 2005: 240; Greene et al. 2013: 32–33).

Moreover, the technologies associated with making and moving MTCs must have had other social impacts (Bevan 2014: 413): they were easily reproducible to a standardised shape; their design meant that they moved easily and widely



through space; they could readily be tallied for economic records; their contents (ideally) could be preserved; and the quickly recognisable shapes of more exotic imports would have impacted on the social standing of the mariners or merchants responsible for their movement. Furthermore, evidence of ‘feasting’ activities, if correctly identified, suggests an avid wine-consuming culture extending at least from the Aegean through Cyprus to the Levant (Callot 1993; McGovern 2003; Steel 2004; Wright 2004). Pliny’s (*Natural History* 14.29.150) observation is thus quite apt: ‘There are two liquids most pleasing to human bodies—inside, wine; outside, oil’.

For diverse reasons and in many different ways (for anointing the body or maintaining culinary traditions, as fragrances or opiates, medicants, etc.), wine and especially olives formed key parts of the Mediterranean diet and were fundamental to the practices associated with a Mediterranean lifestyle (Sherratt and Sherratt 1991: 359; McGovern 2009; Abulafia 2011: 629; McGovern et al. 2013). Olives and vines not only provided a subsistence package but a cultural if not ideological one; their production on the scale necessary for maritime enterprise required a significant level of investment in both ‘manpower and capital’ (Sherratt and Sherratt 1991: 355). It seems clear that the mobilisation of such resources for specialised production appeared very early in the Levant, no later than the mid-third millennium BC, with the manufacture and transport of ‘combed’ and Metallic Ware jars (Marcus 2002: 410; Greenberg 2011: 239). At approximately the same time in the Aegean (after c. 2650 BC, Early Minoan IIA), one can make a similar case for an intra-regional trade involving the Cycladic Collar-necked Jars. Later, around 1750–1700 BC (transition between the Protopalatial and Neopalatial periods), and about the same time that the specialised production of the prototypical Canaanite Jar began in the Levant, the OMA of Minoan Crete came to serve as a standardised MTC for interregional trade. By this time, substantial storage and working areas evident in structures such as Levantine ‘patrician houses’ or Minoan ‘villas’ may have been devoted to oil and wine production for export (Papademetriou and Kriga 2013: 14).

The intensified production of pottery vessels that served for the bulk transport of organic goods by sea also corresponds to the best evidence we have for the emergence of seagoing ships under sail, e.g. the ‘Byblos ships’ that rode the waves between Levantine coastal sites and the Nile delta in the mid-third millennium BC (Broodbank 2000: 342–343; 2010; Marcus 2002: 410). This system of seagoing transport gave Egyptians access to Lebanese timbers (to build larger boats) and made mariners in Levantine communities familiar with the sail, placing polities along the eastern Mediterranean littoral in an advantageous maritime position (Sherratt and Sherratt 1991: 362). The introduction of the sail within the Aegean at some point in the Early Bronze Age established Crete as the fulcrum of contact with the eastern Mediterranean, and the main point of reception for ‘luxury’ goods and other commodities entering the Aegean world (Sherratt 2001: 227).

All these advances increasingly required developed anchorages if not formal harbours (e.g. Byblos and Beirut in the Levant, Poros-Katsambas on Crete, Tell ed-Dab'a in the Nile delta), as well as social systems that could sponsor specialist producers and support demanding consumers. The maritime knowledge required to link consumers with producers was not built up overnight (Horden and Purcell 2000: 125–127 and map 9); rather, it proceeded in a sequential manner, from anchorage to anchorage, or port to port, and not always where ships' captains might have intended to trade. Natural factors and human predators presented a series of obstacles, both along the coastal routes (Pryor 1988: 15) and in ventures to and from prominent islands (Braudel 1972: 150), like Crete and Cyprus. Outbound and return routes could be different, involving different winds and currents that were not always predictable. Such ventures might well be seen as 'travelling bazaars' (Braudel 1972: 107), but it must be emphasised that certain ships with specialised cargoes most likely travelled to specific destinations (e.g. the mixed cargo of the Uluburun as well as the specialised cargoes of the *Tanit* and *Elissa* wrecks).

The last centuries of the Bronze Age, between about 1400–1200 BC, represented 'the climax of bulk maritime trade in the Bronze Age' (Sherratt and Sherratt 1991: 372–374). The systems involved had at least two different components: (1) largely independent boats of limited capacities sailing short distances (not necessarily local) over opportunistic routes (e.g. Point Iria, Cape Gelidonya); and (2) 'heavily capitalised' large ships with major cargoes (e.g. Uluburun) sailing long-distance, international routes marked by ports and emporia such as Tell Abu Hawam, Ugarit, Kommos and Enkomi, as well as way stations like Marsa Matruh or Tel Nami (see also Ward 2010: 157).

Of the 11 shipwrecks dated to the Late Bronze and Iron Age I–II era, only four (Uluburun, the *Tanit* and *Elissa*, Kekova Adası) could be classified even broadly as bulk cargo carriers involving long-distance trade. All the other shipwrecks discussed in this study (Dokos, Pseira, Laconia, Cape Gelidonya, Point Iria, Modi, Sheytan Deresi) most likely served to transport more 'general' or else much smaller cargoes. However, while the size and technological sophistication of the main cargo aboard the Uluburun ship (copper, tin and glass ingots; Canaanite Jars) clearly point to 'bulk' trade aimed at a 'palatial' consumer, other cargo items might suggest a more 'private' level of trade (e.g. ivory, African blackwood, amber, gold, silver and tin scrap metal, possibly the Cypriot *pithoi* stacked full of other types of Cypriot pottery). Moreover, even if the Uluburun, Kekova Adası and 'Phoenician' ships carried bulk cargoes, their size (14–16 m where known) and capacity (10–20 tons) are of a class that certainly allows for cabotage (see Nantet 2010: 109 for the Archaic period). *Caiques* of 13 tons, for example, were used in the nineteenth century of our era to transport pottery between Aegean ports (Casson 1938). Because the longest open-water route (from the Aegean or Cyprus to Egypt) could be traversed in about three to five days, Wachsmann (1998: 331) argued that during the Late Bronze Age 'the division of seagoing ships into coasters and open-water craft has little meaning'.

In considering the cargoes of any of these ships, we have already noted that the lower cost of bulk transported goods via sea enabled a few centres to engage in the specialised production of specific goods or raw materials, while others tended to rely on the import of widely available goods like wine, olives or pottery (Sherratt and Sherratt 2001; Broodbank 2010: 259). Why was it that only certain regions—the Levant, Crete and to a lesser extent Cyprus or Egypt—specialised in producing widely available goods such as olive oil and wine as well as the MTCs in which they could be shipped? Here it is worthwhile to bear in mind that during most later periods, ‘regionalism’ in amphora styles, production rationales and distribution mechanisms is the norm in the Mediterranean (Lawall, in Bevan 2014: 408).

One reason that lay behind the specialised (regional) production of wine and olive oil was that both vineyards and olive groves involved a long-term commitment of both land and labour, and only produced viable harvests after several years, if not decades (Rosen 1995; Fall et al. 2002). Those who produced these goods also required an outlet for them, as they were not suitable for long-term storage (van der Veen 2014: 805): port towns offered an ideal outlet as well as a profitable solution. All this encouraged regional specialisation on a diachronic scale (Bevan 2010: 62). Another reason was that once an industry producing MTCs was established, based no doubt on the close links between local technology and design, as well as on maritime needs, it probably took on a life of its own, mediating between local production and the demands of consumers elsewhere (Greenberg, in Bevan 2014: 406). The intricate, technologically sophisticated design of MTCs suggests that they were made and used within highly local communities of practice, something often confirmed by chemical or petrographic analyses of clay sources. Sugerman’s (2000) petrographic analyses of Canaanite Jars in the southern Levant, for example, suggests a strong directionality in the distribution of locally produced examples of these vessels, as well as a dendritic network that brought them to the larger and wealthier port centres (see also Sugerman 2009: 445–446). Furthermore, the profits involved in maritime trade may have facilitated if not encouraged intensified production in certain areas, which generated enough surplus (and profits) to sustain the cost of imports, whether supplies or foreign goods. In the classical era, the high price differentials between the same products within different areas of the Mediterranean became the ‘driving force behind maritime trade’ (Arnaud 2011: 71). Moreover, the broad similarity amongst the cargoes of certain Roman shipwrecks (first century AD Spanish ships, for example) suggests that during certain periods, many ships carried similar goods along the same routes to the same destinations (Arnaud 2011: 72).

One question we should ask but cannot answer adequately concerns the direction of causality (Purcell in Bevan 2014: 410): did demand for wine and olive oil result in more efficient and increasingly standardised containers and new ships, or did the ease of distribution made possible by new kinds of ships and new containers, as well as growing interconnections within the Mediterranean, generate demand and the production of MTCs to meet it?

During the Late Bronze Age, Broodbank (2013a: 414) suggests that as seaborne connections became more secure and seaborne movement easier, many of the key players involved in diverse systems of Mediterranean exchange found it more sensible to acquire certain end products (in this case, olive oil or wine *as well as* their containers) previously manufactured and consumed locally. Others would have concentrated on materials or products that could be manufactured locally (sometimes only locally, such as metals) or skilfully (e.g. textiles, painted pottery), even if not every polity benefitted equally from this kind of growth. Still others may have invested in developing or ‘branding’ certain aspects of their local products to fulfil specific demands from the wider system: for example ‘designer’ goods such as textiles with special weaves or striking patterns, like those seen on Thera frescoes or New Kingdom faience plaques from Medinet Habu (Ramesses III temple); scented oils (e.g. for the small Mycenaean stirrup jars); or branded packaging, such as the ‘blistered’ surface of a copper oxhide ingot, or perhaps the Base-ring juglets that resembled a slashed opium poppy head (Merrillees 1962; 1969; Manning and Hulin 2005: 281–282; Wengrow 2008: 28; Bevan 2010: 48–72). Cultural preferences amongst consumers, moreover, tended to be idiosyncratic and dependent on the products to which they had easy access or on the areas with which they had close contacts. Elites in the southern Levant, for example, preferred Egyptian-style bronze drinking vessels to the Mycenaean-style pottery sets favoured in the northern Levant and on Cyprus (Steel 1998; 2002; cf. Hitchcock and Maeir 2013: 59–61, and Yasur-Landau et al. 2014: 6, who discuss how Mycenaean kraters were incorporated into Canaanite drinking sets).

With the passage of time and familiarisation, the MTCs themselves would have become as important as their contents for differentiating the product (Bevan 2010: 62). Indeed, some of these containers may have been ‘branded’ themselves: for example, the medium-sized TSJs made in the Argolid and incised with Cypro-Minoan signs (Döhl 1979; Haskell et al. 2011: 129) might have marked them for the Cypriot market. Catling and Karageorghis (1960: 121) long ago suggested that the octopus motif seen on several TSJs found in Cyprus and the Levant (associated with production in central Crete—Haskell et al. 2011: 128–131) might have served as a ‘trademark’ for Cretan products. In a similar vein, certain products—honey, vases and unguents—may have been designated as *kupirijo* on Linear B tablets because they were destined for Cyprus (Palaima 1991: 281, 294). Killen (1995) suggested that the *kupirijo* found on certain Knossian Linear B tablets might refer to a ‘collector’ involved in producing unguents and organising the export of perfumed oils to Cyprus.

In the long term, the complexity and diversity of maritime space on the islands, coasts and the Mediterranean Sea itself meant that networks of trade often shifted, making it difficult for any one place—port, palace or other polity—to maintain a commanding position. Some islands (the Cyclades, Crete, Cyprus) seem to have played a key role in the early production and distribution of MTCs, just as other islands did during the classical–Hellenistic eras. Indeed, Horden and Purcell (2006: 734) suggested that the Mediterranean islands have

always been ‘tightly engaged in networks of which they are often the principal nodes’. Thus the impetus for trade and exchange was not simply generated on continents and then directed into an island ‘stream’; as Knappett and Nikolakopoulou (2014: 34–35) recently put it: ‘The stream could not even get going without these islands—they are always there, in the mix from the outset’.

The timing of sailing seasons (all year, or only certain months?) may also be relevant here: it is likely that only those polities with some level of naval power or wealthy merchants could afford to send large sailing ships on long trips. Based on her detailed studies over many years of the stone anchors from Kition and Ugarit, Frost (1985; 1991: 370–371) long ago concluded that some of the largest Late Bronze Age ships plying the sea-lanes of the eastern Mediterranean must have been of Cypriot and Levantine (Ugarit, Byblos) origin (but cf. Jung 2015). The few large-sized merchant ships known from the Late Bronze and Early Iron Ages carried sizeable, very specific cargoes between the main ports of the day (amongst them Ugarit and Tell Abu Hawam in the Levant, Kommos on Crete, Enkomi and Hala Sultan Tekke on Cyprus, Tiryns on the Greek mainland). As was the case for Roman shipping, various components of these cargoes may have been transhipped onto vessels designated to carry them to other, smaller or secondary ports within easy, coastal-sailing distance of the main port (Wilson 2011: 54; for the classic case of a stopover for *caboteurs* on Roman Cyprus, see Leonard 1995). In turn, coastal shipping—whether we define it as cabotage, ‘coastscares’ or ‘small worlds’—may have served in part to bring all manner of goods and supplies that were in demand from smaller ports to these main harbours, where they were again offloaded and transhipped to larger carriers, as part of a well-organised system of maritime exchange (‘intracultural’, ‘intercultural’) in the eastern Mediterranean. For now, this may be as close as we can get to understanding how ‘nodes of density’ operated within a ‘matrix of connectivity’ (Horden and Purcell 2000: 393) during the eastern Mediterranean Bronze and early Iron Ages.

Even if we had a dramatically richer and more varied archaeological, documentary and shipwreck record—like that of the Graeco-Roman era—at our disposal, we still could not make definitive statements or draw more specific conclusions about the mechanisms, merchants and mariners involved in prehistoric and protohistoric trade in the Mediterranean. Whilst we have singled out or emphasised for certain times or in specific places various natural, cultural and technological factors that impacted on trade patterns overall (Arnaud 2011: 75), leaving aside current debates on object biography or material agency we feel that human agency and circumstance, not to mention serendipity, always takes a primary place in the maritime landscape.

The comparative analysis of early MTCs carried out in this study demonstrates that certain forms of domestic storage or transport containers were adapted for maritime as well as terrestrial use. At times, it is therefore difficult to distinguish between storage and transport vessels in the earliest (Early Bronze Age) phases of their history, e.g. the Cycladic Collar-necked Jars, or early Levantine vessels such as the ‘combed’ or Metallic Wares. During the Middle Bronze Age, certain

land-based polities developed a distinctive maritime presence, namely the Canaanites in the eastern Mediterranean and the Minoans in the Aegean. Increasingly they interacted with each other but nonetheless operated mainly within their own regions. This is the period when the OMA and the earliest forms of the Canaanite Jar were exported beyond their former regional limits. During the Late Bronze Age, the centres producing the MTCs remained the same (but with the addition of Egypt and possibly Cyprus), although some key stylistic and morphological changes took place, e.g. the emergence on Crete of the TSJ, and the disappearance of the OMA. The economic decline at the end of the LBA impacted negatively on long-distance trade, and consequently on MTCs.

The early Iron Age brought an end to the lifespan of the TSJ, and saw changes directly related to the MTCs' production and distribution. In the Levant, MTCs continued to be produced during Iron Age I, but in smaller quantities, if we can judge from the limited numbers exported to Egypt, Cilicia, Cyprus and Crete. In the small maritime worlds of the eastern Mediterranean, five different types have been distinguished: all of them show a remarkable typological relation, which may point to a common tradition that existed along the Levantine coast, mainly on its central seaboard. The limited amount of Iron I vessels traded does not speak for bulk transportation, although their exports to Cyprus seem to be somewhat regular. Interestingly, a clay figurine found in a Cypro-Geometric II tomb at Amathus shows a man carrying a Levantine MTC on his shoulders (Karageorghis 2006: 100, no. 75), which may suggest how these containers were incorporated into everyday life on the island. Their limited distribution, mainly to Cyprus and to a lesser extent to Egypt, may suggest they moved through cabotage or local trade, and most likely in mixed rather than homogeneous cargoes. Nonetheless, they still provide adequate evidence to support the continuity of maritime connectivity within a larger eastern Mediterranean regional sphere of interaction.

By the Iron Age II period, new 'Phoenician' types of MTC emerge, now being transported in greater numbers throughout the Mediterranean. The fact that these MTCs have been found on the *Tanit* and *Elissa* shipwrecks, both bulk transport carriers, leaves little doubt that they signify major changes in the scale of maritime interconnections in the Mediterranean. In the Aegean basin, production shifted from Crete to the northern Aegean, where exchange systems involved new spheres of maritime activity (along the coasts of Thessaly, Macedonian Thrace and Anatolia). Thermaic amphorae are among the earliest Iron Age Aegean MTCs; they were widely distributed throughout the Aegean's coasts and islands. In time, Attica and Corinth, the first Aegean towns involved in long-distance trade with their colonies in the central Mediterranean, produced their own distinctive transport containers in large numbers, respectively the SOS amphorae (stylistically very similar to the north Aegean ones) and the Corinthian amphorae (developed from local storage *pithoi*, also a common pattern in the Levant).

The origins (as determined by chemical or petrographic analyses) as well as the destinations of the MTCs suggest that the major players in Mediterranean

maritime trade came from the Levantine coast and Crete, perhaps Egypt and Cyprus, during the Late Bronze Age, and the Levantine coast, the North Aegean, Attica and Corinth in the early Iron Age. In many respects, this seems to affirm what we already knew, or at least suspected (see, for example, Wachsmann 1998: 327–329). One point, however, clearly is both new and unexpected: the comparative analysis of evidence from the Aegean and eastern Mediterranean indicates a parallel evolution of the MTC in both the Levant and the Aegean at approximately the same time. Moreover, the intensified production of pottery vessels that served for the bulk transport of organic goods by sea corresponds to the best evidence we have for the emergence of deeper-draught, seagoing ships under sail. Thus the ‘opening up’ of the Mediterranean, and particularly of its eastern sector—from Crete and the Cyclades to the Levant and south to Egypt—was the result of a maritime technology based on the use of the sail (Sherratt and Sherratt 1991: 366; Papageorgiou 2009: 202; Broodbank 2013: 288–304, 320–330), which enabled local exchange networks (‘coastscares’, ‘small worlds’) to link into wider regional systems of mobility and connectivity: Mediterranean connections.



# Appendix

## Volumetric Analysis and Capacity Measurements of Selected MTCs

*Stella Demesticha*

### MTC Capacities

Since MTCs are directly connected with the organisation and mechanisms of trade, and because they are not *occasional* transport containers, it is worthwhile considering whether some kind of capacity standardisation existed throughout their history. Such standardisation would have been beneficial both for the sellers, who had to package their products in vessels of known capacity, and for the merchants and mariners who had to estimate the size and space arrangement of their cargoes. Kotsonas (2014:16), however, has convincingly argued that the standardisation of ancient ceramics was relative rather than absolute, and that the MTCs' contexts involved networks of many different economies that used various weights and standards. Apart from trade mechanisms, a functional aspect of MTCs should also be kept in mind: they had to be large enough to hold amounts worth trading and no heavier than could be handled by one or two men, as they had to be moved, carried, stowed and lifted—filled with their contents—several times during their primary life usage. Such specifications did not always apply, especially in times of intensive commerce like the Archaic period or the Roman era, when containers as large as 90 litres (l) were transported—e.g. the Cypriot Basket-handled Amphorae found at Tell Keisan (Salles 1980) or north African amphorae (Bonifay 2004: 89–118). Still it would be useful to consider whether there were certain *approximate* sizes that might have been preferred in different periods because they were the most suitable for MTCs.

The particular value of an MTC's size with respect to its function as a packaging vessel for commercial use was acknowledged already in the earliest stages of their study. Dumont (1872: 231) measured two intact Greek amphorae (one from Rhodes and one from Thasos) and found that they held 26 and 21 l, respectively. In one of her very first amphora studies, Grace (1934: 296) also measured five Chian amphorae and concluded that their *intended standard* capacity was 22 l. Most importantly, the discovery of *sekomata* (stone blocks fitted with cavities that correspond to legally prescribed capacities of standard amphorae) left no doubt that at least after the fifth century BC, MTCs' capacities were standardised (Docter 1988–90: 148–149). As amphora studies progressed, the meaning of the stamps, the *post cottura* (after firing) graffiti or the *dipinti*

(painted inscriptions) on amphorae from various periods also became the subject of several studies related to ancient metrology (e.g. Kirwan 1938: 402; Radulescu 1973; Lang 1976: 55–68), parallel to several other key studies based exclusively on written sources (e.g. Schilbach 1970).

Wallace (1986), in his summary of progress in measuring amphora capacities, underscored the importance of volumetric studies for the study of trade mechanisms. He discussed several key issues, such as the degree of standardisation, the possible control methods of the appropriate capacities, the role of stamps in this process, and the different measuring standards used, as well the accuracy of different archaeological methods of measuring the capacity (with water, polystyrene beads, etc.). After the 1970s, studies on amphora capacities focused mainly on stamped Greek amphorae of the Hellenistic period (Dochter 1988–90: 144). This was especially true for the stamps on Rhodian amphorae, one of the best-studied series of Hellenistic MTCs, which provided sound evidence for the degree of standardisation in their capacities (Wallace Matheson and Wallace 1982). Apart from the stamps, homogeneous shipwreck cargoes have also provided firm evidence about the standardisation of MTCs found in the same shipment (Koehler and Wallace Matheson 1987).

The different standards and units of weights used in different regions are reflected in the diverse capacities of MTCs in antiquity: one of the main concerns of capacity studies is to detect the different standards and systems of measures used by ancient merchants and traders. However, with a margin of tolerance up to 3.5% or more, along with unknown factors such as the thickness of a sealant layer inside the vessels or the point up to which they were filled, relevant calculations are rarely accurate (Garlan 2000: 76–83). Moreover we do not know how MTCs' capacities were measured and controlled in antiquity (Kletter 2009: 364; Kotsonas 2014: 15–16).

Nonetheless, many attempts have been made toward this end, using a straightforward method: the measured capacity of numerous containers of the same type is divided by known standards of the period or the area in question, and only in cases where the result of this formula is a whole number (or close) is it considered possible to determine the standards used for the specific container (e.g. Zapassky et al. 2006 on handmade open vessels from the Iron Age II in the Negev, Israel). Thus Mattingly (1981), based on coin evidence, demonstrated how the capacities of Chian and Thasian amphorae dated to the end of fifth century BC changed in accordance with the Athenian standards system. Dochter (1988–90) argued that Phoenician traders were already using certain standards in the eighth century BC. Roman amphorae, such as type Dressel 20, with painted numeric inscriptions (*dipinti*), provided direct evidence of the control mechanisms and standardisation of trade during the Roman Empire (Colls et al. 1977: 83–85). Even so, during the Late Roman period, the volumes of amphorae found on the Yassı Ada shipwreck presented considerable variations (van Alfen 1996; Pieri 2012: 45).

*Measuring Capacities*

Measurements taken in order to compare pottery vessels may be classified into three kinds: weight, linear and capacity (Dochter 1988–90: 144). The connection between the linear and capacity measures must have existed in practice: potters produced large numbers of vessels of the same type and size by reproducing the basic linear dimensions (height, maximum diameter, rim, base diameter) of a prototype, not by computing their capacities. The weight must also have been a concern in the case of transportation in bulk, when the ratio of the tare (weight of the empty containers) to the net weight should preferably be small. It was only during Late Antiquity, however, that crucial progress was made in minimising the tare of the MTCs (Pieri 2012: 44).

Direct measurements of capacity consist mainly in filling the container with water or a free-flowing solid (sand, rice, lentils, etc.). Although these methods are relatively easy to implement, they are the most difficult to apply for several practical reasons, as most of the vessels are fragmentary or at best fragile after conservation (Engels et al. 2009: 129–30). Moreover, when comparative measuring data are necessary, the access to vessels in storerooms or museum exhibitions of different countries or continents is not always possible. Thus many scholars have explored other, indirect methods, based on geometry.

The geometric or ‘stacked cylinders’ method uses standard geometric shapes as references from which to estimate ceramic vessel volume (Rigoir 1981; Rice 1987: 219; Orton et al. 1993: 158). Usually the vessel’s published scale drawings are used as the basis for such calculations, although they are not always accurate (Senior and Birnie 1995). Measurements on complete vessels are used along with standard equations for geometric forms—such as cylinders and spherical segments—to produce estimates of volume. This may apply for symmetrical vessels made on the fast wheel but handmade pots, or pots made on the slow wheel, are not always symmetrical. In such cases, more elaborate algorithms should be used (Rodriguez and Hastorf 2013). Many of the above problems have been addressed by computer-based solutions (e.g. Engels et al. 2009). The use of 3D models for the calculation of volume has mushroomed in the last decade, as developments in 3D digital technology allow for multiple applications (Pedrazzi 2007: 238, 370, n. 51; Zapassky et al. 2006; 2009).

As scale drawings of different quality had to be used for our own study, we opted for capacity calculation with the use of a 3D model for each container. In order to limit the drawbacks of the method, such as the often-inaccurate inner profile or the distortion of the bar scale in the publication, all available information regarding the measurements of each container was also taken into account. One 3D model was created for each container type, generated in *Rhinoceros*, a computer-aided design (CAD) software application. We used this application not just because it provides a quick and effective way to create 3D models, but also because of its built-in functions that allow for the volume and capacity of 3D models to be calculated. To get some idea of the accuracy, we performed some tests using modern containers (milk and water bottles)

with standard capacities and drawings of ancient vessels to which we had access (e.g. Chian amphorae from the Mazotos shipwreck); the error proved to be up to 5%.

The modelling workflow in the computer-modelling programme was as follows: the 2D drawing was imported into the programme and rescaled to correspond to the vessel's real dimensions. The drawing was then used as a reference from which to trace the vessel's profile and to revolve it around its axis, to create the 3D model. The modelling phase was completed with the addition of certain elements of the geometry, such as the handles. For each container, two different measurements were taken: up to the rim and up to the bottom of the neck, as it is uncertain how full each vessel would have been. We also calculated the average of these two measurements and added it to Table A1 (below); this average is the number cited in the text for the capacity of each container. It should be noted, therefore, that this number is a convention, not the result of a measurement. Thus the differences or the similarities in size of the containers discussed in this book can only be considered as approximate sizes, rather than accurate ones. Finally, in the text we round off these numbers to one decimal point, whereas Table A1 gives the results to three decimal points.

## Results

The main objective of our calculations was to compare the capacities of MTCs from different regions and time periods, in order to determine if there were any common standards for transporting goods by ship, based on functional reasons rather than on local economic values. For each of the main types discussed, one or two containers have been analysed (see Table A1). Where possible, the selected vessels were either found in a shipwreck context, or at a site that was demonstrably different from their place of origin and possibly a destination of transport by ship. No attempt has been made to calculate any measuring units.

From the Early Bronze Age Aegean, three different Collar-necked Jars were measured. Two of them come from the Cyclades—one from Naxos (Angelopoulou 2008: 155, fig. 16.5) and one from Ios (Marthari 2008: fig. 9.18). They show significant differences in capacity (23.5 l and 12.9 l, respectively) (Table A1, nos. 2–3). A third jar, recovered from the Yagana shipwreck (Evangelistis 2000), has three handles, one of them horizontal, which means it might also be classified as a *hydria* (Table A1, no. 1). Its morphological characteristics, however, are very similar to those of the two other Collar-necked Jars, and it had the greatest capacity of the three (27.5 l), which was similar to that of the jar from Naxos. The capacities of Early Bronze Age Levantine jars also differ from each other: the average capacity of the short Metallic Ware vessel from Tel Dan (Greenberg and Porat 1996: 8, fig. 2:6) was 10.1 l, whereas that of an earlier, ledge-handled jar from Abydos was 16.5 l (Hartung 2002: 440, fig. 27.3 bottom right) (Table A1, nos. 4–5).

Table A (Appendix) 1 Calculated Capacities of Maritime Transport Container Types

Number and Figure number	Date	Type	Litres (Up to top)	Litres (Up to base of neck)	Average	Published Dimensions (Cm)	Estimated Dimensions (cm)	References
1. Fig. 16	EB	Collar-necked Jar	27.777	27.193	27.485	–	Ht: 39.34 Max.Diam: 48.75	Yagana wreck deposit (Inv. no. BE 2009/9-2)
2. Fig. 15a	EB	Collar-necked Jar	13.052	12.779	12.915	–	Ht: 32.67 Max.Diam: 31.7	Skarkos, Ios: Marthari 2008: 80, fig. 9,18
3. Fig. 15b	EB	Collar-necked Jar	23.720	23.302	23.511	–	Ht: 45.62 Max.Diam: 36.25	Korfari ton Amygdalion, Naxos: Angelopoulou 2008: 155, fig.16.5
4.	EB	Levantine ledge-handled jar	16.774	16.291	16.532	Ht: 42	Max.Diam: 31.2	Abydos: Hartung 2002: 440, fig. 27.3 bottom right
5. Fig. 4b	EB	Metallic Ware	10.255	10.021	10.138	–	Ht: 33.95 Max.Diam: 26.52	Tell Dan, Israel: Greenberg and Porat 1996: 8, fig. 2:5
6. Fig. 19b	MB	OMA	13.964	13.474	13.719	–	Ht: 40.19 Max.Diam: 30.16	Koulenti (Laconia) wreck deposit (Inv. No. BE 2009/3-3); Spondylis 2012
7. Fig. 19a	MB	OMA	6.129	5.702	5.915	–	Ht: 38.5 Max.Diam: 20.5	Pseira, Crete wreck deposit: Hadjidaki 2004: 46, fig. 2
8. Fig. 11b	LB	Egyptian Jar	11.643	11.177	11.41	Ht: 46.5 Rim.Diam: 12.6 Capacity: 11.2 l	Max.Diam: 23.91	Ashkelon, Israel, Tomb 315: Martin 2008, fig. 9; 2011: pl. 42.1

<i>Number and Figure number</i>	<i>Date</i>	<i>Type</i>	<i>Litres (Up to top)</i>	<i>Litres (Up to base of neck)</i>	<i>Average</i>	<i>Published Dimensions (Cm)</i>	<i>Estimated Dimensions (cm)</i>	<i>References</i>
9. Fig. 11a	LB	Egyptian Jar	14.820	14.118	14.469	Ht: 71.7 Rim Diam: 11.03 Capacity: 14.7 l	Max.Diam: 23.07	Deir el-Balah, Gaza, cemetery: Martin 2011: pl. 45.2; Dothan 1979: fig. 16
10. Fig. 24a	LB	Cypriot Group <i>Il pithos</i>	184.928	170.73	177.829		Ht: 114.24 Max.Diam: 64.97	Point Iria wreck deposit: Pennas et al. 1995: 12, fig. 8c, no. A5
11. Fig. 24b	LB	Cypriot Group <i>Il pithos</i>	330.818	314.621	322.719	Ht: 130	Max.Diam: 85.54	Uluburun shipwreck: Pulak 1997: 242, fig. 10, no. KW255
12. Fig. 7a	LB	CJ	12.509	12.202	12.355	Ht: 54 Capacity: 13 l	Max.Diam: 25.52	Uluburun shipwreck: Pulak 1998: 201, no. KW214
13. Fig. 7b	LB	CJ	7.716	7.378	7.547	Ht: 54 Capacity: 7.8 l	Max.Diam: 24	Uluburun shipwreck: Pulak 1997: 241, no. KW612
14. Fig. 22a	LB	TSJ		11.835		–	Ht: 47.48 Max.Diam: 29.15	Uluburun shipwreck: Abdelhamid 2013: fig. 7.1 (no. KW 5520)
15. Fig. 22b	LB	TSJ		14.023		–	Ht: 48 Max.Diam: 30	Iria wreck deposit: Lolos 1996: 24, fig. 5 no A86
16 Fig. 27	LB	SNA	10.042	9.875	9.958		Ht: 44.34 Max.Diam: 24.67	Kommos, Crete: Rutter 2006: 1171, pl. 3.78, no. 67a/21.
17.	P-G	Transitional type	31.860	30.644	31.252	Ht: 54.3 Max.Diam: 40.5 Base Diam: 15.4	–	Kapaklı Tomb, Volos: Verdellis 1958: 6, fig. 1

*Continued overleaf*

Table A (Appendix) I (Continued)

Number and Figure number	Date	Type	Litres (Up to top)	Litres (Up to base of neck)	Average	Published Dimensions (Cm)	Estimated Dimensions (cm)	References
18. Fig. 45b	P-G	Transitional type	36.706	35.359	36.032	Ht: 58.2 Max.Diam: 43 Base Diam: 14.1	–	Kapaklı Tomb, Volos: Verdelis 1958: 6, fig. 2
19. Fig. 45a	P-G	Catling Group I	22.902	21.907	22.404	Ht: 48.6 cm Max.Diam: 38.7 cm	–	Troy: Catling 1998: 154, cat. 1B; Lenz et al. 1998: 215, pl. 4
20. Fig. 34b	Iron Age I	Pedrazzi Type 4	32.409	32.168	32.288	Ht: 56.2	Max.Diam: 32.27	Maa Palaikastro: Karageorghis and Demas 1988: 127 pl. 194 no. 319
21. Fig. 35a	Iron Age I	Pedrazzi Type 5.2	18.993	18.871	18.932	Ht: 53 Rim Diam: 10.6	Max.Diam: 30.19	Palaipaphos <i>Skales</i> Bikai 1983: 397, no. T83/40
22. Fig. 35b	Iron Age I	Pedrazzi Type 5.2	11.973	11.917	11.945	Ht: 54.5 Rim Diam: 10	Max.Diam: 25.75	Palaipaphos <i>Skales</i> : Bikai 1983: 397, no. T80/46
23. Fig. 36a	Iron Age I	Pedrazzi Type 5.5	11.352	11.241	11.296	Ht: 46 Rim Diam: 10.2	Max.Diam: 22.93	Palaipaphos <i>Skales</i> : Bikai 1983: 397, no. T44/134
24. Fig. 37b	Iron Age I	Pedrazzi Type 5.7	6.709	6.602	6.655	Ht: 43.7 Max. Diam: 101.8	Ht: 43.7 Max. Diam: 18.97	Deir el Medina: Nagel 1938: fig. 101.8
25. Fig. 38a	Iron Age I	Pedrazzi Type 16	17.540	17.318	17.429	Ht: 49	Max.Diam: 29.22	Palaipaphos <i>Skales</i> : Karageorghis 1983: 196, Tomb 74 no. 20, fig. 137



<i>Number and Figure number</i>	<i>Date</i>	<i>Type</i>	<i>Litres (Up to top)</i>	<i>Litres (Up to base of neck)</i>	<i>Average</i>	<i>Published Dimensions (Cm)</i>	<i>Estimated Dimensions (cm)</i>	<i>References</i>
26 Fig. 40b	Iron Age II	Aznar Type 9A	30.638	30.552	30.580		Ht: 58.27	Saqqara:
27 Fig. 41a	Iron Age II	Aznar Type 9B1	13.939	13.825	13.882		Max. Diam: 32.59 Ht: 69.26	Aston 1996: 34–35, fig. 72.2 <i>E/issa</i> Shipwreck
28 Fig. 41b	Iron Age II	Aznar Type 9B1	3.235	3.195	3.215		Max. Diam: 21.06 Ht: 36.31	Ballard et al. 2002: 160, fig. 9.5 <i>E/issa</i> Shipwreck
29 Fig. 42a	Iron Age II	Aznar Type 9B2	15.208	15.137	15.172		Max. Diam: 14.30 Ht: 64.07	Ballard et al. 2002: 160, fig. 9.4 Tyre:
30 Fig. 44	Cypro-Archaic	Cypriot Basket-handled	64.540	63.603	64.071	Ht: 70	Max. Diam: 24 Max. Diam: 51.3	Bikai 1978: 47, pl. III.7 Salamis, Tomb 79: Karageorghis 1973, 1974: 52, no. 720, pl. 221
31 Fig. 46a	LG	Methonian	41.834	40.766	41.3	Ht: 64 Max. Diam: 43	–	Methoni Pierias: Kotsonas 2012: 412–13, no MΘ 2461
32 Fig. 46b	LG	SOS amphora	48.033	46.733	47.383	Ht: 69 Max. Diam: 43.3	–	Pithekoussai, Tomb 719: Buchner and Ridgway: 689: table 210; Johnston and Jones 1978: n. 16
33 Fig. 47b	LG	Corinthian Transitional	61.967L	59.569L	60.768	Ht: 71 Rim Diam: internal 15.4 external 23.4 Max. Diam: 51		Incoronata, Metaponto: Scioli and Sacchi 1992: 63, fig. 104
34 Fig. 47a	LG	Corinthian A	47.302	45.126	46.214	–	Ht: 66.17 Max. Diam: 45.6	Vandiver and Kochler 1986: fig. 7B

According to Poursat and Knappett (2006: 154–55), the standard form ('Type 2') of the ovoid-conical OMA from Malia had capacities that varied from 10–45 l, rarely less. The capacity measurements of two OMAs from shipwrecks tends to confirm this point: the ovoid-conical example from the Laconian Koulenti shipwreck (Spondylis 2012) held an average of 13.7 l, but the one from the Cretan Pseira shipwreck belonged to the much smaller ovoid-concave type (see Poursat and Knappett 2006: 155), with a capacity of 5.9 l (Hadjidaki 2004: 46, fig. 1) (Table A1, nos. 6–7).

On average, the TSJ, which stood about 40–50 cm in height with a maximum diameter of 27–35 cm, had a volume ranging between 12–18 l (Ben-Shlomo et al. 2011: 334). Two TSJs from shipwrecks measured for this study also fall within this range. The average capacity of the jar from the Iria wreck deposit (Pennas et al. 1995: 12, fig. 8a, no. A85) was 14.02 l, whilst the one from the Uluburun shipwreck (Abdelhamid 2013: fig. 7.1, KW 5520) was 11.8 l (Table A1, nos. 14–15). They were both measured up to the middle of the neck; filling to the top of the neck was probably not an option for these jars, as the liquid would have spilled from the spout.

The capacities of the Canaanite Jars found on the Uluburun shipwreck CJs were measured in a preliminary manner, and three sizes (6–7, 12–14 and 22–24 l) were suggested (Pulak 1997; 1998). After much more focused (and ongoing) work, however, Pulak notes (pers. comm., 11 September 2014) that whilst the smallest jars still exhibit a reasonably coherent size, the larger ones are so diverse that they show no obvious standardisation in volumetric measurements. Serpico (2003: 225) had already modified the ranges proposed earlier by Pulak: the largest jars held about 26.7 l, medium-sized ones about 13 l and the smallest ones—representing some 75% of the total—held only 6.7 l. We measured the capacities of two published drawings: KW214 (Pulak 1998: 201) and KW 612 (Pulak 1997: 241). Their capacities were 12.4 and 7.5 l, respectively (Table A1, nos. 12–13).

Two Egyptian Jars found in the Levant were also measured: one found at Ashkelon in Tomb 315 (Martin 2008: fig. 9; 2011: pl. 42.1) and one from the Deir el Balah cemetery (Dothan 1979: fig. 16; Martin 2011: pl. 45.2). They had average capacities of 11.4 and 14.5 l, respectively (Table A1, nos. 8–9). The capacity of the same vessels as measured by Martin (2011: 254–57, table 115) was slightly different: 11.2 and 14.7 l. In both cases, however, they can be grouped with the 'medium' size of the Uluburun Canaanite Jar, i.e. 12–15 l.

Most of the six Iron Age I Levantine MTCs selected for measurements were found on Cyprus. A Pedrazzi Type 4 jar found at Maa *Palaеokastro* (Karageorghis and Demas 1988: 127, pl. 194, no. 319) was the largest of the six, with an average capacity of 32.3 l (Table A1, no. 20). Four MTCs found at Palaipaphos *Skales* belonged to three different types and seemed to belong to two different (standard?) sizes. Two containers of Pedrazzi Type 5.2 (Bikai 1983: 397, nos. T83/40 and T80/46) had capacities of 18.9 and 11.9 l, respectively (Table A1, nos. 21–22). The largest one had a capacity similar to Pedrazzi Type 16 (Karageorghis 1983: 196, Tomb 74, no. 20, fig. 137), which held 17.4 l, whereas the smaller one had a capacity similar to Pedrazzi Type 5.5, of 11.3 l (Table A1, nos. 23, 25). Pedrazzi

Type 5.7 from Deir el Medina was the smallest of all, with an average capacity of 6.6 l (Table A1, no. 24). Pedrazzi (2007: 239) has also suggested two similar sizes for her Type 5.2, one of 9–10 l and one of 18–20 l.

Finkelstein et al. (2011: 250–251) undertook volumetric analyses of 20 examples of Aznar Type 9B1 from the *Tanit* and *Elissa* wrecks, along with 134 examples from land sites (based on published drawings). They concluded that the cylindrical variants represent a standardised form, with a volume of 4 *hekats* (=19.2 l)—the standard liquid trade unit of this period (Finkelstein et al. 2011: 255–257), but with a difference of up to 5%. In other words, their volumes ranged within the volume of 1 *hekat* (approximately 4.8 l), i.e. between 3.25–4.25 *hekats* (15.6–21.6 l). We measured three of these vessel types: the largest one, an example of Aznar Type 9A from Saqqara (Aston 1996: 34–35, fig. 72.2), held 30.6 l (Table A1, no. 26); the other two corresponded to the smallest extreme of the 4-*hekat* standard mentioned above: one Aznar Type 9B1 from the *Elissa* shipwreck (Ballard et al. 2002: 160, fig. 9.5) held 13.9 l, and one Aznar Type 9B2 from Tyre (Bikai 1978: pl.III.7) held 15.2 l (Table A1, nos. 27, 29). It is interesting to note that another, half-sized ('miniature') jar of Aznar Type 9B1 from the *Elissa* shipwreck (Ballard et al. 2002: 160, fig. 9.4) held—according to our measurements—3.2 l, i.e. less than 1 *hekat* (Table A1, no. 28).

Three Protogeometric Aegean amphorae were measured. One from Troy (Lenz et al. 1998: 215, pl. 4) is the only intact vessel in Catling's (1998: 154, cat. 1B) publication on Protogeometric transport containers of the north Aegean. The other two were found in a tomb at Volos, Thessaly (Verdelis 1958: 6, fig. 1–2) but are suggested to be parallels to containers found at Ras el-Bassit, Syria (Courbin 1993: 104–105). The capacities of the Volos jars are similar (31.3 and 36.03 l) whereas that of the amphora from Troy was significantly less (22.4 l) (Table A1, nos. 17–19).

The Late Geometric Aegean amphorae measurements present a significant rise in capacity. Vessels of four MTCs were measured: (1) a representative drawing of Corinthian amphora Type A (Vandiver and Koehler 1986: fig. 7B); (2) a Methonian amphora found at Methoni Pierias (Kotsonas 2012: 412–13, no. MΘ 2461); (3) an SOS amphora found in tomb 719 at Pithekoussai in Italy (Buchner and Ridgeway 1993: 689, table 210; Johnston and Jones 1978: n. 16); and (4) a transitional Corinthian amphora found at Incoronata, near Metaponto, Italy (Scioli and Sacchi 1992: 63, fig. 104). The SOS and Corinthian A amphorae had similar capacities (47.4 and 46.2 l, respectively) (Table A1, nos. 32, 34) whereas the Methonian was slightly smaller (41.3 l) (Table A1, no. 31), and the Corinthian transitional type by far the largest, at 60.8 l. (Table A1, no. 33). Johnston and Jones (1978: 134) proposed that the dimensions of the SOS amphorae were standardised, but not the volume: they measured an SOS amphora from Vulci, dated to the late seventh century BC as having a capacity of 61.75–63.75 l, acknowledging that it was one of the largest of the group. According to Durando (1989: 61–62), the capacities of the SOS amphorae found at Pithekoussai ranged from 49–62 l. The Cypriot Basket-handled amphora from Salamis was the largest vessel considered here, with a capacity

of 64.07 l (Table A1, no. 30). Even so, it cannot be considered among the largest in its series; seventh century BC examples of the same type, found at Tell Keisan, held 65–80 l, and one from the Kekova Adası wreck deposit had a capacity of 69 l (Greene et al. 2013: 24).

### *Conclusions*

The capacities presented here should be considered only as indicative, since no group of MTCs has been systematically measured; thus, any conclusions should be treated with caution. It is interesting to note, however, that the capacity of the measured containers ranges between about 6–60 l (Figure A1), which is similar to but somewhat greater than the capacity range of Greek amphorae from the Archaic to Hellenistic periods (Garlan 2000: 68). Thus, bearing in mind that only general patterns can be detected from these volumetric analyses, we may distinguish at least four approximately common sizes, or clusters of sizes: (i) 6–7 l, (ii) 10–15 l, (iii) 18–22 l, (iv) 31–35 l (Table A2).

The Uluburun Canaanite Jar cargo, the only one from the Bronze Age with multiple intact (or almost intact) MTCs available for study, indicates that many different sizes of MTCs were in use, especially for organised, long-distance seaborne trade ventures. Likewise, different approximate sizes of the same MTC types are apparent in the Aegean from the Middle Bronze Age onward: OMAs from both the Malia and Phaistos palaces (see above) and from two wreck deposits (Pseira and Koulenti) can be classified under at least two different clusters of 4–6 and 10–15 l. Pedrazzi (2005: 61–62; 2007: 238, fig. 4.15; 2010: 53–54), however, has identified a third, less common cluster of

*Table A2* Capacities of the MTCs enumerated in Table A1. Grey lines: clusters of capacities; white lines: vessels whose capacities fall beyond the clusters

<i>Cluster (litres)</i>	<i>EB</i>	<i>MB</i>	<i>LB</i>	<i>Iron I/PG</i>	<i>Iron II/G</i>
					28
6–7		7		24	
			13		
10–15	2, 5	6	8, 9, 12, 14, 15, 16	22, 23	27, 29
	4			25	
18–22				19, 21	
	1, 3				
30–35				17, 20	26
				18	31
45–50					32, 34
					30, 33

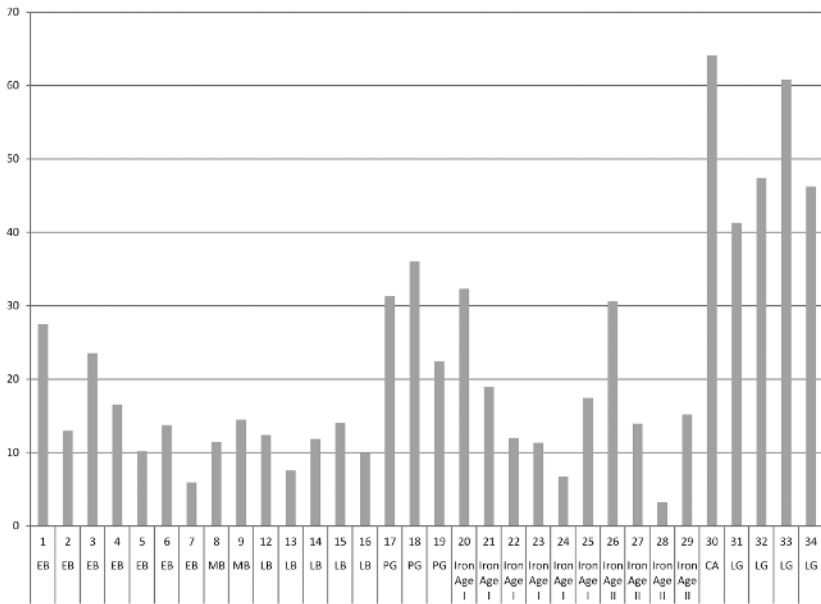


Figure A1 Capacities of the MTCs measured, as numbered in Table A1. Prepared by Andonis Neophytou.

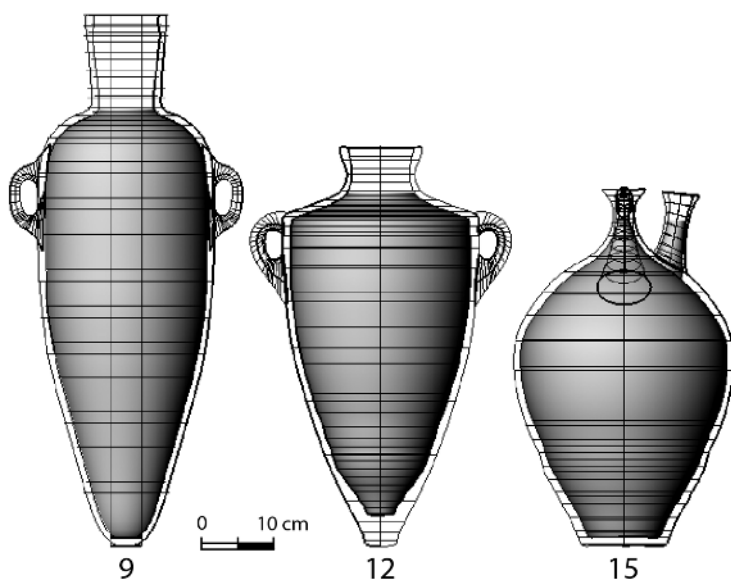
Canaanite Jars with volumes of 18–22 l. It is noteworthy that several other containers fall within the cluster of 10–15 l, namely the Early Bronze Age Collar-necked Jar from Ios, the TSJs from the Iria and Uluburun wrecks, and both Egyptian Jars. The Early Bronze Metallic Ware vessels fall within this cluster (10.138), whilst the Early Bronze ledge-handled vessel falls just outside it (16.532 l).

Further capacity clusters are seen in the case of Iron Age MTCs, with a tendency toward larger sizes. The smallest was the Levantine Iron Age I Pedrazzi Type 5.7 from Deir el Medina, with a capacity of 6.7 l. Three Levantine MTCs from Cyprus and one found at Tyre had capacities between 11–15 l, a cluster in accordance with Docter's (1988–90: 158) suggestion that 11–13 l was the commonest volume range of Phoenician transport containers. Two Iron I MTCs found in Palaipaphos *Skales* (Pedrazzi Types 5.2 and 16) had similar capacities (17.4 and 18.9 l), and may fit into the cluster of 18–22 l documented for Canaanite Jars (see above).

Although Iron Age containers from the Aegean have larger capacities, approximate sizes are still evident. The Protogeometric amphora from Troy fits into the cluster of 18–22 l, but the two from Kapaklı have capacities between 31–36 l, forming another cluster in which their contemporary Levantine MTC, Pedrazzi Type 4 from Maa *Palaekastro*, also belongs. Three of the Late Geometric amphorae measured have similar capacities (41.3–47.4), much larger than any earlier type.

Although there is a pattern of larger volumes in the later periods under consideration, there is a constant preference for a cluster of 10–15 l (Figure A2), which corresponds to the capacity range of domestic transport vessels for liquids (7.5–15 l; Rice 1987: 240). In other words it seems likely that the earlier MTCs were made in sizes appropriate for handling by one person, whether on land or on a ship. Another attribute that this analysis reveals is the existence of different sizes or fractions of the same MTC type. This was true for early types, such as the Early Bronze Age Aegean Collar-necked Jars, but much more for later ones, such as the Late Bronze Age CJs and the Iron Age Phoenician MTCs.

As Bevan (2014: 403) recently demonstrated, multiple factors—political, economic, functional and social—determine changes in the shape or size of a container. The MTCs measured here cover a wide chronological range and originate from regions with entirely different administrative and political systems, diverse pottery traditions, and unequal units of measurement. Thus it bears repeating that the capacities presented here are only indicative, and future work should focus on the systematic measurement of each, or any, group of MTCs.



*Figure A2* Digital models of an Egyptian jar (9); a Canaanite Jar (12); and a Transport Stirrup jar (15). Grey shade in interior shows the volume measured, up to base of the neck (9, 12), and up to middle of the (15) neck. The capacities of all three fall into the cluster of 10–15 l.

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# Index

Figures in *italics*, tables in **bold**

- AAS (Atomic Absorption Spectroscopy)  
63–4, 83, 84, 107
- Abydos 7, 43–4, 175, **176**
- Acre *see* Akko
- Aegean Transport Stirrup Jars (TSJs); *see*  
Cretan Transport Stirrup Jars
- Aegina 15, 27, 75
- Akko (Acre): Bay of 86; Egyptian Jars  
69; harbour 20, 32, 50, 61, 87; TSJs  
84
- Akrotiri 13, 56, 72, 77, 96
- Akrotiri peninsula 32
- Al Mina 25, 125, 143
- Alalakh (Tell Atchana) 25
- Alassa *Paleotaverna* 91, 92
- Alassa *Pano Mandilares* **57**, 58
- Amarna: Canaanite Jars (CJs) 35, 60–3,  
65, 68, 150; Letters 23, 87; River  
Temple 112, 115, *115*, 129
- Amathus 25, 26, 162, 170
- amber 157, 166
- Amenemhet II 48, 78
- Amenemhet III 16
- Amenhotep III 35
- Amiran, R. 52, 64, 103, 105, 118, 126
- Amnisos 13, 14, 15, 26, 85
- anchor: boat 17; depicted on Bichrome  
ware jug 25; deposits 48; Kommos  
26; Levantine type 157; Mirabello  
Bay 15; stone 7, 13, 17, 18, 46, 169;  
Temple of Baal 19; three-holed 14
- Andros 6
- Argolic Gulf 4, 15
- Argolid 83–4, 85, 86, 150, 156, 168
- Argos 56, 136, 144
- Argo-Saronic Gulf 4, 100
- Arwad 20, 21, 23, 161
- Ascalon *see* Ashkelon
- Ashdod 60, 84, 90, 116
- Ashkelon (Ascalon): Canaanite Jars (CJs)  
49, 65; Cypriot *pithoi* 90; Egyptian  
Jars 69, **176**, 180; Geniza manuscripts  
32; Levantine MTCs (LBA/IA) 116,  
Transport Stirrup Jars (TSJs) 84, 86
- Asine 56, 63
- Assiros 135
- Assyria 132, 159
- Assyrians 155, 159
- Athens: Agora 37, 139, 142; Canaanite  
Jars (CJs) 56; Geometric amphorae  
133; Kerameikos 136; olive oil 139;  
Piraeus harbour 6, 158;  
Protogeometric amphorae 133;  
Transport Stirrup Jars (TSJs) 81
- Atlit 13, 22–3, 42, 162
- Atomic Absorption Spectroscopy (AAS)  
63–4, 83, 84, 107
- Attic *kotylai* 139
- Attic *metretes* 139
- Attica: Geometric amphorae 136–7;  
Group II North Aegean amphorae  
147, 150; maritime trade during EIA  
171; Protogeometric pottery 142, 144;  
SOS Amphorae 138–40, *138*, 146,  
150, 170; white painted/slipped  
Collar-necked Jars 72
- Avaris *see* Tell ed-Dab'a
- Ayia Irini 72, 76

- Ayia Triadha 94  
 Aznar Type 9B1 *see* 'Crisp Ware Torpedo Jars'  
 Aznar Type 9B2 ('wasp-waisted jar') 102, 118, 123; *see also* 'Crisp Ware Torpedo Jars'; Phoenician MTCs
- Babylonia 159  
 barley 33, 70, 145  
 'barrel jar', Middle Cycladic II 75  
 Base-ring pottery (Cyprus) 19, 90, 168  
 Bay of Akko 86  
 Bay of Salamis 18  
 beer: content of Canaanite Jars 33; content of Egyptian Jar 69, 150; content of Transport Stirrup Jars (TSJs) 83, 87, 149; epigraphic evidence 11, 33, 51, 149  
 Beirut 13, 20, 32, 162, 166  
 Bichrome pottery (Cyprus) 19, 25  
 Black Sea 140, 155  
 Braudel, F. 3, 153, 154  
 breakwater *see* mole  
 Broodbank, C.: Cycladic Collar-necked Jars 74; Kampos Group 71; Ledge-or loop-handled jars 44; maritime trade, Late Chalcolithic – Early Iron Age 7, 30, 154, 158, 168; Mediterranean Sea 3  
 Bucchero jugs 90  
 Buhen (Nubia) 50  
 'bullet-shaped jars' 126; *see also* Phoenician MTCs  
 burial: cedar oil and wood for 70; goods 35; infant 34, 143; jar 59, 65  
 Buto 70, 125  
 Byblos: boat models 6; 'Byblos ships' 17, 20, 46, 165; Canaanite Jars (CJs) 50; Egyptian objects 46; harbour 13, 19, 20, 162, 166; IA 117; 'Metallic Ware' vessels 44–5; origin of LBA ships 20, 169; Royal Tombs 47, 51; 'ruler of *Shimu*' 49; Tale of Wenamun 22, 33, 155, 163
- cabotage 10, 31, 158–9, 162, 166, 170; definition 30, 151–2, 169; 'diurne' 152; 'grand' 30, 151  
 calcium tartrate 51  
 Canaanite Jars (CJs): capacity 47, 65, 177, 180, 182, 184; cargo of shipwreck 38, 42, 47, 55, 65, 156; chemical analysis 49, 50, 51, 60–4, 107–8, 150; Early Iron Age 107, 109, 112, 115; Egyptian tomb painting 51, 69; with inscriptions or impressions 49, 51, 56, 85–6; morphology 39, 47, 79; occurrence: 35, 48–53, 57, 65–6, 128, 149–50; provenance study 49–50, 57, 60–4, 86, 109, 167; re-use 35; typologies 52–60, 53, 54, 112, 115, 127, 127; volumetric analysis 38, 47, 49, 177, 180, 182–3, 184; *see also* Levantine MTCs (LBA/IA)  
 Canaanites 102, 129, 170  
 Cannatello 81, 84, 86  
 capacity standardisation of MTCs; *see* standardisation of MTC capacity  
 Cape Gelidonya shipwreck: Canaanite Jars (CJs) 55, 56, 65–6, 156; Cypriot *pithoi* 101, 156; dimensions 10, 166; remains of wooden hull 4, 7; Transport Stirrup Jars (TSJs) 41, 81, 84, 86, 156  
 Carmel coast 21, 50, 62, 87, 116  
 Carthage 118, 157; amphorae from Sardinia 100; 'Crisp Ware Torpedo Jars' 124–5, 129; *Elissa* and *Tanit* wrecks 118, 157; Samian amphorae 138; SOS amphorae 140, 157; Tyre 24  
 Catling, H.W. 87, 135, 137, 146, 181  
 Çaycağız Koyu shipwreck 8, 131  
 cedar (*Cedrus libani*) 48, 155; oil 70; Tale of Wenamun 33, 163; wood 17, 46, 70, 160  
 cemeteries: Crete 26; Cyprus 26, 134; Egypt 43, 44, 121, 125; Italy 142, 143; Levant 47, 51, 177, 180; mainland Greece 137, 143  
 cereals 33, 70, 145  
 Chalkidike 135, 138, 143  
 chemical analyses: Abydos wine jars 43; CJs 49, 50, 51, 60–4, 107–8; Cypriot *pithoi* 90; Egyptian Jars 69; Group I North Aegean amphorae 135; Group II North Aegean amphorae 137; Phoenician commercial jars 107, 109; SOS amphorae 139; Southwest

- Anatolian Reddish-Brown Burnished jug 96; torpedo-shaped jars 119
- Chian amphorae 138, 172, 173, 175
- Cilicia: Basket-handled Amphorae 131; Canaanite Jars (CJs) 54, 61, 63, 80; Cypriot pottery 26; harbours 13, 18, 19; Levantine MTCs (LBA/IA) 103, 105, 109, 112, 128, 170; part of a small world 32; part of northern Levantine trade circuit 109; Phoenician pottery 115–16; seafaring merchants 20
- city-states: coastal 20; Levantine 65, 102, 154; mercantile 27, 162; Phoenician 24, 126, 129
- CJs *see* Canaanite Jars
- classical sources 27, 35, 36, 47, 70
- coastscares 31, 151–3, **152**, 158, 169, 171
- Coldstream, J.N. 132–3, 136, 142–3, 144
- collared-rim *pithos* 58–60, 59
- combed ('Metallic Ware') jars: capacity 44, 175, **176**, 183; globular 45; occurrence and provenance 44–5, 45, 46, 75, 127, 165, 169; *see also* Red Polished and 'Metallic Ware' vessels
- communication 2, 30, 31, 41, 82, 153–4
- connectivity 3, 28, 30–5, 152, 155; definition 30; maritime 170; 'matrix of' 169; Mediterranean 164–71
- copper: Cypriot 155, 157, 160; from Feinan 21; goods 16, 33, 34, 157; Hishuley Carmel wreck deposit 6; ingots 6, 8, 14, 15, 157, 168; mines 17; Sardinia 100; Uluburun shipwreck 157, 166
- Corinth: commodities from 156; long-distance trade with colonies 142, 170; maritime trade during the Early Iron Age 171; pottery production 136, 140, 144, 150
- Corinthia 83
- Corinthian Amphorae 163, 170; capacity 146, **179**, 181; 'Corinthian A' amphorae 136, 140–2, 141, 150, 156, **179**, 181; Late Geometric 147; transitional 141, **179**, 181
- Corinthian drinking cup (*kotylai*) 140
- Cretan Short-necked Amphorae (SNA) 62, 88, 93–6, 93, 95, 150, **177**
- Cretan Transport Stirrup Jars (TSJs): bulk trade in 'semi-luxury' goods 149–50; capacity 80, 81, 149, **177**, 180, 184; cargo of shipwreck 41, 81–5, 82, 156, 158, 183; content 33, 83, 149; decorated with an octopus 80, 94, 168; disappearance of 153, 170; epigraphic evidence 36, 81, 82, 149; inscribed (ISJs) 33, 56, 82–5, 158, 168; occurrence 17, 27, 41, 56, 79–83, 80, 82, 86–7; provenance 83–6, 95–6
- 'crisp ware' 102, 107, 120, 121; fabrics 108, 118; typology 118, 126, 127; *see also* 'Crisp Ware Torpedo Jars'; Phoenician MTCs
- 'Crisp Ware Torpedo Jars' 36, 128, 152; *Tanit* and *Elissa* shipwrecks 38, 119–21, 122–3, 123, 125, 126, 127, 129–30; typologies and nomenclature 102, 107, 114, 118, **121**; volumetric analysis 120, 121, 124, **179**, 181
- Cumae 125
- cuneiform records 11, 20, 63, 159
- Cyclades: Bronze Age trade 14, 75, 171; Canaanite Jars (CJs) 56, 149–50; Geometric period 136, 144; MTC production and distribution centres 72, 74, 144, 149, 153, 168; seafaring communities 13; ship depictions and models 6
- Cycladic 'barrel jar' (Middle Cycladic II) 75
- Cycladic Collar-necked Jars: capacity 175, **176**, 183, 184; content 74; Dokos shipwreck 41, 73; Melian broad-steak painted 72; occurrence 71–5, 71, 72, 148, 152, 165, 169; white painted/slipped 72
- Cycladic Narrow-necked Jars *see* Cycladic Collar-necked Jars
- Cycladic 'relief *pithoi*' 141–2
- 'Cycladic-style' pottery 73–4
- Cypriot Basket-Handled Amphorae: capacity 132, 172, **179**, 181–2; cargo of shipwreck 8, 131, 156; inscribed 131; typology 130–2, 130
- Cypriot *pithoi*: capacity **177**; occurrence 17, 88–93, 88, 91, 101, 156, 166;

- Plain White Handmade 58, 90;  
provenance study 58, 90, 93, 148, 156
- Cypro-Geometric wares 116, 130
- Cypro-Minoan markings: on Canaanite  
Jars (CJs) 56, 85–6; on Transport  
Stirrup Jars (TSJs) 17, 56, 85, 158,  
168
- Cypro-Syllabic writing 131, 143
- Dashur 50
- Deir el-Balah 55, 60, 69, 84, **177**
- Deir el-Medina 62, 81, *110*, 114, *114*
- Delos 27, 32
- Desborough, V.R.A. 133
- Dimini 56
- dipinti* (painted inscriptions) 172, 173
- Docter, R.F. 138, 173, 183
- Dodecanese 81, 83, 136
- Dokos shipwreck 4, 166; Cycladic  
Collar-necked Jars 41, 73, 74, 149;  
Oval-mouthed Amphora (OMA) 156
- dolia* 92–3
- Dor 'shipwreck 13, 104, 111, *111*, 112,  
128
- drinking equipment 27, 136, 140, 143, 168
- dye 160; content of Canaanite Jars (CJs)  
33, 51, 112; content of Levantine  
MTCs (LBA/IA) 112, 128, 129;  
content of Transport Stirrup Jars  
(TSJs) 83; murex 112, 128; ochre 94,  
96; purple 23, 33, 112
- Egyptian Jars: capacity **176–7**, 180, 183,  
*184*; content 51, 150; occurrence 22,  
66–8, *66*, 67, 70, 116, 150; with  
painted hieratic inscriptions 51, 68,  
69; provenance studies 69, 95
- Ekron (Tel Migne) 60, 86, 116
- Elephantine 56, 157
- Elissa* shipwreck: bulk transportation  
129, 160, 162, 166, 170; cargo 38,  
118–23, *122–3*, 125–6, *127*, 129–30,  
156, **179**, 181; origin 156–7
- elites: control over trade 154, 159; Crete  
70; gifts 82; southern Levant 168
- emporion* 12, 18, 75, 87
- Enkomi: Canaanite Jars (CJs) 18, 56–8,  
**57**, 60, 63–4, 85; Cypro-Minoan  
potmarks 85–6; *emporion* 18, 166;  
harbour 13, 18, 169; Levantine MTCs  
(LBA/IA) 111, 113; Plain White  
Cypriot *pithei* 90; Sanctuary of the  
Ingot God 18, **57**, 105; Transport  
Stirrup Jars (TSJs) 84, 86
- Ephesos 13, 32, 135
- Euboea: Aegean neck-handled amphorae  
134, 136; copper ingots 15; harbours  
26–7; Phoenician material 129;  
presence at Pithekoussai 143;  
Protogeometric pottery trade 142–3;  
rich imports as burial gifts 26; SOS  
amphorae 139–40
- Euboean Gulf 26, 27
- Euboean 'koine' 135
- exchange systems: between Canaan and  
Egypt 70; different scales of 149,  
151–4, **152**, 158–9; Geometric  
amphorae 147; Mediterranean 18, 19;  
northern Aegean 170; open or closed  
networks 159–60; organisation of  
155–9
- 'Ezbet Rushdi 78, 149
- faience 33, 34, 83, 149; beads 26; plaques  
168
- fat 16, 33, 51, 62, 69
- Fayyum region 69, 70
- fig: content of MTCs 51, 90, 148;  
flavoured wine 43; seed 33, 90; sliced  
43; tree 48
- figurine, clay 130, 132, 136, 170
- Filicudi (Aeolian island) 81, 149
- fish: bones 26, 27, 90; content of MTCs  
33, 51, 69, 91; processed products 40,  
101
- fishhooks 26, 27
- flasks 26, 69, 132, 164
- Frost, H. 9, 23, 169
- fruit 160; content of Canaanite Jars (CJs)  
33, 51; content of Cypriot *pithei* 91,  
101; content of Egyptian Jar 69, 150;  
content of Roman amphorae 40;  
Uluburun shipwreck 33
- Gadir 140
- galleys 11, 20, 27
- gateway community 14, 19, 28, 87, 158
- Geniza manuscripts 32

- Geometric Amphorae: capacity **179**, 181;  
context of use 144–6; Cypro-  
Geometric 130; Group II North  
Aegean (Thermaic) 136–8, 147, 163;  
Methonian 138, 146, **179**, 181;  
occurrence 136–8, 146–7, 183; trade  
142–4; *see also* Corinthian A  
amphorae; SOS amphorae
- Gezer 116
- gift: exchange 28, 31, 93, 144, 163;  
-giving between rulers 153, 158–9;  
‘guest-’ 82; Odyssey 145–6; royal 35,  
150
- Gilat 42
- Gilboa A.: Early Iron Age Phoenician  
commercial jar chronology 105,  
107–9, **109**, 111–12, 115–16, 127;  
Iron Age II Phoenician MTC typology  
115, 121, **121**, 125
- glass: beads 63, 65, 150; ingots 166
- gold: cargo of ships 16, 157, 166; daggers  
decorated with 48; jewellery 6, 26;  
production of 160; talents 145; in  
tombs 26; vessel of 33, 144, 145
- Grace, V.: amphora study 126, 172;  
Canaanite Jars (CJs) 2, 39, 52, 103;  
definition of amphora 37
- graffiti: *post cottura* 172; ‘ships’ 6
- grape: harvest 51, 68, 68; preserved 43;  
seeds 33, 43; tartaric acid as marker of  
51, 63, 119
- Group I North Aegean amphorae 134–5,  
134, 136–7, 146–7, 163, **178**, 181
- Group II North Aegean amphorae  
(‘Thermaic’ amphorae) 136–8, 147,  
163
- Gulf of Izmir 13, 97
- Hala Sultan *Tekke Vyzakia*: Canaanite  
Jars (CJs) 56, **57**, 58, 63, 64, 111;  
Egyptian Jars 69; harbour 13, 18–19,  
169; inscribed Canaanite Jar (CJ)  
handles 85; Transport Stirrup Jars  
(TSJs) 84, 86
- harbourworks: mole 12, 15, 21, 22, 23,  
24; quay 11, 12, 21, 22, 23–4, 27;  
ship-shed 12, 13, 14–15, 26, 62, 94
- Hazor 90, 119, 121, 122, 125, 127
- hekat* 120, 181
- Helwan 44
- Heracleopolis Magna 112, 129
- hieratic inscriptions 17, 51, 61–2, 68, 69,  
150
- Hishuley Carmel 6, 7
- Hittites 155, 157, 159
- honey: cargo of a ship 16, 33; content of  
Canaanite Jars (CJs) 33, 51, 62;  
content of Egyptian Jars 69, 150; of  
*ikaryti* (Ugarit) 62; on Linear B  
tablets 168; mead 83, 87, 149;  
Odyssey 145
- Horden, P., and N. Purcell 30, 31, 168
- Horvat Rosh Zayit 121
- House of the Oil Merchant, Mycenae 41
- Hydra 15
- hydria* 73, 73, 101, 141, 175
- Iberian peninsula 140
- Iliad* 27, 144
- incense 16, 63; content of Canaanite Jars  
(CJs) 33, 51; content of collared-rim  
*pithoi* 59; content of Egyptian Jars 69,  
150; Mit Rahina inscriptions 48, 51;  
stand 119
- Incoronata 141, 142, **179**, 181
- Inductively Coupled Plasma Atomic  
Emission Spectroscopy (ICP-AES)  
50, 60
- Inductively Coupled Plasma Mass  
Spectroscopy (ICP-MS) 50
- ingot: copper 6, 8, 14, 15, 157, 166; glass  
166; oxhide 164, 168; Sanctuary of  
the Ingot god 18, **57**, 105; tin 6, 90,  
166
- innovation 48, 79, 135
- inscribed pottery: Aegean MTCs 143;  
Basket-handled 131; Inscribed Stirrup  
Jars (ISJs) 17, 33, 56, 82–5, 158, 168
- Instrumental Neutron Activation Analysis  
(INAA) 61, 69, 83, 95–6
- interconnections, maritime 27, 29, 30,  
158, 167–8, 170
- interregional trade 1, 105, 115, 151–60,  
**152**, 165
- Iolkos 135
- Ios 72, 72, 74, 175, **176**, 183
- ISJs (inscribed stirrup jars) 17, 33, 56,  
82–5, 158, 168

- Ismarus 145, 146  
 isotope analysis 58, 64, 98  
 Ithaka 145, 146  
 ivory 18, 33, 44, 48, 157, 166  
  
 jar docket 61–2  
 jewellery 6, 18, 26  
 Jezreel valley 21, 44, 59, 69, 87;  
     northwestern 61; western 63  
 Johnston, A.W., and R.E. Jones 139–40,  
     181  
 Jones, R.E., and S.J. Vaughan 63–4, 109  
 Jordan 21, 44, 59, 112  
 Jordan valley 44  
 juglet: Base-ring 168; White Shaved 90  
 jugs 40, 45, 78, 141; Bichrome ware 25;  
     Bucchero 90; Levantine 48, 63, 75,  
     132; Minoan 17; Southwest Anatolian  
     Reddish-Brown Burnished 88, 96–8,  
     97; Syro-Palestinian 164  
  
 Kalamianos 12, 15  
 Kalavastos *Ayios Dhimitrios* 57–8, 91  
 Kapaklı 134, 137, 177–8, 183  
 Karageorghis, V. 58, 99, 107, 168  
 Karnak 65  
 Karphi 96  
 Katsambas *see* Poros-Katsambas  
 Kea 27, 72, 74, 75, 76  
 Kekova Adası shipwreck 7–8, 131, 132,  
     156, 166, 182  
 Kenamun tomb 28, 28, 51  
 Kepçe Burnu shipwreck 8, 131  
 Kephala Petras ship model 6  
 Kephala tholos 96  
 Khania 56, 83, 84, 149  
 Khom el-Khigan 50  
 Killebrew, A. 53–5, 63, 126  
 kiln 89, 119, 128; Sarepta 112, 117, 126,  
     128; sites 40, 42; wasters 124, 126  
 Kinet Höyük 13, 19  
 kingdom: Aegean 154; Cypriot 27, 132  
 Kition: CJs 56, 57, 58; ‘Crisp Ware  
     Torpedo Jars’ 124; harbour 13, 18, 19,  
     25, 32, 162; Levantine MTCs (LBA/  
     IA) 107, 111, 113, 115, 116, 124–5;  
     Plain White *pithoi* 90; ship-sheds 26;  
     stone anchors 169; Transport Stirrup  
     Jars (TSJs) 86  
  
 Kition *Bamboula* 84, *Kathari* 19  
 Klazomenai 135  
 Knossos: Canaanite Jars (CJs) 51, 79, 150;  
     cemeteries 26; EM IIA jars 74;  
     Inscribed Stirrup Jars (ISJs) 85; Linear  
     B tablets 36, 81; Oval-mouthed  
     Amphora (OMA) 76, 77; Short-necked  
     Amphora (SNA) 94, 96, 150; Southwest  
     Anatolian Reddish-Brown Burnished  
     Jug 96; Transport Stirrup Jars (TSJs) 81  
 Kolonna 15, 75  
 Kom Rabia (Memphis) 49–50  
 Kommos: Building N 14; Building P 14,  
     62, 94; Building T 14, 15, 62; CJs 56,  
     61, 62, 65, 86, 150; Cypriot table and  
     fine wares 90; Egyptian Jar 69, 150;  
     harbour 12, 13–14, 26, 166, 169;  
     House X 62; Inscribed Stirrup Jars  
     (ISJs) 85; Levantine MTCs (LBA/IA)  
     103, 107–9, 108, 116, 117, 125, 126;  
     link with Tell Abu Hawam 86–7;  
     Oval-mouthed Amphorae (OMAs) 77;  
     Plain White Cypriot *pithoi* 90;  
     Sardinian vessels 99–100; SNA 93–6,  
     95, 150, 177; Southwest Anatolian  
     Reddish-Brown Burnished jug 96–7,  
     97, 98; Transport Stirrup Jars (TSJs)  
     83, 95–6; Tripillar Shrine 26  
 Koroni 88–9  
 Kos 96  
*kotylai* 139, 140  
 Kouklia *Achni* 18  
 Kouklia *Kaminia* 57, *Mantissa* 84,  
     *Palaipaphos* 56, 57  
 Koulenti shipwreck: Minoan deposit 6;  
     open deposit 7; Oval-mouthed  
     amphorae (OMAs) 78, 78, 79, 176,  
     180, 182  
 Kourion (Episkopi) *Bamboula* 18, 84, 85,  
     86  
 Kynos 26–7, 135  
 Kythera 15, 83–4  
  
 labels: hieratic 68; on MTCs 35, 44, 68,  
     86; wine 69; wooden 44  
 Lachish 60, 65, 121  
 Laconia 144; *see also* Koulenti shipwreck  
 lead: boat model 6; clamps 98; isotope  
     analyses 58, 64, 98; net weight 27



- ledge- and loop-handled jars 43, 44, 175, **176**, 183
- Lefkandi 142; North Aegean amphorae 135, 138; Phoenician pottery 103, 129; Toumba cemetery 26, 134
- Lemnos 72, 135
- Lesbian amphorae 138
- Lesbos 138, 146, 150
- Levantine MTCs (LBA/IA): terminology 102–4; transition from LBA to IA 104–9, 115–17; typology 109–15, **109**, *110–11*, *113–15*, 126, 129, 170, 180, 183; *see also* Levantine ‘commercial jars’ (IA I); Phoenician MTCs
- Levantine ‘commercial jars’ (IA I) 103–5, 107, 111, 116, 126, *127*; *see also* ‘Crisp Ware Torpedo Jar’; Phoenician MTCs
- Liman Tepe 13, 97
- Limassol 18, 90
- Linear B: A-PI-PO-RE-WE (amphora) 36, 81; evidence 83, 149, 154; Inscribed Stirrup Jars (ISJs) 81–2, 83, 84–5; KA-RA-RE-WE (stirrup jar) 36, 81; tablets 36, 81, 168
- Lisht Village 50
- Lokrist 26, 135, 146
- luxury goods 149, 154, 159, 164, 165
- Lycia 32, 131, 152
- Maa *Palaeokastro*: Canaanite Jars (CJs) 54, 56, 57, **57**, 63–4; Cypro-Minoan signs on CJ handle 85; Egyptian Jars 69; Levantine MTCs (LBA/IA) 107, 109, *110*, 111, **178**, 180, 183
- Macedonia 135, 138, 146, 170
- Machroud islet 21
- Málaga 100, 140
- Malia 15, 77, 180, 182
- Malkata, Amenhotep III’s palace 35
- maritime mobility 30, 154, 155, 171
- maritime small world 31–2, 151–2, **152**, 158, 169, 171
- maritime trade: Aegean world 70, 74, 162–3; Canaanite Jars (CJs) 103, 105, 120, 128, 167; connectivity and 30; Cypriot *pithoi* 89–90; between Egypt and the Levant 46; Group II North Aegean amphorae 147; Levantine MTCs (LBA/IA) 107; long-distance 3, 34, 105, 120, 127, 128; mechanisms 7, 160; organisation of 153–60, 170–1; Phoenician MTCs 118, 120, 126, 127; profits 167; regional 151; vessels especially associated with 39, 120, 126; Ugarit 11, 20
- maritime transport containers (MTC), definition 42
- Maroni-Tsaravasos area 64, 90
- Maroni *Tsaroukkas* 13, 18, 19; *Vournes* **57**, 58
- Marsa Matruh: Canaanite Jars (CJs) 56; Cypriot *pithoi* 90; harbour 13, 28; Transport Stirrup Jars (TSJs) 81, 86, 149; way station 17–18, 166
- meat 33, 51, 69, 91, 145, 150
- Medinet Habu 112, 161, 168
- Megara Hyblaea 139, 142
- Megiddo 65; boats incised on pottery sherds 46; Cypriot *pithoi* 90; Egyptian Jars 69; Levantine MTCs (LBA/IA) 116; Phoenician MTCs 121, 125; ‘torpedo-shaped’ jars 119
- Melos 74, 75
- Memphis 46, 153; Canaanite Jars (CJs) 60, 61–2, 65, 68; Egyptian Jars 68, 69, 150; Levantine MTCs (LBA/IA) 112; Kom Rabia 49–50; Mit Rahina 48, 51, 78
- Mersa/Wadi Gawasis 16–17, 56
- Mesara: plain 83, 87, 94, 96; south coast 77; western 14, 93, 96
- metal: boat models 6; bulk goods 29, 159, 164; imports 26; Phoenician quest for 155; precious 18, 33, 48; products 17, 34, 155, 168; scrap 166; trade of the Early Iron Age 26; vases 28, 33
- ‘Metallic Ware’ (combed) jars: capacity 175, **176**, 183; globular 45; occurrence 44–5, *45*, 46, 75, *127*, 165, 169; Red Polished and 44, 45
- Metaponto 139, *141*, 142, **179**, 181
- Methoni Pierias 137, 142, 181
- Methonian amphora 138, 146, **179**, 181
- Miletos 13, 81
- milk 33, 51, 69, 150
- Minet el-Beidha: Canaanite Jars (CJs) 41, 47, 55; Cypriot *pithoi* 90; harbour 13,

- 19, 86, 90, 158; Transport Stirrup Jars (TSJs) 84
- Minoans 155, 170
- Mirabello Bay 15, 77
- Mit Rahina 48, 51, 78
- Mitrou 7, 26, 27, 81, 135
- mobility, maritime 30, 154, 155, 171
- Mochlos 6, 15, 56, 150
- Modi shipwreck 6, 7, 100, 101, 101, 166
- mole 12, 15, 21, 22, 23, 24
- Monochrome pottery (Cyprus) 19
- Motya 140
- MTC (Maritime Transport Containers), definition 42
- murex dye 23, 112, 128
- 'mushroom-lipped decanter' 119
- Mycenae: Canaanite Jars (CJs) 83, 150; harbours of 15–16; House of Oil Merchant 41; Inscribed Stirrup Jars (ISJs) 83; palatial storeroom 81; *pithoi* 101; Transport Stirrup Jars (TSJs) 83, 88
- Mycenaean fine wares 17
- Mycenaean palaces 81, 87, 132; tombs 56, 82, 150
- Mycenaean-style pottery 168
- Myrtou *Pigadhes* 57, 121
- NAA *see* Neutron Activation Analysis
- navigation 9–10, 32, 151, **152**
- Naxos 6, 72, 72, 142, 175, **176**
- Neutron Activation Analysis (NAA): Abydos wine jars 43; basket-handled jars (Tell Keisan) 131; Canaanite Jars (CJs) 49, 60–1, 63–4; Egyptian Jars 69; Group I North Aegean amphorae 135; Plain White Cypriot *pithoi* 90
- Nile River: clay and marls 42, 66, 69; Delta 8, 43, 44, 56, 69, 158, 165; eastern Delta 68; harbours 16, 17, 166; molluscs (*Aspatharia rubens*) 42; Pelusiac branch 16; upper Delta 69
- Nirou Chani 14, 15, 26
- North Aegean amphorae: Group I 134–5, 134, 136–7, 146–7, 163, **178**, 181; Group II ('Thermaic' amphorae) 136–8, 147, 163; Transitional 134, 137, **177**, **178**
- Nubia 50
- Nuraghe Antigori 81, 84, 86, 90
- oared ships 6, 7, 155
- Odyssey* 36, 144–5
- oil: cedar 70; content of MTCs and/or storage jars 61, 62, 150; epigraphic evidence 11, 22, 58, 82, 148, 165; inscribed on jars or labels 33, 44; lamps 90, 142; moringa 62; perfumed 33, 34, 82, 132, 149, 168; pressing installations 57–8; production 79, 129, 165; resinous 70; sweet 44; *see also* olive oil
- olive oil: content of Aegean Neck-handled Amphorae 134; content of Canaanite Jars (CJs) 33, 51, 62, 63, 65, 164; content of Collared-rim *pithoi* 59; content of combed ('Metallic Ware') jars 44, 50–1; content of Cypriot *pithoi* 91; content of Geometric amphorae 136, 139–40, 142; content of Koronian storage jars 89; content of Oval-mouthed Amphorae (OMAs) 149; content of Short-necked Amphorae (SNA) 94; content of Transport Stirrup Jars (TSJs) 33, 81, 82, 87, 149; demand for 89, 154, 160, 167–8; epigraphic evidence 16, 33, 58, 62, 70, 149; inscribed on jars 82, 131; organic residue analysis (ORA) 33, 42, 62, 150; processing installation 23, 41, 44, 131; production 44, 81, 89, 129, 164–5, 167; trade 2, 44, 62, 70, 142, 167–8
- olive tree (*Olea europaea*) 48, 145; cultivation 43, 167; olives 33, 51, 59, 63, 150, 160, 165; stones 33
- olle a colletto* 88, 98–100, 99
- OMA *see* Oval-mouthed Amphora
- ORA *see* organic residue analysis
- organic goods: bulk 3, 42, 93, 96, 165, 171; demand for 59; epigraphic evidence 16, 33, 48, 51, 159; pictorial evidence 51; production 164; trade 19, 52, 58; Uluburun shipwreck 33; *see also* chemical analyses; organic residue analysis (ORA)
- organic residue analysis (ORA): Abydos wine jars 43; Canaanite Jars (CJs) 51, 61–2, 63, 150; Chalcolithic

- torpedo-shaped jars 42; Transport Stirrup Jars (TSJs) 83, 149; *see also* chemical analyses
- Orontes river 25
- orpiment 62, 83, 149
- ostrich egg(shell) 17, 33, 157
- Oval-mouthed Amphora (OMA) 1, 52, 75–9, 75, 76, 78, 149
- paintings 7, 51, 69, 150
- palace: administration 81, 82; collapse of system 87, 153, 154; control and power 126, 132, 162, 168; Cretan 182; demand 88, 166; economy 161; Egypt 16, 28, 35, 49; Israel 48; Levantine 158; Mycenaean 81, 87, 132; organisation 154, 158, 161; storehouse 48, 81, 87; system 81, 132, 158
- Palaikastro 56, 96, **178**
- Palaipaphos 18, 19, 56, 162
- Palaipaphos *Hadjiabdoulla* 107; *Loures* 18, 19; *Marchello* 107
- Palaipaphos *Skales* 107, *110–11*, 113, *113*, 115, *115*, 116, *124*, **178**, 180, 183
- Palaipaphos Urban Landscape Project 19, 107
- Pamphylia 32
- Panaztepe 97
- Paphos 26
- papyrus: ‘Admonitions of Ipuwer’ 70; Anastasi IV 58; Aramaic 157; Tale of Wenamun 22, 33
- Pedrazzi, T.: collared-rim *pithoi* 59–60; LBA typology 127–8; Levantine MTCs (LBA/IA) typology 109–17, *110*, *111*, *113*, *114*, **109**, 127, 128, **178**, 180–3; morphological study of MTCs 47, 52, 105–9; Phoenician MTCs 121, **121**, 128
- perfume: flask 26; perfumed oil 33, 34, 82, 132, 149, 168
- petrographic analyses: Abydos wine jars 43; Canaanite Jars (CJs) 49–50, 57–8, 60–4, 86–7, 167; Chalcolithic torpedo-shaped jar 42; combed (‘Metallic Ware’) jars 44; Cycladic Collar-necked Jars 74, 149; Cypriot Basket-handled Amphorae 131; Cypriot *pithoi* 90, 93; Egyptian Jars 69; Group II North Aegean amphorae 137; Inscribed Stirrup Jar (ISJ) handles 86; Kampos Group (Crete) 73; Levantine MTCs (LBA/IA) 113; Oval-mouthed Amphorae (OMAs) 77; Phoenician MTCs 109, 116–17, 118, 119, 126; Plain White Wheelmade ware (Cyprus) 64; Sardinian wares 98, 99–100; Short-necked Amphorae (SNA) 95–6; Transport Stirrup Jars (TSJs) 83–4, 86, 95–6
- Phaistos 15, 40, 77, 182
- Pharos (Alexandria) 23
- Philistia 116
- Philistines 55, 116
- Phoenicia 46, 52, 106, 107, 117; city-states 24, 102, 117, 126, 129; harbour 21, 22–4, 161
- Phoenician MTCs 102, 103, 104, 117–26, **121**, *122–4*, 127, 128, 184
- Phoenician shipwreck 117, 118–21, 166
- Phoenicians 55, 65, 102, 119, 128; traders 117, 134, 140, 143, 157, 173; westward expansion 107, 140
- Piraeus 6, 158
- Piramesses (Qantir) 60, 81
- pistacia resins 33, 61, 62, 63, 150; *see also* terebinth
- Pithekoussai: Chian amphorae 138; Corinthian A amphorae 142; Euboean presence 143; inscribed Aegean MTC 143; Phoenician MTCs *122*, 123, *123*, 125; SOS Amphorae *138*, 138, **179**, 181
- pithoi* 15, 76, 141, 146, 153; Collared-rim 59–60; Cycladic relief 141–2; Cypriot 17, 58, 88–93, 88, *91*; handleless 101, 141; Modi shipwreck 101; Petri 73; Plain White Handmade 58, 90; Point Iria shipwreck 90, 101, 156; Sardinian 98; Uluburun shipwreck 90, 101, 148, 156, 157
- pithoid amphora *see* Cypriot Basket-handled Amphorae
- pithoid jars 101, *101*
- Pliny 35, 165
- Point Iria shipwreck 4, 7, 10, 166; Cypriot *pithoi* 90, *91*, 93, 101, 148,

- 156, **177**; Transport Stirrup Jars (TSJs) 81, 82, 84, 86, 156, 180, 183  
 polity: BA 154, 155, 161; IA 162; LBA 153–4, 159, 168–9; Levantine 102, 163, 165; mainland Greece 83; maritime trade 9, 11, 30, 154, 155, 158, 169–70; Minoan 83, 94; palatial 154; regional 161; state-level 158, 159, 160  
 pomegranate 33, 90, 148  
 Poros 6, 73–4, 100, *101*  
 Poros-Katsambas: Canaanite Jars (CJs) 56; Cycladic Collar-necked Jars 72, 149; harbour 14, 15, 26, 74, 166  
 potmarks: Cypro-Minoan 17, 56, 85–6; finger impression 108; incised 56, 85–6  
 potter's wheel: fast 38, 128, 174; slow 38, 131, 141, 174  
 pottery production centre: Aznar's Type 9B2 125; 'crisp ware' 118, 120, 126; Cypriot *pithoi* 90; Geometric Aegean 136; Killebrew's Type C22 63; Kommos 93, 150; 'Metallic Ware' jars 44; Pedrazzi Type 5.2 111, 112; Phoenician coast 117, 120, 126; Sarepta 40, 108, 111, 112, 116–17, 126; southern Lebanon 126; Southwest Anatolian Reddish-Brown Burnished jugs 97; specialised 45, 68, 120, 135; Tel Dor 126; Tell Keisan 126; Tiryns 84; Transport Stirrup Jars (TSJs) 83–4, 86; Tyre 120, 124, 126  
 pottery workshop; *see* pottery production centre  
 pre-Corinthian A amphora 142  
 prestige 3; debt and 34; goods 18, 143  
 Protogeometric Amphorae 133–6, *134*  
 provenance work: Abydos wine jars 43; Canaanite Jars (CJs) 49–50, 57, 60–4, 86–7, 95, 167; 'carinated-shoulder amphora' 116–17; Chalcolithic torpedo-shaped jar 42; combed ('Metallic Ware') jar 44; Cycladic Collar-necked Jars 74, 149; Cypriot Basket-handled Amphorae 131; Cypriot *pithoi* 90, 93, 148; Egyptian Jars 69; Group II North Aegean amphorae 137; Inscribed Stirrup Jar (ISJ) handles 86; Kampos Group (Crete) 73; Levantine MTCs (LBA/IA) 113, 128; Oval-mouthed Amphorae (OMA) 77; Phoenician MTCs 109, 116–17, 118, 119, 126; Plain White Wheelmade ware (Cyprus) 64; Sardinian wares 98, 99–100; Short-necked Amphorae (SNA) 95–6; SOS amphorae 139; 'torpedo-shaped jars' 119; Transport Stirrup Jars (TSJs) 83–4, 86, 95–6  
 Pseira islet 15, 56, 61  
 Pseira shipwreck 4, 6, 7, 166; Canaanite Jar (CJ) 156; Oval-mouthed Amphorae (OMAs) 78, 79, 149, 156, **176**, 181, 182  
 pulses 33  
 purple dye 23, 33, 112  
 Pyla *Kokkinokremos*: amphoroid kraters 58; Canaanite Jars (CJs) 54, 56, 57, **57**; Egyptian Jars 69; Levantine MTCs (LBA/IA) 113; *olle a colletto* 98–9, 99, 100; Transport Stirrup Jars (TSJs) 84  
 Pylos 15, 56, 81, 101, 145  
  
 Qantir (Pirameesses) 60, 81  
 quay 11, 12, 21, 22, 23, 27  
 Qurneh 121, 125  
  
 Raban, A.: Canaanite Jars (CJs) 39, 52, 60, 63; harbour at southern bay at Dor 22; Levantine MTCs (LBA/IA) 103, 114, 118, 125, 126  
 Ramesses III 161, 168  
 Ras ibn Hani 13  
 Ras Shamra *see* Ugarit  
 Red-on-Black pottery (Cyprus) 19  
 Red Polished and 'Metallic Ware' vessels 44–5  
 Red Sea 16, 56  
 Rekhmire tomb 51  
 resins: aromatic 159; content of Canaanite Jars (CJs) 33, 51, 56, 62, 68; content of collared-rim *pithoi* 60–1; content of Levantine MTCs (LBA/IA) 105, 129, 155, 160; content of 'Metallic Ware' jars 44; content of Oval-mouthed Amphorae (OMAs)

- 149; epigraphic evidence 48, 51; pine 33; *pistacia* 33; *Pistacia atlantica* 63, 150; *terebinthus* 33
- Rhodes 81, 152, 172
- Rhodian amphorae 173
- ropes 17, 33, 119, 124
- Rutter, J.B.: Canaanite Jars (CJs) 56, 62, 65, 149–50; Middle Cycladic II ‘barrel jar’ 75; resins 62; Sardinian ‘jar-and-bowl’ pairs 100; Short-necked Amphorae (SNA) 94, 96, 150; Southwest Anatolian Reddish-Brown Burnished jugs 97, 98
- Sagona Type 2 jars; *see* ‘Crisp Ware Torpedo Jars’
- sailing: iconographic evidence 6–7, 8; long-distance 10, 151, 166, 169; open-sea 9–11, 31, 151, 156; season 9–10, 169; ships 27, 30, 34, 44, 46, 165; technology 7, 8, 9, 155, 171; time 10, 18, 19, 32, 152; *see also* cabotage
- Salamis: Bay of 18; Cypriot Basket-Handled Amphorae 130, 131–2, **179**, 181; harbour 15, 25, 132, 162; Phoenician MTCs 107, 121; Transport Stirrup Jars (TSJs) 85
- Samian amphorae 138
- Samos 138, 146, 150
- Sanctuary of the Ingot God (Enkomi) 18, **57**, 105
- Saqqara 122–3, 122, **179**, 181
- Sardinia: Cyprian *pithoi* 90; imports from 14, 99–100; *olle a colletto* 88, 98–100; Transport Stirrup Jars (TSJs) 81, 84, 86
- Sarepta: Canaanite Jars (CJs) 112; ‘carinated-shoulder amphora’ 116–17; Cypriot *pithoi* 90; kiln 40, 112, 126, 128; Levantine MTCs (LBA/IA) 111–13, 116, 128; Phoenician MTCs 108, 119, 126
- Saronic Gulf 4, 6, 15, 31, 85
- ‘sausage-shaped jars’ *see* ‘torpedo-shaped jars’
- sea-lanes 3, 4, 9, 12, 28, 169
- Sea Peoples 6, 100, 161
- seal: impressions 49, 65, 93; practice 36, 42, 47, 72–3, 94, 146; stone 6, 18, 48
- Shardana* 100
- shells 17, 23, 27, 42
- Sherratt, A.G., and E.S. Sherratt 9, 26, 57, 161, 164
- Sheytan Deresi shipwreck 4, 7, 48, 97, 156, 166
- ship-building technology 7, 8, 92, 155
- ship model 6, 27, 46
- ship-shed 12, 13, 14–15, 26, 62, 94
- Shiqmona 22–3
- Short-necked Amphorae *see* Cretan Short-necked Amphorae
- Sicily: Corinthian A amphorae 142; Cypriot *pithoi* 90, 148; SOS amphorae 140; Transport Stirrup Jars (TSJs) 81, 149
- Sidmant 81, 84
- Sidon: Canaanite Jars (CJs) 50, 61, 62–3, 109, 116; harbour 13, 20, 21, 22–4, 161, 162; Inscribed Stirrup Jars (ISJs) 84; trade with Byblos 177; Transport Stirrup Jars (TSJs) 83
- silver 16, 157, 166; dagger decorated with 48; shekels 65; vessel 33, 65, 145
- Sinai peninsula 6, 17, 56
- Sindos 135, 137, 142
- Siphnos 74, 89
- small worlds, maritime 31–2, 151–2, **152**, 158, 169, 171
- SNA *see* Cretan Short-necked Amphorae
- social exchange 3, 28, 30–1, 34, 93, 144
- Solon’s decree 140
- SOS amphorae 138–40, 138, 143, 146, 150, 163, 170; capacity 38–9, 146, **179**, 181; Chalcidian/Euboean 139
- Southwest Anatolian Reddish-Brown Burnished jugs 88, 96–8, 97
- sphere(s) of interaction 31–2, 113, 151–3, **152**, 170
- spices 33, 48
- Stadiasmus Sive Periplus Mari Magni* 32
- stamps on amphorae 73, 172–3
- standardisation of MTC capacity: Canaanite Jars (CJs) 47, 180; combed (‘Metallic Ware’) jars 44; ‘Crisp Ware Torpedo Jars’ 119–20; discussion 3, 49, 139, 172–3, 182–4; MTCs at Ugarit 38; Phoenician MTCs 124, 128; Rhodian amphorae 173; SOS

- amphorae 38–9, 139; torpedo-shaped jars 119–20  
 stirrup jar 2, 71, 81, 149, 168; *see also*  
 Cretan Transport Stirrup Jars (TSJs)  
 Strabo 32  
 Sybaris 139
- Tabbat el-Hamman 21  
 Tale of Wenamun 22, 33, 163  
 Tandem Liquid Chromatography-Mass Spectrometry (LC/MS/MS) 63  
*Tanit* shipwreck 7–8, 118, 156; bulk transportation 129, 160, 162, 166, 170; ‘Crisp Ware Torpedo Jars’ 38, 119–21, 122–3, 123, 126, 127, 129–30, **179**, 181; origin 156–7  
 Tarsus 103, 111, 112, 116, 128  
 tartaric acid 51, 63, 119  
 Tartaron, T.F. 12, 15, 31–2, 151–3, **152**  
 Tel Aphek 65, 85, 86  
 Tel Batash 60, 90  
 Tel Beersheba 125  
 Tel Beth-Shan 60, 69  
 Tel Dan 45, 59, 175, **176**  
 Tel Dor: Canaanite Jars (CJs) 50, 60; Cypro-Geometric wares 116; Egyptian Jars 116; harbour 13, 21–2, 116, 162; Levantine LBA/IA MTCs 105, 111–13, 116; Phoenician MTCs 117, 126; Tale of Wenamun 21–2, 163; *see also* Dor ‘Shipwreck 13’  
 Tel Kabri 48  
 Tel Miqne (Ekron) 60, 86, 116  
 Tel Nami 12, 13, 56, 59, 63, 166  
 Tel Qasile 55, 59, 111, 113, 116  
 Tell Abu Hawam: Canaanite Jars (CJs) 55, 60, 63, 87; Collared-rim *pithoi* 59; Egyptian imports 87; *emporion* 87, 166; harbour 13, 87, 169; Levantine MTCs (LBA/IA) 111; Phoenician MTCs 121; Transport Stirrup Jars (TSJs) 81, 84–5, 86  
 Tell Atchana (Alalakh) 25  
 Tell ed-Dab’a (Avaris): Canaanite Jars (CJs) 16, 48–51, 65, 66; harbour 16, 166; *see also* ‘Ezbet Rushdi  
 Tell Kazel 21; Canaanite Jars (CJs) 50; Cypriot *pithoi* 90; Levantine MTCs (LBA/IA) 105, 109, 110, 128; Phoenician MTCs 117, 127  
 Tell Keisan: Basket-handled Amphorae 131, 132, 172, 182; Levantine MTCs (LBA/IA) 106–7, 109, 113, 113, 116; Phoenician MTCs 126, 127  
 Tell Ta’yinat 25, 125  
 Tell Tweini 19, 65  
 terebinth: -infused wine 43; *Pistacia atlantica* 63, 150; resins 33, 51, 63, 65, 150; *see also* *pistacia*  
 textiles 33, 34, 168  
 ‘thalassocracies’ 28, 155  
 Thasian amphorae 173  
 Thasos 138, 172  
 Thebes (Egypt) 16, 56; Levantine MTCs (LBA/IA) 112; Phoenician MTCs 123; production of Egyptian Jars 69; tomb of Kenamun 28, 28; tomb of Khaemweset 51; tomb of Nakht 68, 68  
 Thebes (Greece) 81, 83, 84  
 Thera: Canaanite Jars (CJs) 56; Cycladic Collar-necked Jars 72, 74; frescoes 13, 168; Middle Cycladic II ‘barrel jar’ 75; Oval-mouthed Amphorae (OMAs) 77; Southwest Anatolian Reddish-Brown Burnished jugs 96  
 ‘Thermaic’ amphorae (Group II North Aegean amphorae) 136–8, 147, 163  
 Thermaic Gulf 137, 146, 150, 163  
 Thessaly: coast of 75, 170; Geometric amphorae 136, 144, 146; Group I North Aegean amphora 135, 146; Middle Cycladic II ‘barrel jar’ 75; tomb 181  
 Thrace 146, 170  
 timber 16, 29, 33, 46, 163, 165  
 tin: ingot 6, 90, 166; products 157; raw material 34; scrap 166  
 Tiryns: Canaanite Jars (CJs) 56, 150; harbour 15, 169; Inscribed Stirrup Jars (ISJs) 82, 83–4; Transport Stirrup Jars (TSJs) 81, 83–4  
 Torone 135, 137  
 torpedo-shaped jars: Chalcolithic 42; Early Iron Age 36, 150; Iron Age II 102, 114, 118, 120, 123, 128; *Tanit* and *Elissa* shipwrecks 38, 119, 123,

- 156; *see also* 'Crisp Ware Torpedo Jars'
- 'torpedo storage jars' 107
- Toumba 135
- Toumba cemetery, Lefkandi 26, 134
- trade mechanisms 1, 89; change between LBA and IA 154; maritime 7, 10, 160; MTCs and 172, 173; scales of 149, **152**
- trading network: Bronze Age 10, 161; complex 8; maritime 105, 150–1; Phoenician 124; stability 159, 162
- tramping 10, 17, 31, 151, **152**, 158–9, 162; *see also* cabotage
- Transport Stirrup Jars (TSJs) *see* Cretan Transport Stirrup Jar
- Tripoli 32
- Troy: Group I North Aegean amphorae 134–5, *134*, 136, **178**, 181, 183; Group II North Aegean amphorae 136–7, 138; harbour 13; Transport Stirrup Jars (TSJs) 81
- TSJs *see* Cretan Transport Stirrup Jars
- Tsougiza 56, 81
- Tuthmosis III 65
- Tyre: Aegean neck-handled amphora 134; Cypriot connection 117; Cypriot *pithoi* 90; harbour 13, 20–4, 158, 161, 162, **179**, 181; Levantine MTCs (LBA/IA) 107, 108, **109**, 111–15, *114*, 183; MTC production centre 117, 120, 124, 126; Phoenician MTCs 118, 119, **121**, *122*, *124*, 125, 126, *127*
- U-j cemetery, Abydos 43–4
- Ugarit: Aegean and Cypriot pottery imports 87, 90; Canaanite Jar production centre 61, 63; harbour 13, 19, 28, 166; *ikaryti* 62; olive oil processing installation 44; organisation of maritime trade 155, 157, 158, 169; palatial model 158, 161; stone anchors 19, 169; Temple of Baal 19; texts 11, 20, 28, 148; Transport Stirrup Jars (TSJs) 86
- Uluburun shipwreck: bulk cargo carrier 162, 166; capacity of ship 10; Canaanite Jars (CJs) 38, 47, 55, 55, 62–3, **177**, 180, 182; CJs with incised marks 85; content of CJs 63, 65, 150; content of Cypriot *pithoi* 148, 166; content of Transport Stirrup Jars (TSJs) 83, 149; Cypriot *pithoi* 90, *91*, 93, 101, **177**; Inscribed Stirrup Jars (ISJs) 85; MTC cargo 156, 158, 166; organic remains 4, 33, 62–3, 65, 148; origin 156–8; Transport Stirrup Jars (TSJs) 81, 82, 83, 84, 86, **177**, 180, 183
- unguents 33, 51, 145, 168
- vegetables 33, 51
- vessel weight 38, 39, 174; *dolia* 92; Pedrazzi Type 5.2 112; Red Polished and 'Metallic Ware' vessels and combed jars 45; torpedo-shaped jars 39, 119–20, 128
- vines 43, 70, 165
- Volos *134*, 135, 137, **177**, **178**, 181
- volumetric analyses: Canaanite Jars (CJs) 38, 47, **177**, 180, *184*; 'Crisp Ware Torpedo Jars' 120, 121, 124, **179**, 181; Corinthian A amphorae 146, **179**, 181; Cycladic Collar-necked Jars 175, **176**, 183, 184; Cypriot Basket-handled Amphorae 132, 181–2, **179**; Cypriot *pithoi* **177**; discussion 44, 182–4, **182**, **183**; Egyptian Jars **176–7**, 180, 183, 184; Geometric amphorae **179**, 181; ledge-handled jar 175; Levantine MTCs (LBA/IA) 112, **178**, 180–1; 'Metallic Ware' 175; Oval-mouthed Amphora (OMA) 180; Short-necked Amphorae (SNA) **177**; SOS amphora 146, **179**, 181; Transport Stirrup Jars (TSJs) **177**, 180, *184*
- Wadi el-Jarf 17
- 'wasp-waisted jar' (Azmar Type 9B2) 102, 118, 123; *see also* Phoenician MTCs
- wealth 3, 11, 20, 94, 154–5; *see also* prestige
- weight: balance 26; cargo 10; lead net 27; units of 172, 173; *see also* vessel weight
- White Shaved juglets 90
- White Slip pottery (Cyprus) 19, 90
- wine: 'aged' 142; classical authors 35, 46, 145–6; 'Delta' 43; epigraphic



- evidence 43, 48, 70, 83, 150, 157;  
fig-flavoured 43; labels 69; resinated  
33, 83, 149; terebinth-infused 43
- wine-drinking community and culture 48,  
165
- wine production: Aegean 79; Cyprus 167;  
Egypt 68, 70, 167; iconographic  
evidence 51, 69, 139; Israel 22, 59;  
Levant 79, 165, 167; Minoan 83, 165,  
167; Mycenaean 83; storage facility  
26, 48, 146; wineries 41
- wood: African blackwood 166; barrel 92;  
boat model 6; cargo box 16; cedar 33,  
70, 160; ebony 33; epigraphic  
evidence 33, 46, 70, 157; fine 16;  
label 44; pine 33; remains of a ship 4,  
7, 17  
wool 33, 157, 160
- Xeropolis 26, 27
- Yagana shipwreck 73, 73, 74, 175, **176**
- Yassı Ada shipwreck 173
- Zakros 56
- Zawiyet Umm el-Rakham 17–18, 56, 81,  
85, 86, 149
- Zire island 23–4
- Zygouries 81, 83



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