# A TOPOGRAPHICAL ANALYSIS OF THE LOCATION OF HARBOURS AND ANCHORAGES OF THE EASTERN MEDITERRANEAN IN THE MIDDLE AND LATE BRONZE AGES, AND THEIR RELATION TO ROUTES OF TRADE

Thesis submitted to the University of Oxford in fulfillment of the requirement of the degree of Doctor of Philosophy

Michaelmas 1995

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ABSTRACT

A topographical analysis of the location of harbours and anchorages of the eastern Mediterranean in the Middle and Late Bronze Ages, and their relation to routes of trade

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Doctor of Philosophy, Michaelmas, 1995

This thesis examines second millennium BC harbours and anchorages of the eastern Mediterranean through an interdisciplinary analysis of their location, function and relation to trade. It includes a comprehensive survey of the eastern Mediterranean coastal littoral, from the Nile Delta to the southwestern coast of Turkey, including Cyprus and Eastern Crete.

By analysing the corpus of available literature, an imbalance in the current body of evidence concerning harbours and anchorages of the second millennium BC, is addressed. A combination of documentary, pictorial, geomorphological, and archaeological evidence is used to support this analysis.

A topographical typology of anchorage sites is established, with specific reference to topographical change during and since the second millennium. Through analysis of sea-level and coastal change, it is possible to reconstruct the Bronze Age coastline of the eastern Mediterranean, and to recognise the potential location and morphology of second millennium anchorage sites; and how these factors may have dictated their modification, and in some cases, relocation, over time.

Coastal sites where quantities of second millennium BC artifacts, especially imported goods, have been discovered, and where natural topography offers protection from prevailing maritime conditions, are sure to have been used by second millennium mariners. Consideration is given to maritime conditions, such as winds, currents, swell and fetch, that affect the varying coastal interfaces of the eastern Mediterranean, in an attempt to determine how Bronze Age mariners would have tackled these conditions when approaching and leaving harbours of different aspects.

Finally, the network of harbour and anchorage sites of the eastern Mediterranean is considered in relation to the socio-political environment of the second millennium. A number of maritime trade routes are defined, and the function of individual harbours within these routes is analysed. Particular emphasis is placed upon the relationship between harbour sites and inland centres of production, and the role of harbour sites as nodes of trade.

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## ABBREVIATIONS

| | |
|---|---|
| AJA | *American Journal of Archaeology* |
| ANET | *The ancient Near East*. Volume I. An anthology of texts and pictures, ed. J.B. Pritchard. (1958) Princeton, New Jersey: Princeton University Press. |
| AS | *Anatolian Studies* |
| AY | *Encyclopedia of Archaeological Excavations in the Holy Land*, ed. Avi-Yonah. Vol.I (1975); Vol.II (1976); Vol.III (1977); Vol.IV (1978). London: OUP. |
| BASOR | *Bulletin of American Society of Oriental Research* |
| BCH | *Bulletin de Correspondance Hellénique* |
| BSA | *British School in Athens, Annual* |
| CAH | *The Cambridge Ancient History*. Cambridge: CUP. |
| CMS | *Centre of Maritime Studies Newsletter*, University of Haifa, Israel. |
| EA | *Die El-Amarna Tafeln, I-II*. J. Knudtzon. (1907-15) Leipzig. |
| EAEHL | *The New Encyclopedia of Archaeological Excavations in the Holy Land*, ed. E.Stern. Jerusalem: The Israel Exploration Society and Carta. The Israel Map & Publishing Co., Ltd. |
| ESI | *Excavations and surveys in Israel* |
| IEJ | *Israel Exploration Journal* |
| IJNA | *International Journal of Nautical Archaeology* |
| JAOS | *Journal of the American Oriental Society* |
| JCS | *Journal of Cuneiform Studies* |
| JESHO | *Journal of the Economic & Social History of the Orient* |
| JHS | *Journal of Helladic Studies* |
| JNES | *Journal of Near Eastern Archaeology* |
| KBo | *Keilschrift texte aus Boghazkoy.* |

| | |
|---|---|
| KTU I | *Die keialphabetischen Texte aus Ugarit, I., Neukirchen-Vluyn*. M. Dietrich, O. Loretz & J. Sanmartin. (1976) Kevelaer: Butzon & Bercker. |
| MEM | Acts of the International Archaeological Symposium *Mycenaeans in the eastern Mediterranean*. Nicosia 27th March-2nd April 1972, ed. V. Karageorghis. (1973) Nicosia: Department of Antiquities, Cyprus. |
| MM | *Mariner's Mirror* |
| OJA | *Oxford Journal of Archaeology* |
| PRU II | *Le palais royal d'Ugarit*. Ch. Virolleaud. (1957) Paris. |
| PRU III | *Le palais royal d'Ugarit III*. J. Nougayrol. (1955) Paris. |
| PRU IV | *Le palais royal d'Ugarit IV*. J. Nougayrol. (1956) Paris. |
| PRU V | *Le palais royal d'Ugarit V*. Ch. Virolleaud. (1965) Paris. |
| PRU VI | *Le palais royal d'Ugarit VI*. J. Nougayrol. (1970) Paris. |
| QDAP | *Quarterly of the Department of Antiquities, Palestine* |
| RDAC | *Report of the Department of Antiquities, Cyprus* |
| RS | *Mission de Ras Shamra. Ugaritica I-IV*. C.F.A. Schaeffer. (1939-62). |
| SIMA | *Studies in Mediterranean Archaeology* |
| UF | *Ugarit - Forschungen*. |
| UT | *Ugaritic textbook*. C.H. Gordon. (1965) Roma. |
| U.V. | *Ugariticia V*. 1968. Paris. |

## List of Bronze Age anchorage sites of the eastern Mediterranean and their related site numbers

TURKEY

01 Ekinçik Liman
02 Dalyan
03 Caunos
04 Aşilsk
05 Kizilkuyruk Koyu
06 Tersane
07 Wall Bay
08 Taşyaka (Tomb Bay)
09 Göçek Liman
10 Fethiye
11 Gemili Adasi
12 Ölü Deniz
13 Patara
14 Kalkan
15 Port Vathy
16 Kaş
17 Bayindir Limani
18 Limin Kastellórizon
19 Asar Bay
20 Tersane (Kekova)
21 Karaloz
22 Pölemos Bükü
23 Üçagiz
24 Kale Köy
25 Castle Bay
26 Gökkaya Liman
27 Myra
28 Kök Liman
29 Finike
30 Limyra
31 Karaöz
32 Çavus Liman
33 Çineviz Liman
34 Olympus
35 Tekirova (Phaselis)
36 Kemer
37 Antalya
38 Lara
39 Side
40 Melas
41 Kara Burun
42 Fiğla (Fidan)
43 Alanya
44 Aydap
45 Gazipaşa
46 Antiochia
47 Kalidiran
48 Karataş (Melleç)
49 Anamur Burun
50 Bozyazi
51 Gözce
52 Soğuksu Liman
53 Aydincik
54 Sipahill Limani
55 Ovacik
56 Ovacik Adasi Anchorage
57 Ağalimani
58 Taşucu
59 Silifke
60 Hüdüde Hüyük
61 Susanoğlu
62 Narli Küyü
63 Kizkalesi
64 Ayas
65 Tömük Hüyük
66 Soli (Viranşehir)
67 Mersin
68 Kazanli
69 Tarsus
70 Adana
71 Karataş
72 Domuz Tepe
73 Ayas (Yumurtalik)
74 Soyali Hüyük
75 Kara Hüyük
76 Kinet Höyük
77 Payas
78 Iskenderun
79 Arsus
80 Seleucia Pieria
81 Al Mina
82 Antioch

NORTHERN LEVANT

83 Kara Duran (Qasab Bay)
84 Ile Pigeon
85 Ràs el Basit
86 Īsā Begli
87 Slaiyeb Turkman
88 Rās Fasori
89 Minet el Beida
90 Minet el keban
91 Rās Ibn Hàni
92 Tell Farous
93 Latakia
94 Nahr el Kebir
95 Qal'at er-Rūs
96 Jebeleh
97 Tell Sūkās
98 Arab al Mulk
99 Hareissoun
100 Baniyas
101 Tartus/ El Mina
102 Arwad
103 Marathus
104 Machroud
105 Tabbat el-Hamman
106 Tell Simiriyan
107 Nahr al Abrash
108 Shiek Jabber
109 Tel 'Arqa
110 Tel Haned
111 Tripoli
112 El Qalamun
113 Enfeh
114 Šigata
115 Batrun
116 Jebeil (Byblos)
117 Juneh
118 Nahr el Kelb
119 St. George's Bay
120 Beirut
121 Nahr el Awuali
122 Sidon
123 Nahr Zahrani
124 Sarafand
125 Tyre
126 Tel Habeish
127 Alexandrion

SOUTHERN LEVANT

128 Rosh Haniqra
129 Rosh Haniqra Islands
130 Misrefot-Yam
131 Tell Akhziv
132 Akhziv Islands
133 Nahariya
134 Acco
135 Tell Nahal
136 Tell Regev
137 Tell Abu Hawam
138 Rambam
139 Tell Shiqmona
140 Northern 'Atlit Bay
141 Tell Megadim
142 Atlit
143 Neve Yam
144 Tell Nami
145 Dor
146 Ma'agan Michael
147 Tell Tanninim
148 Tell Mevorakh
149 Caesarea
150 Sedot Yam
151 Tel Zeror
152 Tell Girth
153 Tell Mikhmoret
154 Tel 'Ashir
155 Tel Poleg
156 Apollonia
157 Tell Michal (Makmish)
158 Tell Aviv
159 Tell Qasile
160 Tell Jerishe
161 Jaffa
162 Tell Haraz (Yona)
163 Yavne-Yam
164 Tel Mor
165 Tell Poran
166 Ashkelon
167 Anthedon
168 Gaza
169 Tell el Ajjul
170 Deir el Balah
171 Tel Ridan
172 Tell el Jinan
173 Tell Rafia

EGYPT

174 El-'Arish
175 El-Flousiyeh
176 Khatib el Kels
177 Tell el-Fara'in
178 Tell Abu Sefeh
179 Kom Tennis
180 Tanis
181 Tell Nabasha
182 Qantir
183 Tell el-Dab'a
184 Tell Basat
185 Tell el Yahudiya
186 Giza
187 Memphis
188 Tell el Amarna
189 Naucratis
190 S-44
191 Buto (Tell el-Fara'in)
192 Kom el-Hisn
193 Alexandria (Pharos)
194 Haruba
195 Abuqir (Canopus)
196 Abusir
197 El-Bordan
198 Mersa Matruh
199 Delphinon

CYPRUS

200 Loutros Bay
201 Karavastasi (Soli)
202 Morphou (Toumba tou Skourou)
203 Ayia Irini
204 Cape Kormakiti
205 Orga
206 Vavilas
207 Lapithos
208 Snake Island
209 Kyrenia
210 Platymeis
211 Stazousa Point
212 Moulous (Akanthou)
213 Dhavlos
214 Ayios Photios
215 Ayios Thyrsos
216 Ayios Philon
217 Aphendrica
218 Kordylia Nisha
219 Cape Andreas
220 Koroni
221 Khelones
222 Korovia (Nitovikla)
223 Gastria Bay
224 Enkomi
225 Cape Greco
226 Ayia Napa
227 Ayios Yeorgios
228 Pyla-Kokkinokremos
229 Kition *Kathari*
230 Hala Sultan Tekke
231 Cape Kiti
232 Petounda Point
233 Maroni *Vournes*
234 Maroni *Tsaroukkas*
235 Kalavasos *Ayios Dhimitrios*
236 Amathus
237 Akrotiri Salt Lake
238 Dreamer's Bay
239 Akrotiri
240 Asomatos
241 Episkopi *Bamboula*/ Episkopi *Phaneromeni*
242 Paramali Bay
243 Evdhimou Bay
244 Pissouri Bay
245 Kouklia (Old Paphos)
246 Yeroskipos
247 Paphos
248 Maa-Palaeokastro
249 Kerati
250 Maniki
251 Drepanum (Ayios Yerghios)
252 Lara
253 Yeranisos
254 Kioni
256 Ayios Nikolaos
257 Fontana Amorosa
258 Lachis (Polis)
259 Cape Kokkino

EASTERN CRETE

260 Dia (Standia)
261 Ayia Pelagia
262 Palaiókastron
263 Herákleion
264 Katsambas
265 Amnisos
266 Ayia Theodoroi (Nirou Khani)
267 Chersónisos
268 Malia
269 Sision
270 Spinalonga
271 Elounda (Porou)
272 Palako
273 Gournia
274 Pachia Ammos
276 Kavousi
277 Pseira
278 Mochlos
279 Sitia
280 Pétras
281 Agia Photia
282 Kiriamádhi Bay
283 Ayios Ioannis (Sidhero)
284 Dhaskalia
285 Erimoúpolis (Itanos)
286 Elasa
287 Kouremenos
288 Palaikastro
289 Karoumes
290 Zakros
291 Katsonvaui
292 Ampelos
293 Kouphonisi
294 Akri Goudara
295 Agia Photia
296 Ierápetra
297 Myrtos-Pyrgos
298 Arvi
299 Trokhaloi (East)
300 Trokhaloi (West)
301 Kastri Keratokampou
302 Sudsuro
303 Trypeti
304 Léntas
305 Kali Liménes
306 Trypeti
307 Matala
308 Kommos
309 Ayia Triada
310 Ayia Galini

## Foreword

Within the scope of archaeological literature on harbours of the eastern Mediterranean there is a considerable amount of information on the existence and location of Classical Greek, Roman, and even Phoenician harbours. However, despite the significant growth of insight into the expanding tradition of maritime trade and activity through the second millennium BC, direct indications of the location and character of harbour sites of this period are much less evident. It is to this question of the identification and nature of second millennium BC anchorages and harbours of the eastern Mediterranean that this thesis is directed.

It proceeds by addressing the evidence for coastal topography, maritime conditions, changing geomorphology and sea level (Ch.IV), available archaeological material from both survey and excavation (Ch.III), and by reference to historical and textual data related to Bronze Age settlement and trade (Ch.I), so that a greater understanding of the location and nature of second millennium BC harbours of the eastern Mediterranean, may be acquired. The geographical area covered by this thesis encompasses the whole of the eastern Mediterranean basin, from the Nile Delta to the south-western coast of Turkey including Cyprus and Eastern Crete (but excluding the Aegean). The area covers a diversity of types of coastline

(and a range of Bronze Age urban economies), and corresponds to the major cycle of maritime trade routes linking the eastern Mediterranean societies of the later second millennium BC.

Definition of terms :

The terms anchorage, harbour, port etc are often loosely used to describe a place where vessels seek shelter. All of them refer to a body of water, of a given area and depth, that provides shelter and remains calm in all types of weather (Frost 1972: 95). More specific terms for the different types of site, will be used in the text as follows:

HAVEN : A haven is a naturally sheltered section of the coastline that provides temporary shelter to vessels particularly when maritime conditions are unfavourable, such as when a storm is in the offing, or when rest for a limited amount of time is required. Havens offer no additional facilities.

ANCHORAGE : An anchorage is a recognised naturally sheltered body of water where the ground is suitable for vessels to lie at anchor, giving a good and secure holding for vessels (Kemp 1988: 23). Anchorages afford

protection in most maritime conditions. Anchorages would usually posses a supply of fresh water and possibly limited facilities for mariners and their vessels eg beaching, anchoring, mooring, overnight rest etc.

HARBOURS : Harbours provide permanent shelter for vessels, and may offer mooring, anchoring, or unloading facilities, possibly man-made, depending upon the demand, the natural topography, and the needs of sailors. They are usually located in natural anchorages, attached to a small community, and supported by a limited infrastructure, eg routes inland, trade facilities etc.

PORTS : Ports are well established harbours with a wide range of facilities for berthing vessels and amenities for the loading and unloading of cargo, eg market, storehouses etc. Permanent mooring facilities are provided, either adapted from natural anchorages, or constructed artificially. Ports are nowadays often built on the nucleus of a natural anchorage. Only a very limited number of ports were developed during the second millennium BC.

## The history of research into second millennium BC harbours and related coastal surveys undertaken around the shores of the eastern Mediterranean

The first major work on early harbours was published in 1923 by Lehmann-Hartleben. He summarized the archaeological and textual evidence relating to all major ancient harbours sites then available. For some time it remained the definitive work on the subject of ports and harbours of the Mediterranean; but although it still provides the basic literature and useful plans for a number of important Classical and Roman ports, the information it provides on prehistoric anchorages is limited.

During the first half of this century, archaeological work began at a number of the major harbour sites around the shores of the eastern Mediterranean. Survey and excavation both on land, and to a lesser extent underwater, was undertaken by archaeologists such as Schaeffer (1939-1978), Dunand (1963), Poidebard (1939) Poidebard and Lauffray (1951), Jondet (1916), and Braidwood (1940). A brief but informative summary of the results of this phase of work was compiled as a report in Antiquity 1941 by Sir Leopold Saville.

Analysis and excavation of harbour installations of the eastern Mediterranean has continued, with the publication of a number of reports relating to particular

excavations or general discussion of harbour archaeology. Of particular importance is the work compiled by Blackman (1982), and others including Frost (1963), du Plat Taylor (1965), Casson (1971: 361-370), Bass (1974: 87-112) and Muckelroy (1980: 75,162-63). However, it is only in the last decade or so that attention has also focused on prehistoric anchorages, as well as later installations, together with a complimentary consideration of coastal topography, topographical change, maritime conditions, and the relation of anchorage sites to the overall pattern of second millennium BC contact and trade in the eastern Mediterranean.

Some of the leading work in this field, characterised by an interdisciplinary approach to harbour archaeology (and from which this thesis has derived much inspiration) has been undertaken by Raban (1981, 1983, 1985, 1987, 1991) along the coast of the Levant, and Flemming (et al 1973, 1978, 1986) around the shores of southwest Turkey, the Levant, and Crete. They must be seen as pioneers of an integrated approach to harbour archaeology. As Raban (1991: 1) states:

> 'When I've chosen to study the history of ancient harbours in the Mediterranean, I've soon found myself studying the oceanographic characteristics of this inner sea; of what is known to the scholars of earth sciences, concerning coastal processes, quaternarian climatic and topographic changes (such as neotectonics, or eustatic changes of sea levels, isostasy, wave climate, etc); the ever-growing bulk of archaeological data from coastal and submerged sites; the rather well exploited and rather limited corpus of historical references; and - with some measure of

caution - the changing fashionable trends toward various socio-anthropological and socio-economic models'.

Historical information is valuable, since it records pre-industrial maritime conditions and practices. Accounts by early travellers who explored the coasts of the eastern Mediterranean, for example Tevenot (1686), Beaufort (1818) and Hamilton (1842), and even earlier accounts in the Classical literature, by Homer, Herodotus, Pausanias and Strabo, provide invaluable information on contemporary impressions of the shorelines and anchorages they visited. Some of these accounts describe stretches of the coastlines that have since been altered or destroyed by development, or changed due to natural processes. Similarly the editions by the Admiralty Hydrographic Office of the 'Mediterranean Pilot' series (MP 1880-1980), together with modern handbooks for sailors (Heikell 1989; Denham 1964), can be most informative with regards the siting of sheltered anchorages.

A brief guide to the major literature on second millennium harbours and anchorages around the eastern Mediterranean, arranged in sections corresponding to the clockwise order in which they are considered in Part II (Appendix I), is given in Table 1:

Table 1

SOUTH TURKISH COAST -

Flemming et al. (1973), Haifa survey (1987/8), Pirazzoli (1987b), Carter (1978), Blackman (1973), Garstang (1943), Bean (1979, 1989), Gjerstad (1934), Goldman (1950), Mellink (1983, 1985), Seton Williams (1954), Woolley (1938), Braidwood (1937), Toksöz (1986), Rosenbaum et al. (1967), Vann (1991).

NORTHERN LEVANT COAST -

Astour (1970), Riis (1970), Schaeffer (1939-78), Renan (1864), Frost (1963, 1964, 1966, 1969, 1970, 1971, 1972, 1973, 1974, 1980), Dunand (1963), Poidebard & Lauffray (1951), Poidebard (1939), Braidwood (1940), Jidejian (1968), Eiselen (1907).

SOUTHERN LEVANT COAST -

Raban (1983, 1987, 1988, 1989, 1991), Raban & Galili (1985), Neev et al. (1987), Artzy (1990) & CMS, Flemming et al. (1978).

EGYPTIAN DELTA -

Bietak (1986), Baines & Malek (1980), Kemp & O'Connor (1974), Jondet (1916), White (1985, 1986, 1989), Stanley et al. 1992b), Marcus (1990).

CYPRUS -

McCaslin (1980), Karageorghis (1981, 1990), Collombier

(1987, 1988), Dikaios (1971), Nicolaou (1976), Gifford (1978, 1985b), Giangrande et al. (1987).

EASTERN CRETE -

Hadjidaki (1977), Shaw (1985, 1986, 1990), Raban (1991), Leatham & Hood (1958-9), Sotirakis (1992).

These descriptions offer varying degrees of detail in their treatment of coastal areas and sites. Some discuss the topographical aspect of particular sites, others describe the harbours and anchorages, while some consider the second millennium BC remains recovered. As yet, however, no comprehensive comparison of this material, with discussion of relative topography, changing coastal morphology, differing types of anchorage, maritime conditions, and some description of the role played by these anchorages in second millennium trade, has been attempted for the whole of the eastern Mediterranean. The aim of this thesis is to remedy this deficiency, and in so doing, to define the main reasons for the location of second millennium BC anchorage and harbour sites in the eastern Mediterranean.

A principal intention of this thesis is to emphasise the physical aspects of the coastlines of the eastern Mediterranean, together with the micro-topography of individual sites. Archaeologists have traditionally focused

on the most impressive remains of past cultures, and have tended to excavate major centres with obvious urban remains. Because of this, lesser harbour centres - no less important in facilitating maritime traffic - have tended to be neglected. The aim here is to complement this by giving greater attention to the potential of different coastlines in providing shelter. This involves looking more closely at coastal landscapes and environments, analysing the differences between the varying coastlines of the eastern Mediterranean and stressing contrasts in their topography. This reveals how different coastlines favoured or deterred specific types of anchorages and outlines how particular types of anchorage are related to specific types of coastline. Ultimately, the coastal topography was a major determinant of at what stage, and for what reasons, local societies saw the need to adapt these coastlines to improve the harbour facilities.

When stressing physical aspects of coastlines as determinants of anchorage site location, it is not only terrestrial considerations which have to be taken into account. Maritime conditions - the characteristics of the open sea adjacent to the site - are also crucial to the degree of shelter afforded by an anchorage. Thorough analysis of the major physical components that determine anchorage site location is also undertaken, and a topographical typology of different anchorages is proposed (Chapter IV).

However, physical criteria must not be regarded as the sole determinant of anchorage site location, as cultural and political considerations are also of importance. As outlined in Chapter I, the eastern Mediterranean in the second millennium BC comprised many different cultures and levels of social and economic development, with varying requirements and needs, which themselves altered during the course of the Bronze Age. Societies around the shores of the eastern Mediterranean had different relations with the sea: some, such as the Minoans, were immediately dependent upon the sea; while others, such as the Hittite Empire, looked inland for cultural links and trade. The focus of each society influenced the maritime capabilities and technology available, or required. These contrasting needs and preferences affected the scope for trade between the different cultures. Such criteria ultimately influenced anchorage requirements - the need for anchorages, the types of anchorages that were adapted, the desire for facilities to encourage trade, and the timing of these developments.

In all these varying geographical and economic conditions, maritime traffic formed one of the most important activities of the Bronze Age - not only adapting to local circumstances, but also changing these conditions to meet its own needs.

Chapter I

## The historical context of second millennium contacts and trade : A summary

In order to put anchorage and harbour sites in the context of Bronze Age activity in the eastern Mediterranean, particularly that related directly or indirectly to trade, the political and socio-economic climate of the period must be briefly described. The following summary does not seek to offer a comprehensive analysis of the events and problems of the second millennium, but rather a brief outline of the relevant historical and economic background to maritime affairs, ultimately with the aim of establishing who traded with whom, over what sea routes and using which harbours. The events of the second millennium are discussed in chronological order, comparing the changing situation within the different regions of the eastern Mediterranean and their interactions within the expanding network of trade.

The second millennium in the eastern Mediterranean was a period of continuous transformation of economy and trade, on an increasing scale. This growth was stimulated by demands for raw materials by a developing economic core area, centred on Egypt and Mesopotamia but increasingly involving the Levant, Anatolia and the Aegean, through evolving circuits of trade. The economic structure of the

eastern Mediterranean has been discussed in the volume edited by Rowlands, Larsen and Kristiansen (1987), and more recently summarised from a theoretical standpoint by Sherratt and Sherratt (1991), who apply a general model of core and periphery and use this as a description of the growth of Bronze Age trading systems. This perspective disputes the 'minimalist' description of the ancient economy found in the works of A.H.M. Jones, Moses Finley, Keith Hopkins and Anthony Snodgrass, and asserts that the inter-regional movement of material goods was an essential part of economic development.

Bronze Age societies, like all urban economies, can be considered as to some degree, consumption-orientated. For the Bronze Age eastern Mediterranean, the elite consumption of luxury goods was a powerful incentive to trade and overseas contact organised through the network of palaces which centrally controlled much of the trade. As Sherratt and Sherratt (1991: 354) describe the process, it was

> 'the need to acquire supplies of valued materials which motivated the intensification of local production and the extraction of surplus, in order to provide goods for exchange. Moreover the process was a dynamic one, for it set in train an expanding need for consumer goods through a proliferation of centres. Thus what began as the provision of small quantities of luxury items grew to encompass a larger scale of supplies and the local production of commodities for export'.

The initial incentive to trade was not the bulk exchange of natural products between societies, since within the geographical area of the eastern Mediterranean natural

resources were quite similar, but rather those small quantities of highly valued materials whose raw materials were sought in a wide periphery around the established areas of primary urbanisation. This provided the opportunity for local elites to participate in long distance trade, ultimately giving rise to secondary centres of production. 'Growth occurred both by spatial expansion and internal diversification' (Sherratt & Sherratt 1991: 376).

Mediterranean trade of the third millennium developed initially to supply established centres of consumption in the east, principally Mesopotamia and Egypt. Early contacts were established between Egypt and the Levant coast, specifically with Byblos (#116), primarily for the exploitation of Lebanon cedars and pines (Meiggs 1982; Wright 1988). Snofru's inscription on the Palmero Stone (Urkunden I: 236), dated to c. 2600 BC, notes the 'bringing of forty ships filled with pine wood' to Egypt (Pritchard 1975: 227; Landström 1970; Sasson 1966: 127).

The secondary states which grew up beyond the older centres in Mesopotamia acted as centres of exchange between the primary states and their raw material suppliers, and by the second half of the third millennium, with the growth of exchange, developed into major consumers themselves. Of special importance for Mediterranean trade were sites such as Byblos (Dunand 1950; Jidejian 1968; #116), Ebla

(Matthiae 1977,1980; Bermant & Weitzman 1979), Mari (Parrot 1956-1968) and Ugarit (Schaeffer 1939-1978; #89). The Royal Archives of Ebla (c. 2400-2250 BC) and the Mari tablets (the early second millennium, c. 1757 BC) refer to the exchange of large quantities of goods from the east through coastal exchange centres such as Byblos and Ugarit (Astour 1981; Pettinato 1981,1976; Malamat 1971), which were later to become the foci of second millennium trade. Ebla controlled the flow of goods (such as timber from the 'Cedar Forests' of Lebanon between the Levant coast and Mesopotamia, and metals from Anatolia (Kanesh), the 'Silver Mountains' of Tarsus) via the Upper Euphrates to Assur (Astour 1981: 4). The extension of Mesopotamian supply routes up the Euphrates to Syria and into eastern Anatolia, best documented by the Old Assyrian merchant-colonies (Larsen 1967; Veenhof 1972), also stimulated the growth of local indigenous centres, and were to provide the stimulus for Hittite state formation in the mid-second millennium. Thus it was within this north-eastern corner of the Mediterranean that maritime activities first expanded.

During the third millennium BC Aegean trade was conducted primarily within its own exchange system, involving the movement of local resources within a limited inter-island network (Renfrew 1972; Broodbank 1989). Towards the end of this period, the spread of familiar ceramic and metal forms (Yakar 1979) implies the growth of trade links between the Aegean and the southwest coast of

Anatolia (Wiener 1987). Links were also established between Crete and Cyprus, en route to the Levant (Warren & Hankey 1989: 115; Grace 1940: 10,fig.1; Catling & Karageorghis 1960: 110) and between Crete and Egypt, with the presence of Egyptian goods such as stone vases at Minoan harbours (Kemp & Merrillees 1980; Wiener 1984, 1987).

2000-1600 BC

By the beginning of the second millennium BC a marine-based exchange system was emerging, with a small number of primary and secondary centres of power, from Egypt through the Levant to Crete. However, within this system, the evidence for the extensive development of intermediary points of exchange in Cyprus or Cilicia is limited. During the Middle Bronze Age, Cilicia was closely linked with Syria. Ceramic parallels have been identified at both Tarsus (#69) and Mersin (#67) with contemporary levels 3 and 2 at Ugarit (Astour 1965), thus implying maritime contacts between the two regions, and suggesting the importance of Cilicia[1] as a centre of exchange along the south Anatolian maritime axis via Tarsus, to the northern Levant. The discovery of a hoard of bronzes, largely weapons, in a Middle Bronze II context at the site of Soli-Pompeiopolis (Schaeffer 1948: 273-278; #66) finds parallels at a number of other sites, including Tarsus, Ugarit and Beisan, to the east, and in Pisidia and Mysia, in the west,

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[1] The archaeology of Bronze Age Cilicia is unfortunately less well known than other areas of the eastern Mediterranean.

implying a trade route from the Levant to southwest Turkey, via the Cilician Delta (Astour 1965).

From the beginning of the Middle Cypriot I period, the evidence from Cyprus[2] is largely restricted to the north coast which appears to have acted as a 'stop-over' point (see Ch.V), supplying food and water along the routes of trade between Crete and the Levant (Catling 1973; Cadogan 1979; Portugali & Knapp 1985: 44). Toumba tou Skourou (#202) emerged as one of the first havens for vessels travelling from Crete; with Minoan imports also having been recovered in Middle Cypriot I contexts from a number of other coastal sites including Lapithos (#207), Vounous and 'the tomb of the Seafarer' at Karmi (#209; Catling & Karageorghis 1960: fig.1; Åström 1979: 57-62; Mantzourani & Theodorou 1991: 39,fig.1). Egyptian imports to Cyprus are also restricted to coastal sites and are predominantly found in burial contexts (Knapp 1992: 59). Otherwise Cyprus at this early stage was still quite isolated from its neighbours, retaining a relatively low-key role in trade throughout much of the Middle Bronze Age.

From the Ambelikou copper mines, near Morphou Bay,

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[2] The question of the exact location of Alashiya, whether it was a city on Cyprus or the whole island, or indeed at all connected with an island, let alone the island of Cyprus, is still in dispute. However, the identification of Cyprus as Alashiya will be accepted here, and all references to Cyprus in this text will include information attributed to Alashiya (Masson 1973; Holmes 1971; Muhly 1972; Strange 1980 and Hellbing 1979).

north-western Cyprus, early Middle Cypriot mine tunnels have yielded Cypriot Red Polished III ware (Merrillees 1984: 1-13). The copper appears to have been smelted at foundries located in nearby Aletri, before being exported. Thus from the early second millennium the resource potential of Cyprus was realised and a number of these early stop-over points, such as Toumba tou Skourou (#202), that were also associated with copper mines located in the foothills of the Troodos Mountains, gradually emerged as centres that were involved in the production and manufacture of copper (Portugali & Knapp 1985: 66).

Expanding contacts and routes of trade are also attested between the eastern Mediterranean coastal basin and inland centres to the east. Early second millennium texts from Mari (Dossin 1939; Dossin & Birot 1947-1982; Parrot 1959-1968,1974)[3], such as Mari text A.1270 (Dossin 1939; Malamat 1971; Heltzer 1989: 10-13; Villard 1986), record the redistribution of Elamite tin via Mari to the west, through overland routes to Tell Atchana (#82) and Aleppo on the Amuq Plain and via the Orontes River to junctions of trade such as Ugarit (#89). Included amongst the recipients of this tin to Ugarit, are merchants from Caphtor (Kaptaru), usually interpreted as Crete (Malamat 1971; Dossin 1939), and taken as evidence for the early exchange between Crete and the east (Cline 1994: 27;

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[3] The Mari texts date up to c. 1757 BC at which point Mari was destroyed by Hammurabi.

Heltzer 1989: 14). However, there is little evidence to indicate by whom the trade was initiated; whether by Aegean islanders sailing to the east or by peoples from the Levant acting as middlemen between Cretans and the east.

Other texts recovered from Mari (Dossin 1939: 111; Heltzer 1989) at a time contemporary with the Middle Cypriot II period, provide the first documented examples of the exportation of copper to the east, thus, implying that the rich copper deposits of Cyprus had come to the attention of neighbouring countries (Catling 1966: 32,44; Heltzer 1989: 8-9) and were being exchanged for tin, for the production of bronze. Cyprus is also referred to in 18th century BC texts from the palace of Yarimlim at Alalakh (#82), in connection with the distribution of grain (Wiseman 1953: Index 154,2; Muhly 1975: 80-1), thus adding further support to the suggestion of links between Cyprus and the north-eastern Mediterranean, via the Orontes River delta (Heltzer 1989: 24-25).

Middle Cypriot II pottery, notably Red Slip and White Painted wares, has also been recovered from several sites along the coast of the Levant, particularly those near Ugarit, and Middle Bronze IIA sites to the south such as Tel Kabri (#133), Tel Akko (#134), Tel Nami (#144), Tel Dor (#145) and Ashkelon (#166; Marcus 1991: 205; Artzy 1980), implying maritime trade between the two areas although perhaps at this stage not very intensive (Catling 1966: 32-

3). However, no Cypriot material has been recovered from coastal sites between Tell Sukas and Sidon, perhaps suggesting that sites to the north were associated with trade between Ugarit, inland and the west; and those to the south with Byblos and Egypt. Marcus (1991: 203-211) has suggested that this gap may represent two separate, although not mutually exclusive, trade networks (Redford 1992: 90). Alternatively, it could represent a lack of archaeological research in the region (Hankey 1993: 101).

From the beginning of the 12th Dynasty, Egypt appears to have dominated trade along the coast of the Levant, importing wood, olive oil, resins, and dry goods (Marcus 1991: 19; Na'aman 1981). Contact is particularly evident from the material remains recovered from sites in the northern Levant, especially Byblos (#166). During this period, Byblos is described by Bietak (1987: 43) as the 'partner harbour' of Egypt and large amounts of Egyptian material have been recovered from this site particularly during the reign of Amenemhet III, c. 1844-1797, whose name was honoured on monuments at Byblos (Redford 1992: 96-97). There is evidence to suggest that Egyptian mercantile agents were stationed at Byblos and that strong cultural links were established between the two areas (Bietak 1987: 43). Noticeably, however, Byblos, as well as Ugarit, remained politically independent (Wright 1988).

During the Middle Bronze IIA period, a number of

settlements located at river mouths and linked with upstream settlements on the coastal plain of the southern Levant, such as Tel Akko (#134), Tel Nami (#144) and the associated anchorage of Newe Yam (#143), Tel Mevorakh[4] (#148), Tel Poleg (#155), Tel Michal (#157) and Tell Jerishe (up the Yarkon River; #160), began to emerge as landfall anchorages serving coastal traffic plying the sea route between the Egyptian Delta and the northern Levant (Marcus 1991: 41-42; Artzy & Marcus 1991). They were located approximately 40km apart (ie approximately one day's sail (Marcus 1991: 207-8,fig.53), and formed a series of 'stop-over' points along the Levant coast that were essential, not only for additional trading (thus maximising cargo densities) but also as ports of entry for foreign trade and as access to inland markets along the Jordan River Valley (Marcus 1991: 44,170). They all reveal quantities of imported Egyptian artifacts and were active parties within the growing system of international trade (Marcus 1991: 210). Egyptian artifacts have also been recovered from Ugarit (#89) and Alalakh (#82) further to the north, and a series of stone anchors found at sites in the Delta and Byblos (#116), as well as in an offshore context at Neve Yam (#143) in the southern Levant (Frost 1964: 70). Thus, during this period the traditional overland caravan route along the Via Maris was largely replaced by maritime routes that plied the Levantine coast

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[4] An Egyptian stone vessel and mollusc shells from the Nile Delta have been recovered from Tell Mevorakh (Marcus 1991: 41).

between Egypt and Byblos.

However, trade routes between Egypt and the Levant were by no means secure. A campaign to Canaan was conducted under Senwosret III, c. 1878-1842, as a reaction to disrupted Egyptian trading due to attacks by Asiatic raiders. During the Middle Bronze IIA period, with the growing strength of the Amorites in the north, an increasing number of sites were established in the southern Levant that displayed cultural contacts with the north. In the Middle Bronze IIB period a number of these sites were enlarged and fortifications introduced (Redford 1992: 95). Although Byblos remained allied to Egypt, the increasing threat of raids along this coast gradually deterred trade.

The main channels of exchange in the early part of the second millennium were thus centred around the eastern Mediterranean with movement between Egypt, the Levant (particularly Ugarit and Byblos), Cyprus and further east. Within this framework there is archaeological evidence for expanding links between Crete and the east (Watrous 1992; Niemeier 1991).

The earliest Cretan wares discovered along the Levantine coast are Kamares wares at Ugarit (#89), and Middle Minoan IB cups at Byblos (#116) and Beirut (#120; Wiener 1984: 18,1987; Walberg 1983; Cadogan 1979: 65; Hankey 1993: 104). The recent discovery of botanical

remains originating in the Aegean (Crete or Thera) at Tel Nami (#144), provides further proof of contacts between the two regions. Contacts via overland routes with the east are evidenced by the discovery of Middle Minoan II Kamares wares recovered from Qatna, Hazor and Atchana (Alalakh), and the recording of Cretan products, such as weapons and textiles, in texts from Mari, presumably imported via the harbour of Ugarit (Heltzer 1989: 14). Cretan links, via the Levant, with Egypt (Kemp & Merrillees 1980; Cline 1994; Phillips 1991) are also evident by the presence of Middle Minoan II pottery at a number of Egyptian sites including Kahun in the Fayum (Hood 1971: 46); el-Lisht, el-Harageh and Buhen; the 12th Dynasty tombs of Abydos and Lahun (Lorimer 1950; Stubbings 1951: 53; Wiener 1984: 18; Hankey 1993: 110); and the recovery of Minoan Kamares ware at Tell el-Dab'a on the Delta (Kemp & Merrillees 1980; Walberg 1992: 158).

The sea afforded Crete, an essentially agriculturally based, island society, the means by which to acquire high value products from the east, such as metals (particularly for use in the production of weapons) and stone which was used to make Middle Minoan II-III seals (Wiener 1991: 329). So far only a small number of Cypriot imports have been identified in Crete (Warren & Hankey 1989; Mantzourani & Theodorou 1991: 38-39,figs.1-2). As Wiener states (1984: 18),

> 'although we have no direct evidence for Minoan naval activity, it seems to me most probable that

> the bulk of Middle Minoan trade, contact and colonization was carried out on Minoan ships',

indicating perhaps irregular but established Middle Minoan trading ventures (Hankey 1993: 103).

Apart from those artifacts recovered from Knossos, all imported goods from this period have been found at Minoan harbour sites in eastern Crete; these include the so-called harbours of Knossos, Katsambas/ Poros (#264) and Amnisos (#265), and Kommos (#308), Malia (#268)[5] and Zakros (#290), and the 'gateway' settlements of Mochlos (Branigan 1991) and Pseria (#277; Betancourt & Banou 1991). The evidence therefore implies the indirect relaying of vessels from Crete, along the southern coast of Anatolia, to Ugarit and thence south to the Nile Delta. This is described as the 'Northern Route' (Vercoutter 1954: 419,fig.162; see Fig. VI.2) between Crete and Egypt and vice versa; it is unlikely at this early stage that vessels sailed directly from Crete to Egypt.

The increasing influence of 'Asiatics' spreading down from the coast of the southern Levant soon became evident in Deltaic Egypt. Around 1640 BC the position of the 13th Dynasty in Egypt was usurped by a foreign group known as the Asiatic Hyksos (Van Seters 1966; Baines & Malek 1980: 42; Redford 1992: 106-122) and Egypt split up into northern

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[5] The first large Cypriot vessel to be discovered in Crete was found in the Old Palace period at Quartier Mu, Malia.

and southern parts, with a strong Semitic character being evident at sites in the north. Thus Tell el-Yahudiya (#185), Tell el-Maskhuta and particularly Tell el-Dab'a (#183), the Hyksos capital (Bietak 1986), all reveal strong Semitic, and potentially even Aegean, influences.

Despite these changes, trade between Egypt and the rest of the eastern Mediterranean thrived in the hands of Asiatics, as the Hyksos already belonged to the international maritime world and its system of trade (Van Seters 1979). A treaty was made between the Hyksos and Byblos and an influx of foreign wares is evident in Egypt and likewise, Egyptian material in the southern Levant. In the 17th Dynasty, when the Thebans began their struggle to expel the Hyksos, Kamose, prince of Thebes, attacked the Hyksos rulers at Avaris and captured one hundred ships laden with imported goods from western Asia (Van Seters 1979). In addition, 'Minoan' style frescoes have been uncovered at Tell el-Dab'a from this period (Bietak 1992; #183), which have been compared with the frescoes at Alalakh and painted-plaster floors at Tel Kabri in the southern Levant (Niemeier 1991). This implies continued and diverse cultural and political contacts between Egypt and Crete via the Levant during the period of Hyksos domination. It was not until c. 1570-1560 BC that native Egyptian dynasties expelled the Hyksos rulers and regained control of Lower Egypt, laying the grounds for the rise of the strong, unified 18th Dynasty (Hankey 1993: 109).

1600-1400 BC

By the beginning of the Late Bronze Age, the scale of trade had intensified along earlier-established routes, and smaller nodal points of exchange developed, supported by their local hinterlands. Routes between Mesopotamia and the Syrian coast via the Orontes and Ugarit, and between Egypt, the Levant and eastern Crete, became major arteries of trade. In the context of this international trade smaller independent states flourished, centred upon coastal 'free ports' such as Ugarit (#89), Byblos (#116), Beirut (#120) and Tyre (#125). The inland powers such as the Mitanni, the Hittites and the Assyrians became dependent upon such coastal emporia as inlets of trade from the eastern Mediterranean - it was to the mutual benefit of all the major powers to assure the 'neutrality' of these 'free ports' (Knapp 1986: 43).

Between the Middle Cypriot III and Late Cypriot I periods, with increased demands for Cypriot copper ore from external markets (Muhly 1973: 192-199, 1982), copper production in Cyprus intensified. Sites along the north coast of Cyprus, such as Toumba tou Skourou (#202) and Ayia Irini (#203), retained their importance within the exchange network and specialised areas of production emerged particularly in the east and south, with the establishment of harbour-towns such as Enkomi (#224), Hala Sultan Tekke (#230), and Kouklia (#245). By the Late Cypriot IA period Enkomi had emerged as one of the most important centres of

metalworking on the island, with the introduction of refining installations for intensified copper production (Knapp 1994: 287).

Cypriot trade with the eastern Mediterranean likewise expanded and Cyprus established trade in ceramics, particularly Proto White Slip ware, with the Levant and Egypt (Knapp 1986: 39; Gittlen 1975: 113; Merrillees 1968; Artzy 1980). By the Late Bronze I period direct contacts were established between Cyprus and Crete, particularly for the import of copper to the Aegean, as witnessed by the recovery of a copper ingot in a Late Minoan I context at the 'gateway' harbour of Zakros (#290). Conversely, Late Minoan I pottery occurs in Cyprus. The obvious strategic advantages of the geographical location of Cyprus made it an important stage and an integral part of the trade networks of the eastern Mediterranean (Georgiou 1979: 85), and the wealth of its copper resources ensured its economic prosperity and, to a certain extent, its immunity. Cypriot copper was soon to become one of the major commodities extensively traded within the eastern Mediterranean.

Hittite power in the north, centred on the Anatolian Plateau, was secured c. 1650-1600 BC when Hattušili I established the Hittite capital at Hattušaš. In c. 1600 BC, the Hittites under Mursilis I marched on the Old Babylonian Dynasty of Mesopotamia, as recorded in the Babylonian Chronicle (Gurney 1975: 23-24); and the Cilician Delta,

Alalakh, Ugarit and the northern Levantine coast came within the Hittite sphere of influence (Astour 1965; Hankey 1993: 101). The Mitanni, who occupied the Syrian saddle that linked Mesopotamia and Babylonia and acted as a buffer zone between the Hittite and Assyrian kingdoms, soon became another important player in the trade network (Van Seters 1966; Redford 1992: 139-140).

During the Late Minoan I period, Minoan Crete reached the apex of it's prosperity as a result of intensified agricultural, textile production, and wide-ranging trade contacts, particularly with the eastern Mediterranean, which served to funnel luxury goods into the economy[6], increasing the socio-political power of the palaces. This climax in Neo-Palatial overseas maritime activity is witnessed at Minoan harbours, particularly Zakros (#290), which had a crucial role in Minoan trade with the east and Egypt (Platon 1984: 66). Simultaneously, with the establishment of the Late Minoan IA colony and harbour town at Trianda, Rhodes emerged as an important entrepôt between the Aegean and the Anatolian coast. Cypriot pottery has also been recovered here indicating a two-way trade between Cyprus and the Aegean[7]. Rhodes was the first Aegean port

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[6] See Cline (1994: 9-13) & Phillips (1991) for a breakdown of the imported and exported goods between Crete and the eastern Mediterranean over the period of the Late Bronze Age.

[7] Late Minoan IA objects have been found at Toumba tou Skourou and Ayia Irini on the north coast of Cyprus, as well as at Enkomi and Kouklia along the eastern and southern shores of the island (Cadogan

for traders coming from the east and was the obvious place to trans-ship cargo from the Levant[8] and Cyprus, acting as a junction, controlling the trade of goods between east and west (Portugali and Knapp 1985: 53).

From 1500 BC the renewed expansion of Egyptian power is demonstrated in the wealth of the royal centre in Thebes; and by increasing control of the Egyptians over coastal Levant, particularly following Tuthmosis III's campaigns in the first half of the 15th century BC (Redford 1992: 148-166; Astour 1981: 11). In an effort to gain access to raw materials and dominate routes of trade (Drower 1973: 506), Egypt established what have been described (Linder 1973: 317; Artzy 1988: 185) as 'supply ports' along the coast of the Levant, whose purpose it was to provide a maritime inlet for provisions to Tuthmosis' army. Ashkelon (#166), Jaffa (#161), Tell Abu Hawam (#137; Artzy 1994: 130,nt.13), Tyre (#125), Tell Haned (Ullaza; #110) and Byblos (#116) are amongst those coastal settlements that are believed to have performed this function.

Tuthmosis III is also known to have seized and used Canaanite ships, imposing tribute on the Syrian states,

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1979: 65).

[8] Cretan links with the Levant are well attested, as witnessed at such sites as Alalakh, Ugarit, Byblos, Beirut, Tel Kabri and Tell el-'Ajjul (Niemeier 1991; Hankey 1993: 104).

which required the delivery of boats, often full of spoil, to Egypt (Sasson 1966: 130,nt.21). Thus, it appears that 'Pharaonic sea-power' was made up of Canaanite vessels. An array of goods (Drower 1973: 480-1) were transported from the Levant coast and presented as trade and tribute by Syrian merchants, to Egypt, implying the expansion of maritime routes along the Levantine coast.

It is interesting to note that Ugarit (#89) and Arwad (#102; Astour 1981: 12) are not mentioned amongst the conquests of Tuthmosis III, and therefore must have enjoyed special treatment from Egypt, possibly, as Drower (1968: 475) believes, 'for the benefit of their mutual maritime trade'. Cyprus is also mentioned in connection with tribute lists of towns on the adjacent coast (Muhly 1972: 208; Georgiou 1979: 96). Over time these harbours flourished into centres of maritime commerce, eventually acquiring political and economic independence from Egypt (Linder 1973: 318; Cline 1987: 6).

During the 18th Dynasty the Keftiu, usually identified as Cretans, are first depicted in Egyptian tomb paintings. Tombs of officials at Thebes, notably those of Senmut (T.71), Amenemhab (T.85), Kenamun (T.93), Useramun (T.131), Rechmire (T.100), and Anen (T.120), from the time of Hatsheput to Amenophis IV, show, amongst other depictions,

scenes[9] of Aegean 'tribute' (Wachsmann 1987). The depictions of Aegeans in Egyptian tomb paintings and reference to the Keftiu in Egyptian texts[10] (Vercoutter 1956: 51-53, 417-422; Wachsmann 1987), imply that by this stage, if not earlier, a direct open-sea route between Crete and Egypt was being used by mariners. Whether the texts refer to Cretan traders, people engaged in trade with Crete, or the ships that arrived from Crete (Sasson 1966: 123; Strange 1980: 209; Astour 1964: 193-201; Vermeule 1964: 114), it would appear that vessels were departing from the southern shores of Crete and sailing south to the north coast of Africa and then in an easterly direction to the Nile Delta; hence the description in Egyptian inscriptions from the tomb of Rechmire of Keftiu arriving from the west (Vercoutter 1956: 51-53; Sakellarakis & Sakellarakis 1984: 198). Late Minoan IA frescoes from the West House at Thera, have been interpreted as portraying scenes from the north coast of Africa (the north wall) and the Nile River (the east wall); and monkeys depicted in a fresco scene from Knossos are also believed to imply direct

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[9] Although the Egyptian tomb paintings give the impression that contacts between Egypt and Crete involved tribute by Aegeans, it is far more likely that trade between the two regions was quasi commercial in nature. There is much evidence for the return of Egyptian goods to Crete including an alabaster amphora bearing the cartouche of Tuthmosis III which was found in the tombs of the harbour of Katsambas (Platon 1984: 66).

[10] There are sixteen references to the Kftiw or Keftiu from the 15th century BC, two in the 14th century BC, three in the 13th century BC, and one in the 12th century BC (Vercoutter 1956: 417-422).

contacts between Egypt and Crete (Kemp & Merrillees 1980: 271-274). However, Late Minoan I-II pottery in Egypt is surprisingly scarce (Kemp & Merrillees 1980: 226-245; Cline 1994: 31).

Keftiu are also portrayed bringing gifts of types produced in the eastern Mediterranean to Egypt and are depicted with different ethnic groups, including Hittites (Sakellerakis & Sakellerakis 1984: 199), hence implying that vessels from Crete also came via the 'Northern maritime route', and south down the coast of the Levant. Thus, maritime contacts between Crete and Egypt were established in both directions along the 'Northern Route', and from Crete via the direct open sea route to the Nile Delta, thus establishing the circular sea route (see Cline 1994 for details of the expanding contacts between the Aegean and the eastern Mediterranean during the Late Bronze Age period).

Sources of evidence for the varying scales of second millennium trade in the eastern Mediterranean differ greatly. The Egyptian tomb paintings display an array of goods from all over the Aegean, the eastern Mediterranean and Nubia. In particular, the relief in the temple of Karnak which records the booty recovered from a single campaign of Tuthmosis III, demonstrates a wide range of goods and indicates the scale of the Egyptian and Levantine economy. However, the evidence of tomb paintings

illuminates only one side of such trade: for the Aegean and the eastern Mediterranean this sort of precise data is absent. For instance, the relative quantities of imported goods uncovered in Crete seem small when compared to the large quantities of Cretan and later Mycenaean pottery that have been uncovered throughout the eastern Mediterranean, particularly after c. 1400 BC. It has been suggested (Bass 1967 :165) that a large amount of the imported goods to Crete included perishable, consumable or transformable raw materials, such as bronze, tin, Cypriot copper, wine, ivory, gold, faience, and textiles (cloth and purple-dye) (Vermeule 1964: 155-157; Barber 1990), which have left no trace in the archaeological record (Merrillees 1974: 8; Cadogan 1976). As Bass (1991: 76) points out, 'if there were no paintings and reliefs in Egypt we would not have the slightest idea that a single ox-hide ingot ever reached there'.

During the 15th century BC urban centres along the south and east coast of Cyprus, such as Enkomi (#224), Maroni (#233) and Hala Sultan Tekke (#230), came to play a prominent role in Cypriot trade, deriving their wealth from the extraction and export of copper in the form of oxhide ingots. Copper was exported primarily to the Levant coast, particularly Ugarit (#89) and Byblos (#116), and Crete (via Zakros; #290), in exchange for olive oil, herbs, textiles, ceramics, seals, ivory, foodstuffs, and tin (Holmes 1975: 90-110). Textual evidence continues to imply the presence

of Alashyian peoples at Alalakh (Wiseman 1953: Index 154.1), and Cypriot pottery has been recovered from Sabouni (#81) and Qatna (Holmes 1975), confirming this route as a continued inlet for trade with the east. Cypriot White Slip I and II wares have also been recovered from sites along the southern Levantine coast such as Tell Abu Hawam (#137), Ashdod (#164), Tell Jerishe (#160) and Tell el-'Ajjul (#169; Gittlen 1975: 116-7).

Alongside the Late Minoan IB colony of Trianda on Rhodes, a Late Helladic II Mycenaean cemetery has been identified at Ialysos (Stubbings 1951: 102). It would appear that mainland Greece was beginning to take an interest in overseas trade; and the increasing amounts of Late Helladic II and later IIIA pottery recovered from sites in southern and eastern Cyprus, compared with the diminishing quantities of Minoan pottery, recovered from sites in Egypt, would confirm the expansion of trade between mainland Greece and Cyprus, presumably operating via the junction point of Rhodes. Sites in southern and eastern Cyprus also acted as stop-over points or nodes of distribution of Mycenaean pottery otherwise en route to Syria and Egypt (Stubbings 1951: 104). Thus Mycenaean pottery recovered from sites in the Levant is almost always in minor quantities compared to the Late Cypriot I and II pottery that accompanies it (Hankey 1993: 103).

Towards the end of the 15th century BC, increasing

evidence for Mycenaean involvement in Crete is reflected in the mainland character of Palace-Style pottery introduced into Crete in the Late Minoan II period (Vermeule 1964: 145). It is uncertain quite what long term effects resulted from the volcanic eruption of Thera c. 1500 BC or earlier (Thera and the Aegean World I-III 1978-1990); but by c. 1450 BC it would appear that mainland centres had effectively assumed domination of the Aegean. The end of the Late Minoan IB period saw widespread destruction of the Minoan palaces and settlements in Crete and the introduction of the Final Palace/ Post Palatial phase in which Crete was under Mycenaean control. As Vermeule (1964: 155) states 'The ruin of the island palaces is immediately followed by the rise of several on the mainland'.

1400-1300 BC

The 14th century BC is the so called 'International Age' (Linder 1981: 32) when trade in the eastern Mediterranean reached a peak, and a certain equilibrium was established between surrounding powers and their potentially conflicting interests. At this stage the Egyptian province of Canaan and those regions to the north which had been lost to the Mitanni, remained the key area of political, cultural, and economic ties between the major empires, notably the Hittites and the Egyptians (Mazar 1988: 1-2). The main routes of communication by both land and sea converged in the north-eastern corner of the Mediterranean and largely determined the form of

international trade, the bulk of which was handled through the port of Ugarit.

The city of Ugarit (#89) possessed four natural anchorages; Atalliq (#95), Gib'ala (#96), Himulli (Pigeon Island; #84), and the largest, Ma'hadu, Minet el Beidha (#89; Astour 1970: 114-5; Sasson 1966: 134). Ugarit also controlled the shoreline between Mount Casius in the north and Tell Sukas (#97) in the south. Situated on the edge of the economic sphere of the eastern Mediterranean, Ugarit was

> 'within easy sailing distance of Cyprus and the Cilician coast, and [was] the most northerly of the chain of ports which served coastal traffic of the Lebanon, Syro-Palestine, and Egypt. She was the natural link between the Aegean world and the Levant' (Drower 1968: 131).

Ugarit acted as the 'middleman' transferring goods between the eastern Mediterranean basin, especially Cyprus and Crete, and the Near East (Heltzer 1989: 14).

Ugarit is referred to as a kingdom and appears to have retained its independence throughout much of the second millennium. It was only during the reign of Amenophis III (c. 1391-1353 BC), following the alliance between Egypt and the Mitanni, that Ugarit became a vassal of Egypt (PRU II, 18); and, even then, it retained considerable independence as an important commercial centre (Drower 1968: 132,475; Schaeffer 1939-1978; Astour 1981: 15-17). Ugaritic anykn

and Egyptian mnš[11] ships, or cargo boats, transported merchandise along the Levantine coast or the 'Great Green' sea, to Egypt (Säve-Söderbergh 1946: 57-8; Sasson 1966: 131-2; UT 2059), importing copper and lead from the foundries at Ugarit, together with lapis lazuli from Afganistan and other stone from the northern Levant (Drower 1973).

Ugarit has revealed a wealth of textual evidence in the form of thousands of letters and memoranda belonging to merchants and private individuals. Texts uncovered at Ugarit make reference to Ugaritic merchants, both royal and private (UT 2006/7), as well as foreign merchants, some working as agents of the central government of Ugarit, trading throughout the eastern Mediterranean (Linder 1981: 32-36).

Amongst the foreign powers referred to in the texts from Ugarit are merchants from Alashyia (Cyprus), thought to have established a trading community at Ugarit (UT 2008/ 1090/ 2095; Åström 1969: 80; as well as Cypro-Minoan documents having been recovered from Ugarit); Egypt (UT 2059/ 1084); Cilicia (RS 20.212), particularly merchants from Ura (RS 130.316,319); Hattušaš (RS 17.59; UT 1090/

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[11] The origin of the Egyptian word for cargo boats, mnš, is believed to have been adopted by the Egyptians and described a specific type of Syrian vessel (Basch 1978: 106) and thus, possibly relates to the time of Tuthmosis III when Canaanite vessels were seized by the Egyptians in order to transport goods from the Levant to Egypt.

1091)[12]; Carchemish (RS 18.144); Lycia; and Crete (PRU III 16.236; PRU III 112: 9-15), whose merchants were referred to in the texts as Kaptaru or Caphtorite (Cretan) merchants (Schaeffer 1939-1978; Heltzer 1977; Astour 1973, 1981: 28-29). It is also probable that the kings of Ugarit had representatives in the Aegean; we know of one Ugaritian, Sinnaranu, who apparently was an official Ugaritian trader in the Aegean during the mid 13th century BC (Sasson 1966: 135; Astour 1964: 106-7; Heltzer 1978: 120-147). The maritime route taken by Sinnaranu on his return from Crete to Ugarit is described in an Akkadian text from Ugarit and confirms that sea-passage was well established between the two powers (Heltzer 1989: 12; Cline 1994: 49). There is, however, a conspicuous absence of Mycenaean representatives at Ugarit (Astour 1964: 194).

Ugarit also supported a thriving maritime trade with the coastal sites of the Levant. Tablets from Ugarit provide evidence of Ugaritic trade with Arwad (#102), Byblos (PRU II.110-4; #116), Berytus (PRU III.12; #120), Sidon (PRU IV.58; #122), Tyre (PRU V.106; #125), Akko (PRU VI.79-81; #134), Ashdod (RS 19.20; #164) and Ashkelon (U5 N41; #166) (Schaeffer 1957: 64-65, 1962: 1-150; Heltzer 1978: 151). Some of these harbours were aligned with Ugarit, the texts detailing lists of Ugaritic personnel stationed at these ports (Heltzer 1977: 209); others

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[12] There is also evidence of trade with Anatolia in the Hittite texts. eg KBo XII,42 rev. col.III & BO 2810 (Heltzer 1977)

retained a degree of independence; while others, particularly in the south, were under Egyptian control. Merchants also utilised other Ugaritic harbours such as Qal'at er-Rɑs, Ugaritic Atallig (PRU V.56; #95), where copper, bronze artifacts and quantities of Mycenaean pottery have been recovered. Sasson (1966: 135; UT 2056. 1-4) believes that Cypriot copper was transported in large quantities to Atallig, from whence it was shipped to the foundries at Beirut (#120), implying that metalworking was undertaken at coastal sites en route (Linder 1972).

Trade thrived between Ugarit and Cyprus, being particularly prominent towards the end of the 13th century BC (Gittlen 1975; Holmes 1975), although large amounts of Cypriot pottery have been recovered from Ugarit from throughout the Middle Cypriot II period to the end of the Late Cypriot II period (Artzy, Perlman & Asaro 1981). Amongst the finds, Cypriot juglets have been recovered from warehouses stored with 18th Dynasty alabaster vessels (Schaeffer 1939: 31-2, 1949: 141), confirming Ugarit's role as an entrepôt and junction of trade between Cyprus and Egypt.

During this period there is continued evidence for Cretan trade with Egypt (Vermeule 1964: 339-340; Kemp & Merrillees 1980; Cline 1987, 1994; Kitchen 1966; Phillips 1991), possibly sailing direct to Egypt and returning via the Levantine coast. Cline (1987, 1994) interprets the

evidence as an indication of increased contacts expressed in terms of freelance trade between the two nations up to the destruction of Knossos in Late Minoan IIIA. Crete is thought to have exported a variety of locally produced goods to Egypt, including oils and wines, that were possibly exported in storage pithoi similar to those found in the palace and surrounding buildings located in the harbour area at Zakros (#290), and timber (Platon 1971: 244). In Egypt, Aegean pottery of this period has been found at a number of Delta sites, including Tell el-Dab'a (#183), Akhenaten's late 14th century BC city of Tell el-Amarna (#188), and Saqqara (#187) and Qantir (#182; Kemp & Merrillees 1980; Cline 1987: 15,map 3; Hankey 1993: 101,fig.1,110-4). In exchange, a range of Egyptian, eastern Mediterranean and Near Eastern goods - tin, copper, faience, alabaster, seals and scarabs, pottery and stone vessels - arrived in Crete from the east.

A number of geographical documents have also been uncovered in Egypt that provide documentary evidence relating to contacts between Egypt and Crete (see Ch. III.1.ii.b). Of particular interest, in this context, is the 14th century BC Kom el-Hetan topographical list, found at the mortuary temple of Amenophis III, which mentions 'Isles in the middle of the sea' (Kitchen 1966: 23-24; Wachsmann 1987,1989; Cline 1994). This list is thought to record a voyage from Egypt to twelve places in the Aegean. Reference is made to the Cretan towns of Amnisos, Phaistos,

Kydonia, Knossos and Lyktos (see Wachsmann 1987: Pl.LXIX), and possibly, depending on the translation, to Kato Zakros (Cline 1987: 23,Addendum); it also refers to the Keftiu (see above). The inscription could well be describing a mercantile maritime voyage, as a number of Egyptian objects have been recovered from the Aegean, particularly in Late Minoan IIIA and IIIB contexts, bearing the cartouche of Amenophis III or his wife Queen Tiyi, at places that possibly correspond to the names listed on the mortuary temple inscription (Cline 1987: 7, map 1); together with the discovery of two tablets from Knossos that refer to Egyptians (Cline 1994: 35); confirming the exchange of goods between the two areas during the 18th Dynasty (Cline 1987: 1, 1994: 38-9).

Additional column bases from the mortuary temple of Amenophis III, list other sites in the eastern Mediterranean, particularly along the coast of the Levant (Cline 1987: 2). Assuming they also refer to places visited during maritime trade expeditions, then it is probable that in addition to direct contact from Crete to Egypt, indirect trade with Crete continued along the 'Northern Route' or 'coastal trading corridor' (Kemp & Merrillees 1980: 284; Fig. VI.2), entering the Aegean via the junction of Rhodes.

The growth of trade between Cyprus and the Aegean is also noted during the 14th century BC (Cadogan 1993: 92). Cyprus is referred to at least twice in tablets from

Knossos (Cline 1994: 60) and a number of Cypriot vessels, particularly White Slip milkbowls, have been found in Late Minoan II-IIIA1 contexts at Kommos (#308; Watrous 1992: 172). A number of models of sea-going vessels have also been recovered on Cyprus (Ch.II), representing ships which would have been capable of transporting goods to the Aegean, the Levant and Egypt (Merrillees 1968: 187; Åström 1969: 80). Perhaps boats of this nature plied the north coast of Cyprus along routes destined for the Aegean, as witnessed by the number of Bronze Age type stone anchors that have been found along this coast (Frost 1970a).

By c. 1400 BC, the export of Cypriot copper throughout the eastern Mediterranean had reached a peak. Widespread intensification of copper production is noted throughout the island, particularly at Enkomi (#224), Hala Sultan Tekke (#230), Kalavasos Ayios Dhimitrios (#235), Athienou, Maroni Vournes (#233), Apliki Karamallos, Kourion Bamboula (#241) and Toumba tou Skourou (#202; Knapp 1994: 287). Thus, the major centres of trade on the east and south, and to a lesser extent, the north, coasts of Cyprus played an integral part in the wider pattern of Bronze Age trade (Karageorghis 1970; Yannai 1983) and are referred to by Portugali and Knapp (1985: 67) as 'market orientated' centres.

Cypriot contacts with Egyptian, Hattian and Syrian polities were multi-faceted, and Cyprus appears to have

retained a neutral position with regard to the Egypto-Hittite conflict for the political control of Syria. It was to the mutual benefit of both Cyprus and the Hittites to remain on friendly terms as they bordered an important trade route. Cypriot pottery has been found in Late Bronze II contexts at a number of sites on the Cilician Delta, including Tarsus (#69) and Mersin (#67; Holmes 1975), and Cyprus is referred to in both Akkadian and Hittite texts of the 14th and 13th centuries recovered from Boğazköy, which list goods, including gold, garments, copper and bronze, that were sent from Cyprus to Anatolia (KBo I 26; Portugali & Knapp 1985: 65). Thus, because of its importance as a trade centre, Cyprus retained its 'neutral' status with all powers that bordered the eastern Mediterranean (Georgiou 1979: 89).

The wealth realized from this trade, particularly in copper[13], helped to transform Cyprus from a village-based society into a group of states of international importance (Knapp 1992: 123). Throughout the 14th and 13th centuries BC Cyprus acted as a 'middleman', an intermediary station, handling the exchange of both commodities and cultures between east and west; its geographically strategic position gave Cyprus an advantageous market potential (Portugali & Knapp 1985: 67). As Yannai (1983: 85)

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[13] Other goods exchanged by merchants during this period, included grains, oils, pottery and luxury goods, including faience, wines, spices, gold, ivory and textiles (McCaslin 1980: 97-100,table V; Åström 1969: 80).

expressed it - 'Cyprus was in a position to supply directly, or as an intermediary, anything the Levant coast had to offer'.

Between 1450-1200 BC, the strength of the Hittite Empire grew, especially under Suppiluliuma I, who came to power c. 1380 BC. Between 1380-1360 BC, the Hittites took control of the Mitanni areas, Northern Syria and Cilicia, creating a common frontier with the Egyptian empire in the Levant (Drower 1973: 483-493,506-519), and discouraging Egyptian trade. The history of the Hittite Empire and indication of Hittite trade and contacts with the eastern Mediterranean, is outlined in various documents from the Hittite capital Hattušaš (Boğazköy), particularly the 14th century BC Annals of Mursili II (Hooker 1976: 121-131; Cline 1994: 70). The primary aim of the Hittites was to secure its state frontiers to the west, south and east. This was achieved by the establishment of vassal states and by conducting diplomatic relations with bordering powers, especially Assyria and Babylonia. Ugarit was forced to side with the Hittites (PRU IV.2), thereby losing some trade with Egypt but gaining access to the Anatolian market centred on Boğazköy. This period of Ugaritic allegiance with the Hittites and friendly relations with Egypt, proved to be the peak of Ugaritic prosperity (Rainey 1963).

Thus, the Hittite Empire developed 'close commercial relations with Ugarit, the centre of eastern Mediterranean

trade' (Yakar 1979: 124), encouraging mercantile activity to the mutual benefit of both Ugarit and the Hittite Empire. Trade was conducted via the tamkaru merchants at the harbour of Ura (PRU IV 17.30, PRU V 16, PRU V 59) in Cilicia[14], a local merchant colony under Hittite control, with the transfer of grain and dyed blue-purple wool, and no doubt tin and copper, from northern Syria to Cilicia (RS 20.213). The Hittites maintained officials at Ugarit to conduct their business (Sasson 1966: 135-6), and at Hattušaš a 'house of documents' was established by Ugarit to monitor trade transactions (RS 17.59; Sasson 1966: 135). Thus, Ugarit remained loyal to Hattušaš until the fall of the Hittite Empire (Astour 1981: 23), whilst maintaining her position as a commercial intermediary between Egypt and the Hittite Empire (Drower 1973: 139).

After the final destruction of Knossos in the Late Minoan IIIA period, Minoan links with the eastern Mediterranean declined (except at Kommos), in favour of Mycenaean pottery imports (Hooker 1976; Gilmour 1991: 1-6). During the Mycenaean domination of the Aegean the palaces controlled the production and manufacture of goods for export. Details of this process are well documented in the Pylos tablets which describe a bureaucratically controlled system of economy, overseeing bulk 'industrial' production and craft specialisation (Killen 1985).

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[14] A letter from Hattusili III c.1282-1250 to the king of Ugarit has been recovered regarding the regulation of Ura merchants (Gordon 1958).

Thus, the emphasis shifts towards a Mycenaean monopoly of Aegean trade, particularly contacts with the Hittites, Cyprus, for the acquisition of Cypriot copper, and the Levant (Yakar 1979: 126). Rhodes continued to perform its function as a junction between the Aegean and the east, with increasing amounts of Mycenaean pottery recovered from Late Helladic IIIA2 tomb contexts at Ialysos (Stubbings 1951: 6-7,fig.1). Northern Syria and Cyprus are believed to have extended port facilities to the Mycenaeans in return for similar accommodations in the Mycenaean controlled ports (Yakar 1979: 126). Thus, the route along the south coast of Anatolia became important for shipping between the Aegean and the eastern Mediterranean. It offered refuge to vessels during storms and access to fresh supplies of food and water during the long journeys from Crete or Rhodes to Cyprus and other eastern ports (and visa versa). Ugaritic texts support the use of this western trade route (Nougayrol 1960: 163), and the 14th century shipwreck of Uluburun[15] and the later 13th century shipwreck of Cape Gelidonya, together with copper ingots found offshore near Antalya (presumably from other shipwrecks), suggest that the Lycian coast was an important link along the maritime route between the Aegean and the eastern Mediterranean (Yakar 1979: 126,ft.53). Yakar (1979: 126) has outlined four major regions along this route that handled trade between the Aegean and northern Syria; Cyprus, Cilicia,

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[15] Evidence for Mycenaean contacts is implied by the range of Mycenaean goods recovered from the Uluburun shipwreck (Cline 1994: 36-7).

Lycia and Caphtor (Crete)[16].

However, despite the existence of commercial links between Hittite Anatolia and the Aegean (Mee 1978), the archaeological evidence suggests that the Hittites did not wish to encourage the permanent presence of Mycenaeans in their kingdom (Yakar 1979: 121,126-7,fig.1). Both Akkadian and Hittite (KBo I26, KBo XII 38,39) documents from Hattušaš record Hittite relations with Cyprus from c. 1400 BC (Güterbock 1967: 73-81; Knapp 1980) and it is quite possible that Cyprus performed an intermediary role in trade between the Aegean, the Hittite Empire and the Levant, with direct Mycenaean contacts extending no further east than Cyprus or even Rhodes (Knapp 1992: 59; Merrillees 1973: 182). Mycenaean IIIB pottery has been recovered from the Orontes River valley and further east at Kadesh and Qatna (Stubbings 1951: 104). A variety of Mycenaean pottery has also been found in Egypt, with the most substantial amounts at Tell el-Amarna (#188; Cline 1994; Hankey 1973: 136,fig.3, 1993: 102,fig.1,113-4; Stubbings 1951: 91,fig.34). Although the evidence for actual Mycenaean presence in Egypt, whether direct or indirect trade[17], is ambiguous, there is plenty of evidence for overseas trade

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[16] It must be noted that from the same period, Amarna tablet EA 38.9-12 records a raid against Cyprus by Lukka pirates from the southern coast of Anatolia in the mid 14th century BC, implying that this coast also presented a threat to mariners (Åström 1969: 80).

[17] Wachsmann (1987, 1989) believes that Mycenaean pottery in Amarna was brought by middlemen ie Cypriots or Syrians (EA 33: 19-32; 35: 40-41).

in Mycenaean goods reaching Egypt up to the mid 13th century BC.

The role of Crete during this period seems to have been one largely peripheral to the mainland, although Cretan ports, particularly Kommos (#308) on the south coast, continued to flourish and could well represent the beginnings of the Minoan trade with the west (Watrous 1992: 182-3; Cline 1994: 11). From Late Minoan IIA contexts at Kommos, large amounts of Cypriot pottery (particularly White Slip II bowls) and Canaanite jars, particularly from the southern Levant, have been recovered (Watrous 1992: 175-6), as well as Egyptian vases in Late Minoan IIIA1 contexts. Trade from Crete is believed to have been conducted with Egypt via the port of Mersa Matruh (#198; White 1985,1986). Mersa Matruh is situated some 300km west of the western Nile Delta and is conveniently located at the first landfall after the four or five day sail from Crete (see Ch.VI.2.1). It is located along the major route to the Nile Delta, which continued in an anti-clockwise direction back around the eastern Mediterranean, via the coasts of Canaan and Cyprus (Bass 1987: 693-735; Watrous 1992: 176). The fact that 80% of imported material recovered from 14th century BC occupation levels at Mersa Matruh, is Cypriot (especially White Slip II bowls), supports the idea of a circular trading route and the use of this trading station by merchants having travelled from Cyprus via Crete to the coast of North Africa (Watrous

1992: 176).

With the growth in exchange networks, and export and manufacturing activity, the nature of trading developed to commercial levels, with a degree of activity falling into the hands of independent merchants operating within a framework of diplomatic links. However, commercial transactions of high value goods continued between the primary principalities, expressed in terms of 'gift exchange' in contemporary texts. The intensity of this process of royal exchange of 'gifts' is well illustrated in the Amarna letters. Tell el-Amarna (#188) was established in c. 1360-1330 BC as the Egyptian royal centre after the move from Thebes under Amenophis IV. Its establishment was a distinct attempt to break with Egyptian tradition (ANET I: 226). Tablets recovered from Amarna (EA 105: 14-16.85-88) record transactions of exchange between Egyptian vassals in the Levant (ie Gaza and the coastal area between Sidon and Beirut) and ruling princes in Assyria, Babylonia, Anatolia and Cyprus (Moran 1987; Conder 1894; Drower 1968: 475).

Cuneiform letters and tablets recovered from Amarna recount the active trade between Egypt and Cyprus[18] (EA 35-40) and between the Levant and the Aegean, via Cyprus (EA 114.49-53; Wachsmann 1989). Goods exported from Cyprus to

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[18] The King of (Alashiya) Cyprus referred to Amenophis IV as his brother implying that the two powers were on equal and friendly terms.

Egypt include wine and raw materials, particularly wood (EA 36.16, 35.28, 40.6-15, 36.12-13); oils, tin, copper, organics; and manufactured products such as boats (EA 36 1.13); as well as an abundance of pottery, both Cypriot Base Ring II and White Slip II and large quantities of Mycenaean pottery (Stubbings 1951: 91,fig.34; Merrillees 1973: 180; Wachsmann 1987,1989; Hankey 1973; Holmes 1975: 90-2; Alexiou 1987). Cypriot imports have been found at a number of Delta sites including Memphis (#187) and Tell el-Dab'a (#183), and although Egypt is known to have extracted tolls from foreign ships entering the Delta (EA 39.14-20; Castle 1992: 245; Wachsmann 1987), trade between these two powers was both commercial and tributary in nature (Georgiou 1979: 96)[19]. In return Egypt exported gold, ivory, glass and faience, together with chariots, horses, furniture, jewellery and cloth (EA 34.20,28) to both Cyprus; particularly via harbours along the south coast such as Enkomi (#224), Kition (#229) and Hala Sultan Tekke (#230); and the Levant (Holmes 1975: 94-6; Halstead 1988; Georgiou 1979: 98; Åström 1964; Clerc et al. 1976; Peltenburg 1986). The Amarna and Ugarit texts refer to a sizeable Cypriot mercantile fleet (EA 40.15,35; Linder 1981: 40; Georgiou 1979) by which some of these cargoes were no doubt transported.

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[19] Yannai (1983: 93) believes that the Amarna transactions primarily reflect 'gift exchange' rather than trade or tribute. Liverani (1978: 66-70) also discusses the irrational aspect of Late Bronze Age trade.

Egypt is known to have used Syrian boats obtained through tribute, in order to conduct its maritime activities (Sasson 1966: 130,nt.21). Canaanite mariners took advantage of their position in the Egyptian fleet to harass and plunder other cities that were still loyal to Egypt. Amarna text EA 101.11-18 refers to boats from Arwad being used by Canaanite sailors in the Egyptian fleet, to plunder Byblos. Thus, a proportion of the imported goods recovered in Egypt no doubt also represents a lively independent trade on the side. Merrillees (1973: 178) believes that 'private enterprise trading must have been inherent in the economic structure of ancient Egypt', although the bulk of commercial activity was still in the hands of the pharaohs and the temple.

1300-1100 BC

By the beginning of the 13th century BC, Egypt was losing her hold over north and central Syria, an area which she had maintained control over throughout most of the second millennium. Tensions between the two great powers, Egypt and the Hittites, who had jointly dominated the eastern Mediterranean for the last three to four hundred years, continued to grow, until the Hittites began to pursue aggressive campaigns in Syria thereby threatening Egyptian interests. The ultimate conflict finally came about c. 1286 BC at the Battle of Kadesh on the Orontes River (Sandars 1987: 29-33). After an Egyptian retreat, a peace treaty was at last agreed around 1269 BC and the

Hittites, Egyptians, and Ugaritians renewed diplomatic relations, which were to remain for the next ninety years (Gurney 1975: 28; Sandars 1987: 32-38).

Despite this alliance, the balance of power was not stable either between the core centres of power or within the domestic sphere of the empires. The Hittite Empire was experiencing increasing internal tension, notably from the northern tribes, and widespread famine (Gurney 1975: 33-34; Sandars 1987: 32-38). Internal struggles also developed in Egypt, with attacks on the western borders by Libyan tribes during the reign of Merneptah, c. 1220 BC (Rowe 1954: 489). The threat of Assyrian power in the east continued to disrupt diplomatic relations between Egypt and the Hittites, and Hittite ships continued to be attacked in the sea channel between northern Cyprus and southern Anatolia (KBo XII 38; Åström 1969: 80).

Cyprus, however, appears to have maintained a crucial and seemingly independent role in eastern Mediterranean trade, still important as a large supplier of copper. The increase in the amount of imported Mycenaean and locally produced Mycenaean style pottery found in 13th century BC Cyprus indicates the growing involvement of Mycenaeans with Cyprus (Catling 1973b); indeed some scholars believe that a number of sites in Cyprus were actually settled by Mycenaeans or Achaean migrants around 1200 BC (Maier & Karageorghis 1984; Catling 1973b; Cadogan 1993). However,

whether this be the case or not, there appears to have been a stronger economic link with the Aegean during the latter part of the second millennium BC, demonstrated by the arrival of increasing amounts of Mycenaean pottery, particularly Late Helladic IIIB pottery, followed by the local production of 'Rude Style' and 'Mycenaean IIIC:1' pottery in the 13th century and later in the 12th century BC (Cadogan 1973: 169); and (some would argue) the introduction of some Mycenaean architectural elements at a number of sites including Enkomi (#224), Maa Palaeokastro (#248) and Pyla Kokkinokremos (#228); as well as Aegean influences seen in metal working, ivory carving and seal cutting (Nicolaou 1973: 52; Karageorghis 1990). All these sites afforded useful anchorages where traders could exchange goods.

Cypriot copper became the primary product of Late Bronze Age trade (RS 33.16, 35.10; Holmes 1975: 90). Copper was transported as copper ingots, over 450 (c.10 tons) examples of which have been recovered from the late 14th century BC shipwreck of Uluburun (Pulak 1994; Gale 1991). However, copper is rarely so evident in the archaeological record, as it is recyclable. The practice of recycling scrap bronze utensils is implied by the quantities of broken bronze tools recovered from the 13th century BC Cape Gelidonya shipwreck, which were found along with copper,

bronze and tin ingots[20], as well as a balance-pan and weights, in a variety of shapes and sizes comprising a number of different standard weight systems used around the shores of the eastern Mediterranean. The ship appears to have been carrying all the elements necessary for bronze-making, presumably melting down the metal at coastal sites en route, and thus being able to trade anywhere in the eastern Mediterranean (Bass 1967). It is possible that sailors were involved in this recycling trade in their own right, as distinct from the main cargo of the ship. This is described by Artzy (1994: 126-7) as 'sailor's trade'. A similar assemblage of scrap metal and bronze tools for the production of metals has been discovered in a Late Bronze IIB context at the site of Tel Nami (#144) on the coast of the southern Levant (Artzy 1994: 126-7), and scrap metal hoards have also been found at sites in Cyprus, such as Pyla Kokkinokremos (#228; Karageorghis & Demas 1984: 55ft.). An ingot mould recovered from Ras Ibn Hani (#91) was presumably used in the recycling and production of copper ingots (Lagarce et al. 1983).

In addition, evidence from the late 14th century Uluburun shipwreck (Pulak 1994), the 13th century Cape Gelidonya shipwreck (Bass 1967), and the more recent

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[20] Tin ingots have also been recovered off the coast of the southern Levant in the vicinity of Hahotrim and Kfar Semir, some of which display Cypro-Minoan marks. They no doubt represent a lost cargo of a vessel sailing along the coast of the southern Levant possibly from Cyprus.

discovery of a 13th century BC Cypro-Mycenaean shipwreck off point Iria in the Argolic Gulf, whose finds include Late Helladic IIIB stirrup jars and Late Cypriot IIC/IIIA pithoi (Vichos & Lolos 1994; ENALIA 1995: 9-15), display a wealth of Cypriot copper ingots and Cypriot pottery, and help to redress the apparent imbalance in exported Cypriot goods, plus serve to demonstrate the importance of Cypriot pottery in trade beyond Cyprus (already demonstrated somewhat earlier at Kommos). The discovery of these wrecks also helps to confirm the diverse types of cargoes exchanged in the Late Bronze Age, as well as indicating the routes along which maritime activity was conducted.

A great deal of Mycenaean pottery has been found along the Levantine coast (Stubbings 1951; Hankey 1967: 113-143,fig.1; Peltenburg 1986; Gilmour 1991: 51-55; Mazar 1988: 4; Cadogan 1973; Leonard 1994). Late Helladic IIIA2-IIIB, predominantly Pictorial Style, pottery has been recovered from over forty sites, from as far north as Alalakh to Tell el-'Ajjul in the south (Hankey 1967: 109,fig.1, 1993: 112), with the largest deposits of Late Helladic IIIB pottery recovered from Tell Abu Hawam (#137) and Ugarit (#89; Hankey 1967: 123-5, 1973: 135,fig.2, 1993: 102-107,fig.1). Ugarit (#89), Tel Akko (#134) and Tell Abu Hawam (#137), and to a lesser extent, Tel Nami (#144) and Tell el-'Ajjul (#169), are believed to have been ports of entry inland of Mycenaean goods (Stubbings 1951: 105; Artzy 1994: 130-1). Much of this pottery is found in conjunction

with quantities of Cypriot pottery, such as Base Ring II/ White Slip II bowls (Merrillees 1973: 182; Hooker 1976; Gittlen 1975: 117; Holmes 1975: 98; Gilmour 1991: 55-69; Peltenburg 1986)[21], implying the intermediary role of Cyprus within the transfer of Mycenaean pottery to the Levant (Cadogan 1973: 169-170; Hankey 1967: 145-7; Gilmour 1991: 34-46). However, by the post Amarna period in Egypt, there is a significant decline in Cypriot and Mycenaean pottery (Cadogan 1973; Merrillees 1968), with a total absence recorded after the Late Helladic IIIB period (Hankey 1993: 112). Locally and/ or Cypriot produced Mycenaean style pottery ('Mycenaean IIIC:1' as it is known in the Levant and Cyprus) has also been discovered on the Cilician coast of Turkey post 1200 BC, especially at Tarsus (#69) and Kazanli (#68; Mee 1978; Seton Williams 1954; Sherratt & Crouwell 1987).

Despite attempts by the main powers to maintain order, and control their monopolies of exchange, the 13th and 12th centuries were a time of growing unrest and disorder, highlighted by increased employment of mercenaries by competing states. As Sandars (1987: 29) describes it:

> 'The equilibrium that had held for centuries between the two great powers, Egypt and Hittite Anatolia, was a delicate one, and when it failed the repercussions were felt far beyond the confines of the east Mediterranean. Yet disaster,

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[21] All the Mycenaean IIIA2-IIIB pottery discovered in the Levant has been found with similar quantities of Cypriot pottery, particularly White Slip II ware (Merrillees 1973: 182; Gittlen 1975: 117; Gilmour 1991: 25,34-46).

> when it came, cannot have been entirely unexpected. The late annals of the Hittite Empire give an all too plausible picture of internal disintegration, the revolt of more-or-less independent border states and the return of old enemies such as the Kashka on the north and the Assyrians on the east'.

The inability to control the exchange networks is also highlighted by the increased number of piratic acts on merchant vessels[22] which disrupted trade and political order (Georgiou 1979: 95), resulting in conflicts between the entrepreneurs and the principalities. An ever increasing number of mobile ethnic movements emerged (notably the Philistines), particularly around the Anatolian plateau and Levantine foothills. A number of these tribes are described as the Sea Peoples, as they seemed to have presented a force of attack from the sea (Sandars 1987). Internal revolutions, partly caused by frustrations in regional areas which were denied access to the benefits of centralised trade, contributed to the collapse of quasi-feudal systems (Liverani 1987: 69; Mazar 1988: 3). As Knapp (1992: 126) describes the situation:

> 'Economic and political disruptions resulted in demographic displacement, which led to further turmoil and helped set in motion a process about which ancient historians and archaeologists understand very little'.

Contemporary accounts from the last years of Hattušaš and Ugarit record an imminent breakdown, and indicate that

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[22] Revere (1957) believes that prior to this period, ships were protected by a basically unwritten agreement between merchants (RS 17.346).

the continuous raids by the Sea Peoples were both a contributory factor and effect of a collapse of the major centres of power, and a shift in the emphasis of exchange, with trade becoming decentralised (Sandars 1987). The final battle scene of Medinet Habu, depicted on the north wall of the mortuary temple of Ramesses III (c. 1175 BC), shows the twin encounter on land and sea between Egypt and the Sea Peoples.

By 1200 BC 'the collapse of large scale inter-regional trading systems began in most of the heavily capitalised areas' (Sherratt & Sherratt 1991), with the effects extending to all the dependents of the centres of power and exchange network. At this time the major 'emporia' of trade were destroyed, including Ugarit. The Hittite empire collapsed (Hooker 1976: 160) and its capital at Boğazköy was burnt. Egypt became economically impoverished, although it did manage to retain much of its political coherence. Mycenaean palatial centres successively collapsed, and the Levant experienced a period of recession prior to the growth of the Philistine city states. There was a basic degradation of Bronze Age society throughout the eastern Mediterranean, with the exception of Cyprus. Cyprus continued to remain independent and to an extent took over the trade that had previously been controlled by centres of power in the Levant and mainland Aegean.

Many theories have been suggested as to the cause of

this sudden collapse of centralised social organisation (Liverani 1987; Mazar 1988: 1-3; Hooker 1976: 160-2; Astour 1965b: 255; Georgiou 1979: 95), but no comprehensive explanation has yet been offered. Despite the political collapse, the economic effects were not entirely adverse. Political constraints of the large Bronze Age central powers of control were removed, and small scale, primarily independent, merchants were free to trade as and when they wished. The empires of the Late Bronze Age had represented a concentration of power, which after 1200 BC, was replaced by small independent centres, working within more localised trade networks.

This brief summary of the changing contexts of maritime trading activity in the second millennium provides a framework within which to approach more practical questions: the nature and capacity of the vessels, the constraints on their voyaging, and the various requirements for anchorage facilities and harbours.

Chapter II

## An introduction to ship construction and navigation techniques of the second millennium

A glance at the events of the second millennium BC in the eastern Mediterranean and a brief consideration of the nature of the Bronze Age economy, leads one to conclude that links within the eastern Mediterranean were 'opened up' by sea contacts. The economy of the second millennium developed through the expansion of maritime trade. However, political diplomacy, and the desires of the consuming elite, were not the only factors to have stimulated the growth of Bronze Age trade. Another important factor which had an influence on the development of maritime trade was the level of ship construction technology and navigational skills of the sailors; that is, the nature of Bronze Age voyaging.

## II.1 Ship form and construction of the second millennium

The evidence for second millennium ship types is derived from a number of sources but is unfortunately somewhat limited in detail:

### ICONOGRAPHIC

Representations on cylinder seals, pottery, frescoes and tomb reliefs provide the archaeologist with the largest single type of evidence for ship construction and shape. Conversely, our understanding of nautical technology can be hampered by technologically inadequate iconographic representation. The boat forms depicted are largely a product of the skill of the artists and the size and nature of the medium on which they were working - If the craftsman was not necessarily familiar with, or perhaps not interested in, his subject, then he may have been liable to misrepresent the form and detail of the craft. Often only partial views of vessels are depicted: most commonly boats are seen only from the water-line upwards. Detail of rigging is poor, and depictions of vessels with paddles or a number of rowers are not always accurate and can be misleading when trying to calculate the size of the boat. As Coates (1987) noted, representations of ships are usually in profile, so that no cross section, an important indicator of performance assessment, of the hull is depicted and 'hulls may be represented with more curvature than their originals'.

Despite these shortcomings much insight into ship construction has been gained through iconographic sources. The Egyptian tomb paintings, particularly from the New Kingdom, have provided archaeologists with elaborate scenes of sea-going vessels in full sail returning up the Nile River (Landström 1970), and, since the 1971 discovery of the 'Ship Procession' frescoes in the West House at Akrotiri, much insight has been acquired as to the nature, detail and purpose of the boats depicted (Marinatos 1974).

DOCUMENTARY

Detail of ship construction from textual sources is almost non-existent. One of the earliest descriptions of boats, their dimensions and numbers, is recorded on the Palmero Stone, the fragmentary Royal Annals of the Fourth Dynasty Egyptian King Snofru, c. 2575-2551 BC (Pritchard 1975: 227). Indirect evidence for the construction of sea-going vessels during this early period is also provided by reference to the Byblos ships which were sent from Egypt to the coast of Lebanon (Landström 1970).

From the Late Bronze Age, the 13th century BC Ugaritic texts refer to the types of cargo and the number of ships in particular Ugaritian fleets (Linder 1970) but accounts of ship design or construction techniques, even shape, are negligible. A number of Egyptian texts, for example a papyrus record of the Eighteenth Dynasty Royal Dockyards at

Memphis (Glanville 1931), throw a degree of light on techniques employed in the manufacture of Egyptian boats, but again the evidence is limited. Linear B tablets from Pylos describe the number of rowers in a particular boat and give details of the ships rigging ie a single square sail, braces, sheets, and brails (Palaima 1991: 273-310).

From the first millennium BC, Homer describes boats with 'swift, sleek hulls'. He was possibly referring to the traditional long boats of the Aegean that were no doubt used throughout the second millennium and beyond, or to the more contemporary fighting long boats of the first millennium. However, evidence from the Homeric epics has always to be treated cautiously as we can not be sure of the precise period to which he is referring, although it is likely that he describes at least some scenes of Late Bronze Age life (Sherratt 1990; see Chapter III.1.ii).

BOAT MODELS

A number of boat and ship models survive primarily in Egypt as model boats found in tombs whose purpose it was to transport the pharaohs to the underworld. However, none of the Egyptian models found so far represent sea-going vessels (Landström 1970: 75). The greatest number of Egyptian boat models have been found in Middle Kingdom tombs, for example models found in the Tomb of Meketre, Thebes (Landström 1970: 75,78-80). Although detailed in

their designs, the boat models are somewhat schematic and thus present problems when trying to identify realistic details of riverine/ waterborne Egyptian craft.

A number of clay and lead models depicting small craft have also been recovered from Crete (Casson 1971: fig.54) and the Cycladic islands of Melos, Amorgos and Naxos (Ashmolean Museum). These three dimensional examples shed further light on the shapes and designs of boats, but unfortunately the number of Aegean models is limited and their forms restricted to simple, long boats of the late third millennium and beginning of the second millennium BC.

## SHIPWRECKS AND FUNERARY BOATS

Although limited, the evidence from Bronze Age shipwrecks of the eastern Mediterranean and funerary boats recovered from Egyptian tombs, perhaps spreads most light on ship designs and construction techniques of Bronze Age vessels. So far only two wrecks of the Late Bronze Age have been excavated in the eastern Mediterranean, the Uluburun and Cape Gelidonya (Bass 1967; Bass 1986; Pulak 1988; see below). In Egypt, the discovery of the Royal Ship of Cheops (Lipke 1984) and Dashur funerary boats (Johnstone 1988: 70-72), provide details of the construction of riverine boats (see below). In addition, the recent discovery of twelve full-sized funerary c. 3000 BC boats from Abydos has added

to our knowledge of construction techniques (Bailey 1991). However, none of the Egyptian funerary craft offer direct evidence for the construction of sea-going vessels.

From the various sources of evidence outlined above we can begin to address the question of what forms Bronze Age vessels of the eastern Mediterranean may have taken. However, it is not the intention here to go into any great detailed chronology of the development of Bronze Age ship designs and building techniques. Many detailed studies have already been published based upon current available data[1]. The aim here is to develop a basic understanding of the shape and rigging of boats, and an awareness of the various contributing factors that the contrasting regional environments of the Mediterranean made towards the construction of Bronze Age sea-going vessels. Finally, this knowledge is to be assessed in the wider context of craft and crew capabilities and the possibilities of movement around the eastern Mediterranean.

Although the contribution of Mesopotamian riverine craft construction techniques to the knowledge of boat builders in the eastern Mediterranean should not be overlooked, the fact that the two primary images of early craft are the Egyptian Nile boats and later the inter-

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[1] The following are summaries of the development of Bronze Age ship designs: Casson (1971), Johnstone (1988), Bass (1974), Basch (1987), Landström (1970), Säve Söderbergh (1946), Steffy (1994) and Johnston (1985).

island 'long' boats of the Aegean Sea, leads one to look to these areas for the development of Mediterranean boat building techniques. The impulse to utilise waterborne transportation in both these areas came from the immediate environment, one area being orientated to the river and the other being an island archipelago.

The easiest way of moving around the Nile Delta was by boat. Advantage was taken of the currents flowing downstream to the mouth of the Nile, and the prevailing north-northwesterly winds to aid the return journey upstream. It is believed that the Egyptians first used sails in the fourth millennium BC. A vase of the Late Gerzean period, c. 3500-3100 BC (Casson 1971: fig.6), and a stone censer from Qustul, Nubia, which dates to the Naqada III or the end of the Gerzean period, (Vinson 1994: 15-16,fig.8; Williams 1980: 16-19), illustrate the earliest known examples of sails[2]. In the Aegean depictions of boats are not seen before the third millennium BC when long, narrow, high ended craft are represented on 'Cycladic Frying pans', flat terracotta objects that look like mirrors (Basch 1987: 80-83). Indirect evidence for inter-island contact by boat is, however, implied from as early as the tenth millennium BC as a part of the process of exchange of Melian obsidian (Perlès 1979: 82-83). 'This in turn hints at a very confident mastery of sea travel'

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[2] Bowen (Baron Le, 1960) says 'shield sails' were used one hundred years earlier in Egypt, also depicted on vases.

(Renfrew et. al. 1965: 225).

Thus, it seems reasonable to assume that by the second millennium BC boat builders had developed more complex construction techniques for their vessels. Some of the earliest indications of shipbuilding techniques comes from the Royal Ship of Cheops and the Dashur boats, mentioned above. Work on the Royal Ship of Cheops by Lipke (1984) 'has added to our knowledge of the conservation, restoration and re-assembly of the world's oldest planked vessel, the Cheops ship of the mid-third millennium BC' (McGrail in Johnstone 1988: foreword,xv). The Cheops ship was built of planks and secured by lashings and pegs. Such techniques of construction are known to have been used in the Mediterranean prior to the construction of mortise-and-tenon joined vessels. However, 'sewn' (as the technique is commonly dubbed) vessels are seen again in the first millennium BC together with mortise-and-tenon built vessels (Kahanov 1994; Pomey 1981; Basch 1981; Steffy 1994: 39-42). Despite the lack of direct evidence for the continued use of 'sewn' construction techniques for sea-going craft of the second millennium BC, the possibility should not be ignored. However, the traditional construction technique adopted in the building of planked boats in the eastern Mediterranean throughout the Bronze Age and later Classical periods, was the 'shell-first' construction technique ie outer hull planking was erected before the frames were attached.

The Dashur boats which date from the beginning of the second millennium BC and of which four are well preserved, represent the earliest known use of the mortise-and-tenon construction technique of 'shell-built' vessels. They were built up of short lengths of acacia wood with cross beams but no ribs (Johnstone 1988: 70-72). The planks were secured by hour-glass (doubledove tailed) shaped pieces of wood. The planks were edge joined and fastened together by drawn-tongue joints, commonly known as mortise-and-tenon fastenings. In later periods, mortise-and-tenon fastenings were often locked by treenails (wooden pegs through each end of the tenon), but, in the case of the Dashur boat, the tenons were unlocked. Assyrian texts refer to the use of 'dubbin' or 'dovetailed' fastenings, which are believed to be associated with mortise-and-tenon joints, and thus imply the use of Dashur-type fastenings on riverine craft of the Tigris and Euphrates from early in the second millennium (Casson 1967: 286-288, 1971: 25-28).

The 1994 season at Uluburun has provided the most recent evidence for the use of mortise and tenon fastenings with treenails (Pulak 1994, in press). The Uluburun is a late 14th or early 13th century BC ship, that was excavated off the south coast of Turkey (Bass 1986; Pulak 1988). A central keel has been identified as part of the hull remains but no ribs (frames) have been identified. Ribbing would have helped provide internal transverse strength which, together with the longitudinal strength provided by

the keel, would have made for a strongly built sea-going vessel. Although the presence of frames is not evident on the Uluburun wreck it is feasible that some transverse strength could have been gained through the 'shell-built' technique employed in the construction of the vessel.

Longitudinal strength may also be provided by the use of a hogging truss or rope, stretched between the bow and stern of the vessel, with or without extended beams through the planking on the sides. The c. 2450 BC relief of Abusir in the pyramid of Sahure, which depicts sea-going vessels, and the c. 1500 BC Hatsheput relief at Deir-el-Bahari, Thebes, illustrate the use of a hogging truss (Fig. II.1). Interestingly, no hogging truss (or keel) is visible on the depiction of Syrian vessels from the c. 1400 BC tomb painting of Kenamun at Thebes, which is contemporary with the Uluburun wreck. However, neither the hogging truss or keel need necessarily be visible in ship representations and it is also possible that the hogging truss may have been restricted to use in Egyptian craft, as wood to construct keels was a rare commodity in Egypt; not the case in the rest of the eastern Mediterranean. These considerations imply 'that the strength needed for sailing over open seas was supplied structurally' (Casson 1971: 35). But it could also be that the hogging truss was placed lower down in the hull and was therefore not visible; as in the reconstruction of the trireme Olympias (Morrison & Coates 1986: 197). Furthermore, if Beniot (1961) is correct

in his identification of the Greek word hypozomata to mean hogging truss then this would imply its continued use in sea-going vessels way beyond the second millennium BC. The hypozomata is later referred to in Argonautica 1.367-9 from the 3rd century AD where Apollonius describes the launching of the Argo which was fitted with a hogging truss (Morrison & Coates 1986: 197). It should be remembered that the hull strength needed by a vessel is also determined by the function and required carrying capacity. Whatever the method of strengthening it certainly appears that these spoon shaped, plank built vessels were capable of tackling open seas throughout the second millennium BC.

The rounded-hull vessels depicted on Minoan cylinder seals (Basch 1987: 93-106), predominantly from Knossos, early second millennium BC Crete, also imply a degree of seaworthiness and substantial hull capacity. These contrast to the earlier long, narrow, high ended craft powered by multiple oars which are thought to have been used for inter-island communications, transporting low stowage factor cargoes such as Melian obsidian and millstones (Renfrew 1972; Runnels 1985). Renfrew (1972: 358) expressed enthusiasm about the capabilities of the original sea-going long boats, remarking that they 'very significantly enlarged the environment of the Aegean seafarer' to the extent that he envisages long boats undertaking voyages to the Levant or Egypt. However, the possibility of long boats regularly undertaking voyages to the Nile Delta seems

unlikely particularly in light of Broodbank's (1989) analysis of third millennium BC island populations of the Cyclades and the limited long boat activity that was taking place; and the huge distances that would have to be undertaken in such small craft. Open-sea voyages are therefore unlikely to have been undertaken on a regular basis until the emergence of larger hulled vessels, such as those depicted on Minoan cylinder seal impressions or represented by the clay and bronze large hulled merchant boat models from Cyprus (Stieglitz 1972-1975). However, the fact that Crete is an island on the outermost fringe of the Aegean Sea makes it more probable that indigenous vessels were quite soon designed to handle rough seas.

The crescent shaped design of Minoan craft depicted on cylinder seals gives the impression that the vessels were reasonably seaworthy. However, it should be noted, as Coates (1987) commented, that these vessels are only depicted in profile and not in cross section and may therefore represent a distortion of the realistic ship shape. It is also assumed that the craft were constructed with the use of 'shell' built construction techniques. Based on this assumption and an analysis of the hull shapes, Säve-Söderbergh (1946) believes the Minoan vessel form was adapted from the Egyptian 'riverine' prototype. This similarity of form between the Egyptian and Aegean vessels is particularly noticeable in the case of the crescent shaped ships represented in the Thera Miniature

Ship Procession fresco (found in the West House, Room 5, North wall) (Morgan 1988: 121-143). The fresco depicts ships under sail, and others being rowed or paddled. Some display sails lowered on to their booms, a feature also seen on the sailing vessels depicted in the c. 2450 BC Abusir relief in the pyramid of Sahure. Other comparable Egyptian features include steering oars, and curving prow and stern. However, the Abusir reliefs depict vessels which are one thousand years earlier than the Thera boats; this is a large time gap over which to make comparisons. However, this gap could possibly be reduced as recent debate has arisen in relation to the details of the ships depicted in the Thera fresco and the period of maritime activity that they portray (Casson 1975). It is possible that the vessels represented on the Thera frescoes portray a period earlier than the mid-second millennium BC context in which they were discovered, as they bear strong comparisons to ship representation on vases from Aegina, c. 1700-1600 BC (Casson 1975; Gillmer 1985; Basch 1986).

Both the Thera frescos, and the Cycladic cylinder seal impressions depict oared craft. However, it seems unlikely that the deeper hulled cargo vessels of the later Bronze Age would have been equipped with permanently fixed facilities for the use of multiple oars. Oared cargo vessels would have required additional crew and equipment space at the expense of the cargo. It is more probable, as Georgiou (1991: 62) suggested, that while cargo ships may

have included oars they were neither numerous nor permanently installed. The oars would have been placed at the bow and stern of the vessel and the cargo amidships. The use of oars on cargo vessels may have been restricted to entering and leaving harbours, to movement within the harbour confines, and over short distances when sailing to windward or when attempting to round a headland.

Thus the evidence for ship form, particularly from the Egyptian New Kingdom reliefs and from the Late Bronze Age shipwrecks, strongly suggests the existence of boats capable of undertaking open-sea voyages during the second millennium BC. More appropriately constructed vessels emerged over the period, capable of transporting low density, high bulk cargoes. Many of the Egyptian tomb paintings, such as the c. 1400 BC tomb painting of Kenamun (Säve-Söderbergh 1946), display scenes of Levantine ships arriving at Egyptian ports. The Syrian vessels, although very similar in form to the well rounded, spoon-shaped hulls and prominent overhangs fore and aft of the Egyptian vessels, were in fact stockier and straighter hulled, and thus, more seaworthy and better adapted for maritime transportation, than the contemporary Egyptian craft.

The evidence of the ship forms strongly suggests that from the beginning of the second millennium BC mariners were able to undertake coastal voyages. Fevrier's (1950) description of a Middle Bronze Age model of a merchant ship

that was uncovered by Dunand at Byblos in the northern Levant, as 'C'etait un petit mais robuste bateau de mer', alludes to this probability. In addition documentary evidence informs us that as early as the third millennium BC Egyptians were journeying to the Lebanon to bring back cedars for boat construction. The 'Bringing of 40 ships filled (with) cedar logs' is listed among the accomplishments of Pharaoh Snofru c. 2600 BC (Breasted 1907: 146,147). These vessels were referred to as the 'Byblos Ships' a term which by 1500 BC was used as a general reference to sea-going vessels (Säve-Söderbergh 1946) - yet further indication that Bronze Age seamen were able to undertake open-sea voyages during the second millennium BC (see below). By the 14th century BC we can assume through evidence derived from the Ugaritic texts and descriptions of Egyptian campaigns over-seas, that vessels were constructed in a manner capable of undertaking open-sea voyages of considerable lengths.

Thus, the vessels performance improved over the course of the second millennium due to changes in boat design. The internal strength of the hull was increased and the introduction of deeper hulled vessels enhanced carrying capacity. Additionally, improvements in ship performance came about as a result of changes to the ships rigging, the movement of the mast to the amidships position, and the removal of the boom from the foot of the sail. The next section considers these adaptations.

## II.2 Ship and sailing capabilities of second millennium seafarers

Having established the form of second millennium BC vessels used in the eastern Mediterranean and gained an insight into the voyages that were undertaken, we need to assess boat capabilities and those of the sailors to navigate the shores of the eastern Mediterranean. How did Bronze Age man increase the performance of his vessel, and what evidence do we have to support these changes ?

The ability of ancient sailors to use the wind and propel boats by sail, is believed to have been developed long before the second millennium BC. In the earliest known Egyptian images of vessels, c.3500-3100 BC (discussed above), we see riverine boats with many oars and a single mast and small, square sail positioned relatively close to the bow of the boat. No details of rigging are visible (Casson 1971: fig.6). The predominant image of the sail in the early third millennium BC is of a tall, narrow (high aspect ratio (see below), braced sail set forward of amidships. From the late third millennium BC the subsequent evolution of efficient sailing vessels can be traced through the Egyptian iconographic record. Although not all the innovations originate in the Nile Valley they spread so rapidly throughout the eastern Mediterranean that their date of occurrence in Egypt is an approximation to their first development elsewhere.

Thus the sail was developed on the Nile in riverine conditions, taking advantage of the northerly-flowing river current downstream and onshore wind to manoeuvre upstream (see above; Ch.IV.3). The sailing conditions were reasonably predictable, with little chance of the vessels being swept off course by changeable winds, as was the case in the Mediterranean Sea. However, sailing conditions in a marine context were quite different from riverine conditions and had a deep and far-ranging effect on the development of boats and seafaring. It is important therefore to establish the parameters affecting seafaring in the eastern Mediterranean based on the assumption that maritime conditions of the second millennium BC were comparable in direction and strength to those that prevail and are experienced by mariners today (Hydrographic Office). This will be discussed in more detail in Ch.IV.3, but a brief outline is included here:

The predominant sailing season in the eastern Mediterranean would have been from late spring to early autumn, with caution practised during the height of the summer, ie July/ August when the winds were strongest. The sailors took advantage of the strong, regular NW Etesian or meltemi winds, the clear skies which provided good visibility of land, and the regular, more predictable, maritime conditions. The prevailing north-westerly winds blow down from the Aegean and cross the eastern Mediterranean, along the south coast of Turkey. They

decrease in force beyond the Gulf of Finike and on reaching the Gulf of İskenderun they back south-westerly. The meltemi winds also pass north and south along the coast of Cyprus and across to the Levantine coast, and on down to the Egyptian Delta. Wind patterns in the south-eastern corner of the Mediterranean are also affected by the seasonal Persian Low that brings changeable winds throughout the course of the day.

The sailing season and wind direction combine to give a recognisable pattern to ancient seaborne activity. Nautical activities were mainly restricted to the summer months, and ships travelling due south could generally expect a rapid voyage thanks to the prevailing north-westerly winds. However, the return journey would not be as simple. It is important to have an understanding of the prevailing maritime conditions in the eastern Mediterranean when considering the capabilities of early mariners.

## II.2.i Sailing Capabilities

The main aim of ancient sailors was to improve the efficiency of their vessels under sail by attaining increased sail control, particularly in order to sail closer to the wind, and producing maximum efficiency in the steering. This was achieved over the period of the second millennium BC through the introduction of a number of improvements:

1. Position of mast

Flemming (1972: 35) observes that 'it took the Egyptians nearly 2000 years to discover that the best place for the mast and sail was in the middle of a ship'. The late fourth millennium BC Gerzean vase, mentioned previously, depicts the mast set relatively close to the bows on a riverine vessel. The c. 2450 BC Abusir relief (Casson 1971: fig.17) portrays ships with masts situated one third of the ships' length aft of the bow. Over the ensuing millennium the position of the mast gradually shifted to amidships. By the mid-second millennium BC the mast was commonly placed amidships, as illustrated in the c. 1500 BC depiction of Queen Hatshepsut's ships at Deir-el-Bahari (Casson 1971: fig.18; Fig. II.1).

It is relatively easy to sail a square-rigged vessel in calm conditions with a following wind (Fig. II.3.i); however, the rig must be able to adapt to changing weather conditions. Conditions on the Nile, in calm seas or coastal

areas would to a large extent be within the capabilities of a square sail, stepped well forward, as the conditions would remain relatively consistent. However, sailing down wind in the Aegean where conditions are more changeable, or across open seas, could be fatal to a ship rigged in this manner. If the wind blew from any direction other than astern, mariners could easily lose the ability to steer their vessel and the ship may turn uncontrollably down wind (Fig. II.3.ii), possibly in danger of broaching or swamping[3]. This problem was reduced by stepping the mast closer to amidships - 'With a single square sail on a mast near amidships the Centre of Effort (CE) and Centre of Lateral Resistance (CLR) will be only slightly separated longitudinally and thus there will only be a small couple tending to turn the boat into or out of the wind' (McGrail 1987: 217,220)[4].

As a consequence of moving the mast amidships, steering problems were reduced on a beam wind, broaching or swamping were less likely to occur, and thus vessels became more effective under sail (Fig. II.3.iii). These

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[3] Broaching is when the ship turns uncontrollably to lie across the wind; and swamping is when it is overwhelmed by water and begins to sink.

[4] CLR is at the centre of mass of a plane figure the outline of which corresponds to the underwater profile of a boat ie the point at which lateral pressure would have to be applied to move the plane figure sideways with no tendency for it to pivot (Hiscock 1950: 150). CE is at the centre of mass of the whole sail plan regarded as a plane figure (Hiscock 1950: 150).

improvements would at least have allowed the vessel to sail with the wind in the sector 35 degrees either side of the boat (Flemming 1972: 31; Fig. II.2), rather than being restricted to sailing only with the wind from the stern sector, and by the latter half of the second millennium, the positioning of the mast amidships probably allowed ships to be sailed with the wind on the beam ie at right angles to the boat or 8 points (90 degrees) into the apparent wind. An improved ability to steer the vessel was also achieved as it shifted the Centre of Effort of wind or sail directly above the Centre of Lateral Resistance of the hull (Fig. II.4), thus, minimising steering problems.

2. Shape and aspect ratio of sail

By the mid-second millennium wider and lower square (low aspect ratio) sails were introduced. The low aspect ratio sails, illustrated on the Hatsheput relief (Casson 1971: fig.18; Fig. II.1), greatly reduced the heel or listing effect of the vessel, so increasing its stability. As illustrated in Fig. II.5, the low aspect ratio sail has the same area as the earlier high aspect ratio sail and therefore approximately the same driving force. However, the couple which induces the heel effect is less as the vertical distance between the Centre of Effort and Centre of Lateral Resistance is reduced.

3. Rigging (support)

Improvements to the ship's rigging led to a more efficient and versatile control over the sail, particularly sail shape, thus increasing the efficiency of the vessel and making it possible to sail closer to windward. Along with the sail,

> 'The rigging of a ship is the most crucial aspect of the design [as it controls the sail]. Because it is not a permanent construction [presumably referring to running-rigging and not standing-rigging[5]] as is the hull, it can be fine-tuned and altered by pressure [by pulling on ropes] according to need, individual judgement, wind and weather conditions, and angles of sail' (Georgiou 1991: 63).

Bronze Age mariners wished to achieve optimal sailing, with the sail as close as possible to the wind. Significant aspects of a ship's rigging and the improvements that were made to the rigging design over the second millennium to try and achieve optimal sailing, are outlined below.

i. Braces, lifts and bowlines. Braces are rigging that turns the yard, the spar along the head of the sail (Casson 1971: 387), to the optimum angle relative to the wind. Braces have been identified on sailing craft from as early as c. 2400 BC seen depicted on a relief from the tomb of Kaem'onkh at Giza (Casson 1971: fig.19). Braces run from the deck to the yardarms (ie the end of the yard). One of the vessels that appears

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[5] Running-rigging refers to the rigging by which means sails are hoisted, trimmed, and controlled, as opposed to standing-rigging, which is a fixture. Standing-rigging supports the mast and is not handled in the sailing of the vessel (Hiscock 1950: 463-5).

under sail on the Thera fresco portrays the use of braces with the yard braced well round (Morgan 1988: fig.70; Fig. II.6, Fig. II.7/c). Basch (1987: 95-105) also discusses a number of Aegean cylinder seal impressions which depict vessels with braced sails. Braces were crucial to achieving sail control. An improved performance was achieved c. 1500 BC when braces were used in conjunction with yard lifts and the bowline (Gillmer 1985; Fig. II.7/a). Lifts can be defined as 'a pair of lines running from the masthead to the yardarms to keep the yard level or cocked as need be' (Casson 1971: 230). Standing lifts take the weight of the yard, while running lifts can be used to alter the angle of the yard and therefore cock it when necessary. The bowline, or tacking spar, was a particularly important piece of ships rigging as it allowed the sail to be flattened forward, and held the leading edge of the sail, known as the luff, taut and into the wind, when the wind was further forward than astern (Fig. II.8). As a result, the shape of the sail relative to the wind was improved, by creating an aerofoil shape, which would maximise the Bernoulli effect and produce the optimum driving force. Sheets (running-rigging that help trim the sail) in the lower corner of the sail also helped to achieve this aerofoil shape (Fig. II.7/d).

Thus, braces controlled the yard and hence the

top or head of the sail; sheets controlled the foot of the sail; and the bowline held the leading edge taut into the wind; and the combination of all these three enabled seamen to trim the sail to the optimum shape.

Gillmer (1985) believes that braces used in conjunction with yard lifts, as seen in the Aegean (Thera frescos (Morgan 1988: fig.70; Fig. II.6 & 7) and in a number of reliefs in Egypt throughout the second millennium, for example the relief in the tomb of Kenamun at Thebes, c. 1400 BC (Davies & Faulkner 1947: Pl.VIII; Casson 1971: fig.57; Fig. II.9), would have provided sufficient control over the sail to enable sailing a few degrees to windward.

ii. Halyards were running rigging used to raise and lower the yard, so allowing the effective area of the sail to be adjusted to match the wind velocity (Fig. II.10/b). Halyards are depicted on vessels, such as Hatshepsut ships (Fig. II.1), from the mid-second millennium onwards.

iii. The brail permitted even greater control over the sail, and is defined by Casson (1971: 70) as

> 'the ancient's distinctive device for shortening or furling the sail. These were a series of lines made fast at fixed intervals along the foot, whence they travelled up the front surface of the sail guided by fairleads, over the yard, and then down to the deck aft'.

Vinson (1993) presents a number of Eighteenth Dynasty Egyptian riverine boats with brailed sails. He also discusses several depictions of sea-going vessels with furled sails from this period, although none of these show any details of brails. Possibly the earliest depiction of a brailed sail on a sea-going vessel is on a vessel depicted in a c. 1350 BC relief of an Eighteenth Dynasty official's tomb at Memphis (Millet 1987: 89). The c. 1190 BC Medinet Habu relief (Casson 1971: fig.61; Fig. II.11) also depicts a number of sea-going vessels with brailed sails.

Brails allowed even greater control over the sail and sail shape. Brails have two roles: they vary the effective area of the sail (the sail is rolled up from the foot), and they can also be asymmetrically adjusted to produce the optimum aerofoil shape. In this way, and by adjusting the yard into a position nearer the longitudinal axis of the vessel, the sailor could make his square sail into a fore-and-aft sail, thus allowing the ship to sail closer to the wind. Brails provide immediate and complete control of the sail from the deck and permit the shortening of the elected area of the sail (Roberts 1991: 55, pl.XVII; Fig. II.12).

4. Loose-footed sails

Throughout most of the second millennium, sails were supported by an upper yard and lower boom. Although booms had some advantages, such as that they enabled the sail to be set well without undue bellying, they tended to restrict Bronze Age mariners from adjusting and trimming the sail to an optimum position if the wind were from anywhere in the NOGO area ie the area in which a vessel is unable to make headway due to opposing winds (Fig. II.13). In the c. 1400 BC Kenamun relief, Syrian vessels docking in an Egyptian harbour are depicted with their boom being raised to the yard. Theran vessels display the opposite, more cumbersome, procedure, that of lowering the upper yard to the boom (Fig. II.6).

Towards the end of the Late Bronze Age the boom was removed and loose-footed sails were introduced. Loose-footed sails allowed greater control of the sail shape, as they were more easily trimmed to the aerofoil shape. This was a definite advantage to sail control as the wind is never consistent in speed or direction and more or less continuous trimming of the sail and/ or rudder is thus required in order to maintain the optimum angle to the wind and optimum shape of sail.

Until recently the first substantial evidence of loose-footed sails was the Medinet Habu relief of c. 1190 BC, where both Egyptian and Syrian war galleys are depicted

with loose-footed sails. However, Millet (1987: 89-91,fig.1; Fig. II.11) has since identified loose-footed sails depicted on a relief of c. 1350 BC from an Eighteenth Dynasty official's tomb at Memphis. The relief depicts merchantmen, assumed to be sea-going vessels because one of the ships has a crow's nest for which there would have been little need on an Egyptian riverine craft. Casson (1971: 35,fig.58) also describes a relief of a Syrian vessel c. 1400 BC with a possibly loose-footed sail. However, he states that the 'painting is in too poor condition to tell if there was a boom along the foot'. Artzy (1993 personal correspondence) has recently identified loose-footed sails furled onto yards depicted on rock faces in the gap of the Me'arot River on the Carmel Range, dated to the 13th century BC. However, these representations are also in a poor condition and details are unclear.

Several advantages of a loose-footed sail were that, on fighting vessels, where the boom previously impeded the movements of fighting sailors, this inconvenience was removed, and on a merchant vessel a smaller crew would have been required to hoist the rig. However, despite the increased efficiency of loose-footed sails, new problems were encountered. With no boom, when the sail was brailed, the yard bent on an unsupported mast, thus increasing the curvature of the yard. Roberts (1991: 58) concludes that this problem was never overcome in the Aegean Bronze Age.

5. Hull design

During the latter half of the second millennium BC, the handling of craft was made easier by designing the vessels' hulls with similarly shaped ends, as is demonstrated in the Thera vessels. This would result in an even distribution of buoyancy, allowing the ship to float with the water-line parallel to the keel and to the top edge of the sides (McGrail 1994, personal communication).

6. Stern projection

The directional stability of the ship was also improved by the addition of the stern projection. Georgiou (1991: 66) states that the stern projection 'lengthens the waterline without increasing hull size and may act as a stabilizer ... useful in the handling of a ship in motion.' The introduction of the stern projection also increased the potential speed of the vessel, as maximum speed is proportional to the length of the vessel in the water (Kahanov 1995 personal communication).

7. Side rudders

From early in the second millennium the performance to windward was also improved by the use of deeply immersed side rudders which not only could be used to steer the ship and maintain the direction of the vessel but also functioned as leeboards, thus opposing and therefore

reducing leeway by causing an increase in Lateral Resistance, and resulting in a balance between the hull and sail (Casson 1971: fig.10). Side rudders are seen depicted on the relief of Queen Hatshepsut's ship, c. 1500 BC (Fig. II.1). The introduction of side rudders was a substantial improvement over the previous use of steering oars but adversely reduced the speed of the vessel (Kahanov 1995, personal communication).

What manoeuvrability does this imply that vessels under sail were capable of achieving during the second millennium period ? By the mid-second millennium BC, braces, coupled with the introduction of lifts, bowlines and halyards, provided enough sail control to undertake open-sea voyages (Gillmer 1985). Improvements to a vessel's performance under sail were achieved by placing the mast amidships and by the introduction of the stern projection which reduced steering problems and increased potential hull speed. Additionally, the introduction of deep wide rudder blades helped to reduce leeway. However, problems were still encountered depending on the direction and strength of the wind.

The direction from which the wind blew was a crucial factor in determining the course, and therefore the route, of the vessel. Roberts (1991: 56) believes that performance was good with a following wind, 'The rig (with square sail)

is excellent for presenting a broad area of sail to a following wind'. However, Georgiou (1991: 63) questions the stability of a vessel in a following wind and raises the possibility of swamping and pooping[6] or plunging, as the Centre of Lateral Resistance would be situated too far forward, particularly in strong winds. Thus, it would seem that maximum performance was achieved with the wind slightly on the quarter or reaching with the wind abeam, rather than dead astern. By the 15th century BC it does appear to have been possible to sail with the wind anywhere in the sector from the beam through the stern to the opposite beam (Fig. II.13).

By the latter half of the 14th century BC, with the introduction of brails and loose-footed sails, it would have been possible for vessels to sail 1 or 2 points to windward, excluding leeway[7] (Fig. II.14.i). However, as Georgiou (1991: 68) points out, 'the rig with a single yard arm [ie no boom] and with a loose-footed sail adjusted by brails is a major breakthrough in sailing which would not have occurred without prior experimentation'. This statement emphasises that although it was not until the end of the Bronze Age that we have direct evidence for the

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6 Pooping or Plunging is the effect produced on the boat when the wind blows from astern and the force is greater than the speed of the boat, causing water to surge over the stern, or if strong enough, causing the bow to go under.

7 Leeway is the amount of sideways movement or drift down wind and can be measured by the angle between the course steered and the course made good.

improved performance of ships under sail, throughout this period techniques were being developed and sailing abilities were being expanded and perfected. Presumably, the innovations in rigging meant that some time before 1350 BC there were some ships that could adjust their sail to an optimum angle to the wind and to an optimum shape (ie close to achieving aerofoil shape). Thus, the evidence for technological innovations, material evidence of trade and contacts (particularly in the Late Bronze Age eastern Mediterranean), and our understanding of navigational abilities in open seas (to be discussed in the next section), allows us to postulate that it is quite feasible that towards the end of the second millennium vessels were able to sail 8 or 7 points off the wind (including leeway) ie 1 point to windward (including leeway; Fig. II.14.ii), and were certainly capable of tackling open-sea voyages in a variety of wind conditions.

II.2.ii The scope of Bronze Age voyaging

We must now examine the question of what this all means in terms of the manoeuvrability of sailing vessels in the differing waters of the eastern Mediterranean during the second millennium BC.

Manoeuvring within harbours does not appear to have been a problem. If required, the vessels could always resort to the use of oars or paddles, or a smaller vessel. The size of the haven, and possibly the degree of congestion encountered, especially in the Late Bronze Age, would have influenced the degree of control over the sail that was required to manoeuvre under sail within the harbour.

With regard to entering and leaving a harbour, the aspect of the harbour in relation to prevailing maritime conditions was crucial. If, for example, prevailing winds when entering a harbour where offshore, then mariners would have to lower the sails and use oars to row to the shore or wait outside the harbour for a fair wind. In certain circumstances, it may have been possible with a brailed sail to manoeuvre the vessel into the harbour on very long tacks, against the prevailing wind. In order to leave the harbour the sailor would do so with the wind astern. These problems will be discussed in more detail in Ch.IV.3, Part II and Ch.VI.2.

Sailing on the Nile River is known to have been practised before the second millennium BC (see above). Moving upstream, sailors employed sails to exploit the prevailing north winds and maintained the course with the use of side rudders or steering oars. The northerly-flowing Nile current was employed to bring vessels downstream, with the use of a paddle or oar to steer. Herodotus (The Histories 2.94) describes the similar use of 'a stone with a hole through it weighing some four hundredweight' (250kg), that was attached to the stern of a vessel travelling downstream on the Nile. The stone dragged on the river bed and slowed down the boat to a speed less than the current and thus gave steerage-way.

Within the Cyclades, as the predominant wind was northerly, voyages in a southerly direction could readily have been undertaken with the wind astern. Advantage could also be taken of land and sea (diurnal) breezes, particularly along the Turkish coast and for inter-island movement. However, when windward conditions prevailed sailors would simply have to wait until conditions were favourable for movement in the desired direction. Watrous (1992: 178) recounts how elderly Cycladic fisherman recall rowing between Naxos and Thera or Crete and back this century, in order to reach good fishing grounds. Although rowing will propel a boat into the wind, this tires out the rowers quickly and progress is discouraging as the boat slows down or even stops during the recovery stroke (McKee

1983: 23). In strong winds with limited numbers of rowers, the result will be the reverse!

Short journeys in sight of land would have been common from the earlier part of the millennium. It seems quite probable that most voyages were undertaken with adequate sail control, assuming the winds were not too strong or gusting. Such short-distance passages would imply the need for numerous anchorages - ones positioned at conveniently located sheltered points for access between the islands. By the end of the second millennium it seems that the outer-island Cycladic route was also used, and supported rather more substantial harbours which acted as trading centres. The smaller inter-island anchorages were used more by local traffic and fishermen.

Turning to coastal voyages, the documentary accounts of the Byblos ships (Landström 1970) provide evidence of Egyptian vessels undertaking coastal voyages in the third millennium BC. With the increased internal strength of second millennium vessels and their improved rigs (see above), it is clear that coastal voyages were certainly feasible. On coastal routes, vessels could have taken advantage of diurnal breezes (see Ch.IV.3). These breezes could be used to the sailors' advantage when their strength exceeded that of the predominant winds that often opposed the desired direction of travel. Land and sea breezes could also help provide easier access into and out of harbours

However, delays would have been encountered while the sailors waited for the diurnal effects to overcome predominant winds and thus make for a more broken passage.

Coastal piloting meant that the craft were generally in sight of land and could therefore use landmarks for purposes of navigation. However, coastal voyages never 'hugged' the coast: a safe distance offshore was maintained so as to avoid major obstacles, rocks, and headlands. Sailing around headlands would only have been possible when the wind was in the correct sector on both sides of the peninsula. Short distances of rowing, assuming conditions were favourable (ie wind not too strong in opposing direction of passage) were no doubt still resorted to when necessary for manoeuvring around peninsulas (Fig. II.15) and in and out of harbours. Bronze Age mariners knew the coastal routes and, despite the increase in knowledge of the seas and sailing experience, would have hesitated to undertake open-sea voyages without good reason. Even Odysseus (Homer Odyssey III.153-185) was cautious about taking the quicker but more treacherous open-sea route across the Aegean rather than the coastal, inter-island route that was more regularly taken and better known. Bronze Age mariners had time and were no doubt prepared to wait for favourable conditions before embarking on their onward passage.

Braudel (1972: 103) outlines how even in the 16th

century AD, Mediterranean 'shipping was active only along the coastline. Navigation in those days was a matter of following the shoreline, just as in the earliest days of water transport, moving crab-wise from rock to rock, from promontories to islands and from islands to promontories'. He continues 'great stretches of the sea were as empty as the Sahara'. Only occasionally would a sailor embark on a direct open-sea route out of sight of land, such as from Rhodes to Alexandria. However, coastal piloting also encountered dangers. Vessels voyaging too close to the shore would have to encounter obstacles such as rocks, peninsulas and associated divergent winds, such as encountered by Odysseus (Homer Odyssey IX.79-82) when he was blown off course when attempting to round the notoriously perilous Cape of Malea (Malkin & Fichman 1987: 254). Many sailors would thus recommend keeping a good distance offshore; as Yannai (1983: 96) stresses 'coastal hugging is dangerous'. Thus, Braudel may be somewhat over cautious, particularly in relation to the latter part of the second millennium BC, when he states that open-sea voyages were rarely undertaken. Coastal routes and tacking took time; the risks when the wind got up were such that numerous stops en route would have been required for shelter, rest or water when required. A considerable number of anchorages must have been required to sustain such voyages.

Karmon (1985: 2-3) identifies a distance of some 50km

as the maximum coastal voyage undertaken along the Levantine coast, assuming favourable maritime conditions, between two coastal ports (and allowing for the time it takes to leave one harbour and enter another); and some 20-30km, ie one day's sail, for smaller sailing vessels. Similar spatial distances are evident from the distribution of harbours along the coast of the southern Levant during the Middle Bronze Age (see Chapter I) and can be inferred from analysis of the distribution of harbours around the shores of the eastern Mediterranean (see Main Map).

However, by the Late Bronze Age, archaeological and documentary evidence and implications of the capabilities of sailors and their craft, would imply that most open-sea routes would certainly have been feasible. Imported material was widely dispersed throughout the eastern Mediterranean, implying widespread contacts and often direct links between regions, such as Crete and Egypt, over large expanses of open sea (see Ch.VI.2). At the same time, increased capabilities in ships rigging and hull design (see above), particularly the introduction of brails, which enabled a greater degree of sail control, was achieved, making the practicalities of open-seas voyages more feasible. Advantage would have been taken of the prevailing winds within the eastern Mediterranean basin, particularly north-westerlies for movement in an easterly direction, on open-sea routes from the Aegean to Egypt and the Levant. For the return voyage the evidence seems to imply that the

rigging capabilities allowed tacking back along the coast, with the consequential need for anchorages.

Open-sea voyages encountered less risks in terms of coastal obstacles and associated divergent winds; 'a sailor feels better in the open seas!' (Kahanov 1995 personal communication). The nature of the voyage was also a factor in deciding the route; coastal voyages being more preferable to itinerant sailors pedalling goods at harbours en route, but for those sailors undertaking direct passage between two areas, open-sea voyages were often much quicker. Thus, it would appear that open-sea voyages, although less frequently undertaken in the earlier part of the period, became more common by the Late Bronze Age.

II.2.iii Size and capacity of second millennium vessels

From an examination of varying boat designs and implications of the number of oarsmen depicted on oared craft, we are able to derive some impression of the size of second millennium vessels. Iconographic evidence also gives some impression of the size, and possibly an indication of the capacity, of these early craft, although the limitations of iconographic evidence must be taken into account (see Ch.III.2).

With regard to merchant vessels, the size and capacity is difficult to interpret through iconographic means because numerous oarsmen are not necessarily required or depicted. However, in the case of vessels depicted on Cretan cylinder seals, iconographic interpretations are useful, as the number of oars shown can help to give some idea of the crew number and thus the size of the craft. Between 10-15 oars are depicted on one side of a Cretan cylinder seal craft which implies an overall length of c. 17-25m (Casson 1971: 34,fig.40-41,47). Likewise, Johnston (1985: 7,nt.16) believes that Cycladic 'frying pan' boats, which have 12-26 oars or paddles, would have been approximately 15-30m in length[8]. In the mid second millennium BC Queen Hatshepsut's sea-going Red Sea vessel portrays fifteen rowers a side and is believed to have been

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[8] Rough rule used to estimate the length in meters of a vessel based on the number of oars depicted = 1 meter/ each oar on one side + 25% (McGrail 1995, personal communication).

as long as 30m (Casson 1971: 21-22,fig.18; Fig. II.1).

Contemporary texts also provide a certain amount of information on ship size and capacity, particularly for the Late Bronze Age when technology and ship capacity seem to have increased along with, or as a symptom of, increased demand for imported products. The Ugaritic texts make reference to merchant ships and their cargoes. One particular letter written by the Hittite king refers to a 17th century BC merchant ship from Ugarit transporting 2000 kors of grain 'in a single bottom' (RS 20.212; Nougayrol 1960: 163-71) to Ura. This is believed to be equivalent to 455 metric tons (Casson 1971: 36), 'a good size' (Casson 1971: 36) when one considers that Columbus's ship was only c. 100 tons! Stone anchors weighing up to half a ton, have been recovered from Ugarit thus supporting the idea that Ugaritian merchant vessels were large, although perhaps more in the order of 20m long and with a capacity of 200 tons (Linder 1972). A large percentage of the Late Bronze Age anchors at both Ugarit and Kition were very heavy ie over half a ton, whereas of the anchors recovered from the Middle Bronze Age temples at Byblos, only one weighed as much as 200kg, thus implying that boats of the Late Bronze Age were larger than those of the Middle Bronze Age (Frost 1995: 167-8). Another example of the carrying capacity of vessels is to be found in the third millennium BC Egyptian riverine barges which must have measured well over 65m long and 24m wide and carried huge obelisks down river from the

quarries at Aswan (Casson 1971: 17,fig.14).

However, not only are a number of the vessels discussed above not sea-going craft, but in fact, the somewhat limited archaeological evidence that we have from this period implies that most sea-going vessels were not nearly so large. The evidence from the Gelidonya wreck (Bass 1967: 44-49) implies that the vessel was small, just 10m in length, and carried a cargo of approximately 1 ton. Similarly, the Uluburun shipwreck was only 15m long.

The Ugaritic texts also provide evidence of the great merchant fleet of Ugarit and of the size of its navy. The Ugaritic 'Catalogue of Ships' refers to hundreds of ships in the fleet (UT 319, UT 2085; Sasson 1966: 131). However, a tablet found just before the fall of Ugarit, c. 1200-1100 BC, indicates that the fleet numbered, perhaps more realistically, one hundred and fifty ships (UT 2062; RS 18.148); while other texts refer to some Syrian ships carrying up to ninety men. The texts also serve to indicate the various different terms to which ships were referred and the range of boats being used. Various terms in Akkadian and Semitic are used to describe ships; br, tkt and mns - a flotilla of twenty mns belonged to Zakar-Ba'al, prince of Byblos (Sasson 1966: 132). The most commonly used term used to describe a ship was any eg any kn, a 'stable ship' or cargo vessel (UT: 2059).

## II.3 Techniques of ancient navigation

Navigation, as defined by McGrail (1991, in press), is 'the art and science of knowing where you are at sea, and how to get from A to B and back again.' From the previous section it is apparent that a certain amount can be deduced about a ship's hull, rigging, and performance, but very little is known about early navigation techniques employed in the eastern Mediterranean.

From Classical times we have evidence for the use of charts and maps known as periploi, and from the Medieval period instruments of navigation were employed (McGrail 1987: 275-6). However, prior to these periods, 'seamen used non-instrumental navigational techniques based on inherited traditions, personal experience and detailed observation of natural phenomena' (McGrail 1987: 275-6) to determine their course and fix their position. Sailors constructed a 'mental chart' in their heads, analysing the spatial relationships between the mainland and islands in order to establish a route. 'For a chart [the sailor] relied upon his visual memory and experience of the coastal sky-lines' (Taylor 1958: 3). No doubt many of the voyages that were successful were repeat voyages, the sailor having undertaken particular routes many times. This cumulative body of knowledge, especially of local waters, was inevitably passed on through an oral tradition, such as in the Arab period when knowledge of the seas was transferred

into verse.

Although no written records referring to navigation techniques or charts describing routes or maritime conditions have as yet been recovered from the eastern Mediterranean during the Bronze Age, this does not mean that they did not exist. Charts and maps could well have been etched into wood (perhaps even the planking of the ship) or constructed of organic materials, which have since perished. Comparable ethnographic evidence from Polynesia, displays a number of elemental charts made of twigs tied together know as Marshallese stick charts which show swell patterns surrounding various islands (Chicago Ethnographic Museum; Lewis 1994: 245-249).

A number of aids are believed to have been employed by ancient seamen to enhance their understanding of the ship's relative position at sea and the course to be taken. As outlined in an Egyptian story the 'Tale of the Shipwrecked Sailor' (Erman 1927: 30,32):

> 'They scanned the sky, they scanned the earth, and their hearts were more ... than those of lions. They foretold a storm or ever it came, and a tempest when as yet it was not'.

This passage mentions two of the navigational aids adopted: the knowledge of land and sky, and the forecasting of the weather. Other physical phenomenon that early navigators were likely to have used include the wind, stars, swell, tide, currents, clouds, visibility, temperature, colour of the water and birds.

No evidence has yet been found for the use of instruments of navigation in this early period other than the sounding pole and the sounding lead. The use of a sounding pole is depicted in the c. 1400 BC relief of the tomb of Kenamun (Davies & Faulkner 1947). The sounding lead is known from Middle Kingdom Egypt, c. 2000 BC, where it is shown in use on a funerary boat from the tomb of Meketre (Bass 1974: 28,fig.18; Landström 1970: fig.238). Other evidence for the use of the sounding lead in the second millennium BC includes the lead that is believed to have been recovered from the Late Bronze Age shipwreck of Uluburun (Calcagno 1993, personal communication). In the 5th century BC Herodotus (2.5.2) informs us that leads were used to determine the depth of water and the nature of the seabed when approaching the Nile delta -

> 'On approaching it by sea ... when you are still a day's sail from the land if you let down a sounding line you will bring up mud and find yourself in 11 fathoms of water' (approximately 100km from shore).

The lead was able to give an indication as to the general location of the vessel with respect to the land and a series of depths were taken over time when approaching land.

The virtual absence of evidence for instruments of navigation in the second millennium eastern Mediterranean does not however indicate a lack of navigational knowledge. The voyages that are known from the archaeological and documentary record to have been undertaken in this period,

serve to illustrate the navigational skills of the sailors. This is similarly illustrated in Pacific navigation where, despite the impressive results of native Oceanic navigation, no position fixing instruments were ever used (Lewis 1972: 2).

Prior to the invention of the magnetic compass it is assumed that most ancient navigators took their bearings from the wind. Each wind had a different signature in terms of temperature, strength and moisture content - The feel of the wind would dictate the type of weather it brought depending on the time of year. The feel of the wind would also indicate the direction from which it blew. Homer (Odyssey XII.286-290; XIV.455-460, 475-480) was aware that different winds from different quarters had recognisably different characteristics: Boreas (North wind, bringing cold weather); Notos, now known as sirocco or hamsin (South wind, a hot, dry wind that often carries wind from the Sahara); and Zephyros (West wind, a wet wind). Subsequently the Phoenicians and Greeks developed this into an eight wind system, ultimately known as a 'wind rose'. Away from the land the swell, a surface undulation of the sea which is caused by the wind and persists in the same direction as the wind for a much longer period than the wind (see Ch.IV.3), can be relied upon for bearings over a longer period (McGrail 1983: 316; Lewis 1994). However, as Wachsmann (1989: 267) notes 'winds ... must be compared often with more reliable phenomenon'. It was essential that

the navigator check all natural aids to navigation, such as the stars, wind, swell, and sun, in order to check his direction. It was this cumulative experience of changing maritime conditions that formed the basis of knowledge of early navigators.

Thus, direction would also have been established by the position of the sun. The point of sunrise and sunset, as well as the midday (zenith) position of the sun helped determine east, west, and south, respectively. As Taylor (1958: 6) points out, 'The midday position of the sun and the shadows it cast, served to divide the east from the west, as well as to define two more quarters of the sky'. Again this is not a fool-proof method since the exact point where the sun rises and sets fluctuates with the seasons and with latitude, but, in a certain band of latitude and over a short number of days, 'nearly east' and 'nearly west' will be 'fixed'. However, it difficult to spot the precise point of the sun when at its zenith and it is possible that ancient navigators used the shadows cast by the sun over his craft as an aid to fixing his position.

As ancient sailors used the sun by day, so they used the stars, particularly the North Star (Polaris) in Ursa Minor, and Ursa Major, by night. Navigation by this group of stars provided a relatively 'fixed' point by which to establish directions and direct the course of a vessel, and has an additional advantages over the sun in that you can

look directly at the stars. The Egyptians are believed to have developed the art of astronomy by 5000 BC (Taylor 1971: 9) - after all they relied on the stars to carry their dead to the underworld. Although little direct evidence exists for navigation by the stars in the Bronze Age, a wealth of information from Egyptian sources implies a great depth to their knowledge about the stars. A recent discovery at Giza implies that the Fourth Dynasty pyramids were built in direct alignment with the constellation of Orion (Bauval & Gilbert 1994).

Polaris, part of the 'Little Bear' constellation, was an especially useful star to navigate by as it kept a tight circle around the Celestial North Pole. If Polaris was obscured by cloud then the navigator could rely on the oblique rising and setting of other constellations over the horizon to establish his directions. Homer refers to steering by the stars in the Odyssey (V.270-275). When leaving Calypso Island Odysseus -

> 'spread his sail to catch wind ... There he sat and never closed his eyes in sleep, but kept them on the Pleiades, or watched Bootes (Arcturus) slowly set, or the Great Bear nick named the Wain, which always wheels around in the same place'.

Later in this passage Homer (Odyssey V.275-280) describes how the course was kept steady for apparently seventeen days by following the Great Bear, which, according to Severin (1987: 250-1), implies that they were sailing in a east-north-easterly direction.

'It was this constellation the only one which

> never bathes in Ocean's Stream [ie never went below the horizon] that the wise goddess Calypso had told him to keep on his left hand as he made across the sea' (Odyssey V.275-280).

Further evidence for celestial navigation is provided in the story of Wen-Amon's voyage to the Levant (ANET: 16-14/25-29). He was able to avoid Tyre 'by taking the light (of the stars as the only guidance)' (Goedicke 1975: 45-6, nt.57).

By establishing the position of Polaris in relation to the direction of known winds, other stars, or swell, it was possible to divide the horizon into sectors. One fixed direction divides the horizon into two sectors, each of 180 degrees. If you go on dividing these sectors it is possible to establish up to sixteen points or sectors (each point is 22.5 degrees), which today has been expanded to thirty two points. However, Bronze Age mariners no doubt relied on as many direction 'roses' as possible to check their position. Twilight is a particularly good period for cross checking position indicators, as it is a time when it is possible to observe both the night sky and the other natural aids to navigation, such as the position of the sun and the direction of swell.

Finally, some thought should be given to the development of basic navigational instruments, despite the lack of any evidence to support their existence during the Bronze Age. The use of hand spans (palms), thumbs, or fists

held at arm's length, or a seated figure a certain length in front of the navigator, can estimate height and angle against the mast and therefore determine the relative altitude of Polaris or Ursa (Fig. II.16). This can be compared with the relative altitude of the star at a known port and from this the navigator knows whether he is north or south of this port. McGrail (1991, in press) points out that

> 'from the Nile delta, the Great Bear constellation just grazes the horizon as it orbits the Pole, whereas off Crete it is approximately four degrees (2 thumb breadths) above it. Thus a voyage south across the Mediterranean is marked by the Great Bear getting closer to the horizon.'

It is even possible that a device known as a kamal was used in place of fists and handspans to work out the relative altitude of the stars. The kamal was a remarkably accurate yet simple tablet of horn or wood with a calibrated string inserted through the middle. The kamal was used by Arab seamen from the 9th century AD (Fatimi 1995, in press) up to the beginning of this century in the Indian Ocean to determine the altitude of stars (Tibbetts 1971; McGrail 1987: 278-9; Al-Said 1991: 99). However, no remains of such devices of navigation have yet been identified in a Bronze Age context.

When navigating within coastal waters within sight of land shoreline marks could be used to fix the course or position of the vessel and thus, be sure of a secure route. Naked eye transit bearings, that is the lining up of two

Naked eye transit bearings, that is the lining up of two fixed bearings on shore to make a transit bearing, preceded and were no doubt in use concurrently with more sophisticated methods of position fixing and determining altitude. As often as possible sailors would navigate along familiar shores keeping clear of inshore hazards, or from one land mass to the next maintaining visibility of the land and recognisable landfalls.

Severin (1987: 62), in his account of the voyage of Odysseus, identifies key landmarks and argues that

> 'Bronze Age sailors navigated by line-of-sight. They used good sea-marks such as bold headlands, tall mountain peaks and distinctively shaped islands to serve as their sign posts across the sea'.

Examples of the use of natural landmarks as a means of navigation in Homer's Odyssey, include offshore islands such as Pharos, west of the Nile delta (Odyssey IV.355-360), and prominent mountains such as the 'wooded peak of windswept Neriton' near Odysseus' home town of Ithaca (Odyssey IX.20-25). Reference is made in Sixth Dynasty Egypt to 'the nose of the Gazelle's head' which Marcus (1994 personal communication) believes refers to Mount Carmel (Lichteim 1973: 20), possibly a landmark by which sailors could also navigate inshore. Man-made landmarks may also have been constructed. Homer describes how the bones of Achilles, Patroclus and Antilochus were buried under

> 'a great and glorious mound on a foreland jutting out over the broad waters of the Hellespont, so that it might be seen far out at sea by the sailors of today and future ages' (Odyssey

XXIV.76-84).

Yon (1992: 116,fig.14.2) suggests the possibility that the temples at Ugarit were aligned so as to guide the sailors to the harbour. Temples certainly functioned as coastal landmarks in the Classical period in the same way that churches built around the shores of the British Isles provided a way of differentiating ports during the Medieval period.

Artzy (1994: 138) has recently identified images of ships carved into the rock at a point which marks a distinctive gap in the Carmel Range, south of Haifa, Israel. The break in the Carmel Range marks the point where the Me'arot River exits from the Range and 'is readily discernable from the sea' (Artzy 1994b). Artzy believes this distinctive gap provided a landmark for ancient navigators that wished to enter a number of anchorages along this stretch of the coast including the Bronze Age anchorage of Tel Nami, some 4km to the west. The boat images carved into the rock are believed to date to the late 13th century BC and could well be placed at this point in the gap in the Carmel Range to indicate its function as a good landmark (Artzy 1994: 138-9).

In such a way navigators no doubt learned to recognise visible landmarks some of which were subsequently given names, like the 'Antelope's Nose' mentioned by Uni (Wachsmann 1989: 268), and 'Phorcys' mentioned in Homer's

Odyssey as the name of a cove on the island of Ithaca that was named after the 'Old Man of the Sea' and had 'two bold headlands squatting at its mouth so as to protect it from heavy swell' (Odyssey XIII.76-101).

Winds also helped indicate the closeness of land from a point at sea when land was out of sight, particularly in poor visibility or when sailing at night. These particular winds are known as land and sea breezes and are common in coastal areas, being a product of the effects of temperature changes between day and night at the interface between land and sea (see above; Ch.IV.3). Land and sea breezes help provide an indication of approaching land.

There are a number of additional indications as to the imminent proximity of non-visible land some of which are more precise than others. Orographic clouds are characteristic cloud shapes that rise upwards over mountains and can be seen from great distances. Changes in the colour, salinity or temperature and depth of water, are also obvious signs of approaching land. Certain species of birds do not fly beyond a limited distance from the land and their presence would therefore indicate the approach of land (Hornell 1946). Migratory birds can indicate direction as they did in the 'Journey of Wen-Amon to Phoenicia' when he identified birds migrating south to Egypt:

> 'Haven't you seen the birds go down to Egypt a second time?' (ANET: 23/25-29).

The luminescence content visible in the sea at night is

more prevalent in coastal waters and the distinctively coloured outflow of great rivers such as the Nile, can also be seen some distance out at sea. Both these phenomena indicate nearby land. Lastly, smoke rising high in the sky from signal or natural coastal fires is a further indication of land.

The evidence suggests therefore that within the eastern Mediterranean there existed a range of ship types and that constructional techniques, navigational skills, sailing abilities and capacity improved over the period of the second millennium in response to increased contacts and greater demands for the products of trade. Bronze Age mariners had mastered the construction of substantial merchant craft, with hulls approximately 11-30m in length and capable of carrying up to 150 tons (Casson 1975: 3-11; Bass 1967: 44-49). By the end of the Late Bronze Age it is apparent from iconographic details of ships and their rigging, together with the voyages that are known to have been undertaken, that sailors could now sail closer to the wind than 8 points (90 degrees), possibly as much as 7 points off the wind (including leeway) ie they could make ground to windward. No doubt the risks involved in maritime ventures were still great but it does seem that by c.1200 BC a peak had been reached in terms of trade, knowledge of ship construction and performance, and navigational and pilotage techniques.

# Chapter III

## Ports, harbours and anchorage sites: A critical appraisal of the evidence

### III.1 Sources of evidence for determining the existence of Bronze Age anchorages

The degree and complexity of trade and exchange between Bronze Age societies of the eastern Mediterranean, as described in Chapter I, must imply extensive maritime activity. To sustain such levels of maritime exchange, widespread access to anchorages and harbours and their associated facilities was necessary. On this basis we can assume that natural havens, anchorages and harbours were established and used in the Bronze Age in order to provide shelter to vessels. However, direct archaeological evidence for such sites is limited. The various reasons for the paucity of evidence for harbours and anchorage sites, will be discussed, along with available sources of evidence, in the following section.

It should first be pointed out that not all anchorages were involved in trade or even supported a large community with related harbour facilities. Many second millennium anchorages were simply naturally sheltered bays or protected bodies of water either side of a rocky peninsula, which did not necessarily require additional protection such as that offered by constructed harbour installations.

As a result, archaeological evidence for Bronze Age harbour installations is limited. More often than not, archaeologists have to interpret indirect archaeological evidence to infer the location of second millennium harbour sites.

Any assessment of the existence of anchorage sites using available archaeological evidence should involve an analysis of the problems incurred when collating such data. There are a number of sites around the shores of the eastern Mediterranean that were undoubtedly used as harbours in the second millennium, as evidenced by the identification of the remains of contemporary harbour works. Such sites include Ugarit (#89) in the northern Levant, Kition (#229) in Cyprus, Dor (#145) in the southern Levant, Birket Habu (Thebes) in Egypt, and Malia (#268) and Kommos (#308) in Crete. However, such tangible evidence is unfortunately rarely attainable, and for a number of reasons our current knowledge of anchorage site location within the second millennium is somewhat incomplete (see below).

Sheltered coastal sites with associated Bronze Age material, particularly imported goods and pottery, may also be identified as functioning anchorages or harbours. With further excavation of coastal sites containing second millennium remains, additional second millennium anchorage sites may yet be located. One word of caution: however

convincing the suggestions are that coastal sites functioned as anchorages in the second millennium, it does not necessarily follow that harbour remains will be uncovered or ever even existed. Additionally:

> 'Rather than coherent structures, we may expect to find the remains of individual mooring posts or anchors of stone... Clusters of artifacts which are otherwise inexplicable may also indicate a regularly used landing-place...'(McGrail 1983: 311).

Finally, by simply using topography as a criterion for determining anchorage site location, it is often possible to suggest that a naturally protected bay or sheltered river outlet, was used when necessary, as an anchorage or haven in the Bronze Age. Although a number of sheltered bodies of water around the shores of the eastern Mediterranean are believed to have functioned as anchorages in the Bronze Age (Part II), it is impossible to prove unless subsequent survey or excavation is able to determine that these sites were at least occupied at some time during this period.

A crucial issue is the degree of archaeological survey and excavation that has so far been undertaken around the shores of the eastern Mediterranean, particularly in second millennium contexts. It is clear from distribution maps of survey areas or excavations around the eastern Mediterranean coast, that there is a disparity in the amount of research undertaken. When choosing which site to excavate archaeologists have traditionally tended to

concentrate on sites of evident size and importance, or sites of a known identity, and within those sites to focus on the palatial or administrative centres. The harbour or anchorage is all too often neglected.

Additionally, certain coastal areas or countries in the eastern Mediterranean, owing to political factors and/ or shortage of funds, have been relatively neglected archaeologically. For example, until recently little work had been carried out along the coast of Syria or Lebanon due to political instability. As a result there are large disparities between different regions regarding the degree of archaeological coverage. There are inequalities not only between geographical areas studied, but also between periods studied. It is often easier to identify Classical sites than those occupied during the Bronze Age, as later remains take on more monumental proportions. For this reason, there has in the past been more recording of Classical sites. As Bryce (1974: 112) points out in relation to Lycian Turkey, 'one cannot definitely say that there are not Bronze Age remains to be found until one has properly searched for them'.

Imbalance in available archaeological evidence may lead to erroneous conclusions. We must constantly be aware of the disparities in survey and excavation when making conclusions as to the general socio-economic picture and to the distribution of harbour sites vital to the network of

trade in the eastern Mediterranean. There are, no doubt, a number of second millennium anchorages not yet identified for which the evidence is either lost or remains to be investigated. For example, a number of Bronze Age tell sites have been identified along the ancient course of the Ceyhan and Seyhan rivers on the Cilician Delta, some of which display a quantity of second millennium remains including some imported material (Seton Williams 1954: 121). As outlined later in this chapter, documentary evidence suggests that the Cilician Delta was an important link between the northeastern corner of the Mediterranean and the centre of Hittite power on the Anatolian plateau to the north, thus it is quite feasible that a number of these sites could have acted as riverine ports for the handling of goods being transferred up stream. However, only limited investigations have been carried out at these sites to ascertain their archaeological importance.

Similarly, while areas of concentrated survey and excavation often reveal substantial quantities of second millennium goods, thus indicating potential harbours, they may not necessarily have been the sole or major centres involved in maritime trade. For example, the site of Dor on the coast of the southern Levant is believed by Raban (1985: 25-26) to have played an important role in Bronze Age trading between Egypt and the Levant. Excavations at Dor have been extensive and are continuing. Besides the great quantity of imported second millennium artifacts

recovered and extensive Late Bronze Age remains, Raban (1983: 236-238) has identified a series of 13th century BC quay structures (see #145). Thus the archaeological evidence, together with references to the site in contemporary literature, suggest that Tel Dor was a significant centre of Bronze Age maritime activity, but the apparent pre-eminence of this site could easily be misleading, as it is one of the most substantially investigated sites in this area. Perhaps a different pattern will emerge when other coastal sites of the region are excavated as thoroughly, and Dor is examined in relation to other coastal sites of the southern Levant. It is necessary therefore to put known evidence in context: to examine the topographical possibilities along with the direct archaeological indications.

## III.1.i Archaeological evidence: A summary of the state of survey and excavation of Bronze Age sites around the coast of the eastern Mediterranean

### South Turkish coast

There has been relatively little attention either in terms of survey or excavation along this coast: Beaufort's pioneer investigation of the coast of Karamania in 1818 (Beaufort 1818); later coastal surveys of Bean in the 1960s (Bean 1979, 1989; Bean & Mitford 1965); a number of smaller archaeological surveys over the last sixty years (Rosenbaum et al. 1967; Hellenkemper & Hild 1986; Seton Williams 1954; Gjerstad 1934; Mee 1978; Vann 1991); and recent work undertaken by Turkish archaeologists. Lycia or the Teke Peninsula, in southwest Turkey, has received the most attention, with excavations being primarily concentrated on the Lycian sites of the 7th century BC - 2nd century AD (Toksöz 1986). Some evidence for Bronze Age settlement and trading activities has also been revealed at a number of sites, such as Myra (#27), the now inland site of Limyra (#30), and to a lesser extent the site of Kaş, Antiphellus (#16).

A similar pattern emerges for the area to the east of the Pamphylian Plain across to Cilicia. Little is known of the sites on the Pamphylian Plain and around Antalya. A number of coastal Classical sites have been identified, such as Anamur (#49), Side (#39) and Alanya (#43), but very

little research has been undertaken on Bronze Age sites.

Limited research, both of an archaeological and geomorphological nature, has been carried out on the Cilician Delta. A number of second millennium anchorage sites have been identified on the north-western edges of the Seyhan delta. These include the sites of Tarsus (#69), Mersin (#67), Kazanli (#68) and Soli (#66) which appear to have acted as centres of trade handling the transfer of imported goods across the delta through the Cilician Gates to the centre of Hittite power on the Anatolian plateau in the north (Seton Williams 1954). However, the changing alluvial nature of the area is thought to have obscured any potential Bronze Age harbour sites (see Ch.IV).

Little is known of the precise nature of Bronze Age coastal emporia involved in trade along the coast of south Turkey, or in fact, to what extent advantage was taken of passes inland, such as the routes via Antalya and across the Pamphylian Plain. More extensive survey of the numerous sheltered anchorages along this coast would no doubt reveal additional information.

Northern Levant Coast

Coastal survey and excavation along this section of coast was greatly reduced after the middle of this century because of political instability. Excavations inland at sites such as Mari (Parrot 1956-1968) and Ebla (Bermant &

Weitzman 1979) reveal an active economy from the third millennium BC onwards. Many of the coastal centres such as Sidon (Poidebard & Lauffray 1951) and Tyre (Poidebard 1939) were excavated prior to the 1950s and little information was gleaned as to the nature of the occupation of these important anchorage sites other than that relating to their later history. Restricted research has been undertaken at a number of coastal sites such as Byblos (#116), Ras Ibn Hàni (#91) and Arwad (#102), but with limited attention paid to the harbour areas. The site of Ugarit (#89) is the only coastal site along this stretch of coast to have received extensive archaeological attention.

The extensive maritime activity along the northern Levantine coastline during the second millennium, outlined in Chapter I, suggests that other anchorages existed along this coast to support the volume of traffic, particularly in the area of Ugarit (see Ch.I). Frost (1990, personal correspondence) stresses the importance of this coastline in connection with trade. However, no systematic surveys have been carried out to investigate this hypothesis.

Southern Levant Coast

This coastal area, on the other hand, has received considerably more attention (Raban 1981, 1983, 1983b, 1985, 1987b; Raban & Galili 1985; Galili et al 1993; Galili & Shavit 1994). Most of the coastline has been examined to a greater or lesser extent, and new data is constantly being

discovered. As a result a series of harbour sites, predominantly associated with river mouths and fringing reefs and containing second millennium material, have been identified along the Levantine coast (see Part II). Some sites especially, such as Dor (#145), Akko (#134), Tell Abu Hawam (#137), Achzib (#131) and Tel Nami (#144), have received more extensive archaeological attention than others in the region and reveal a wealth of contemporary remains and some indication of harbour works. In addition, a number of comprehensive encyclopedias (AY 1975-1979, EAEHL 1993) and bibliographies (Vogel 1934, 1982) have been compiled listing all sites within the southern Levant. The Centre for Maritime Studies (CMS) at Haifa keeps a constant watch on coastal archaeological activities in this region and publishes details annually.

Egypt

The Nile delta and the main Nile channels have received some attention, although traditionally excavation and survey has been restricted to the Pharaonic centres such as Thebes, Memphis (#187) and, more recently, the Hyksos capital at Tell el-Dab'a (#183). Recent palaeogeographic work in the northern reaches of the Nile Delta, as part of the Mediterranean Basin Program (Warne & Stanley 1993) is proving to be an effective means of locating ancient delta sites.

Cyprus

Cyprus has received fairly extensive attention in restricted areas (particularly burial sites), and research has revealed such important anchorages as Enkomi (#224), Hala Sultan Teke (#230) and Kition (#229). Systematic coastal surveys have been undertaken along limited stretches of the coast by McCaslin (1978,1980), Green (1973) and Giangrande et al. (1987). However, a large number of questions remain unanswered, particularly concerning the island's growth and affiliations during the Late Bronze Age.

Eastern Crete

On the island of Crete, in addition to the traditional areas of research being restricted to the palatial sites of Knossos and Phaistos, a considerable amount of research into Minoan harbours has been undertaken particularly in the east of the island (Hadjidaki 1977; Sotirakis 1992; Raban 1991; Shaw 1990; Evans 1928; Leatham & Hood 1958-59); Betancourt & Banou 1991; Schäfer 1991). A number of second millennium sites on the coast of Crete that have yielded a large amount of pottery of the period, as well as providing adequate shelter to shipping, are referred to as Minoan harbour sites (see Part II).

This brief summary of the extent of survey and excavation of second millennium sites undertaken around the

coasts of the eastern Mediterranean reveals the disparities in the relative amount of research between the different regions. Although some areas, such as Eastern Crete, parts of Cyprus and the southern Levant have received a considerable amount of attention, additional survey and excavation is required in order to enhance our understanding of the nature of second millennium harbour sites of the period, particularly with regards to the identification of additional Bronze Age harbours.

The sample of anchorage sites so far investigated does not appear to be representative of those actually in use in the second millennium. For example, additional research is required along the coast of the northern Levant. Continued archaeological and geomorphological survey in Egypt (especially on the delta and along ancient channel courses, where most of the aforementioned sites are situated) would undoubtedly shed more light on those Bronze Age harbour sites that may have since been buried. In addition, further investigation along the north and parts of the south coasts of Cyprus would no doubt shed light on the role of smaller anchorages, particularly in areas such as the Akrotiri Peninsula and Morphou Bay where there has been significant geomorphological change. Thus, we must not let the uneven amount of research lead us to believe that certain areas were much more important, or that they supported a far greater number of harbours, as this may not necessarily be the case.

## III.1.ii Documentary and Pictorial evidence

Contemporary documentary and iconographic evidence provides further indications as to the location and nature of Bronze Age anchorage sites, information that is often unattainable from direct archaeological evidence. However, this must be treated with a degree of caution. Detail may be misrepresented due to lack of knowledge or incorrect information, and there may be exaggeration with a view to impressing the recipient. The `artist's impression' of his subject, and the subsequent interpretation by archaeologists, may also be subjective and therefore misleading.

a) Documentary evidence:

First millennium BC

Surviving ancient texts can aid our understanding of the location of ancient harbours. One of the earliest technical books relating to harbour facilities to survive was written by the engineer Philon in the 3rd century BC. Unfortunately, no similar documentation has yet been discovered for the second millennium BC, although useful information can be extrapolated from later documents to help clarify Bronze Age issues. The geographical periploi or `coastal pilots' that acted as navigational aids or guides to sailors and provided details about harbours, anchorages, landmarks, watering points, etc, can serve to make hypotheses regarding routes taken and harbours

utilised by Bronze Age seamen. For example, the c. 500 BC periplous of Scylax discusses voyages in the Mediterranean and Black Sea, while the 3rd century AD Stadiasmus Maris Magni gives detailed directions from place to place all around the coast of the Mediterranean. However, although these descriptions may be written versions of much earlier oral accounts, they are of a later period and give only indirect suggestions for the reconstruction of second millennium routes and rarely offer detailed descriptions of ancient harbours beyond the number of harbour basins available. Later Classical writers such as Strabo, who wrote a description of the harbour of Alexandria, Josephus, who described the harbour of Caesarea in the 1st century AD, and Herodotus, who gave an account of the great mole in Samos harbour, contain far more details of the layout of Greek and Roman harbours.

Homeric evidence, however, offers a source of information for maritime activities of the Aegean, some of which is of potential relevance to the second millennium BC. Both the Iliad and the Odyssey refer to coastal sites and harbour towns; for example the `Catalogue of Ships' (Iliad II.484-759) lists the gathering of hundreds of ships from all around the Aegean. It refers to

> `Argos and Tiryns of the Great Walls, the men of Hermione and Asine, towns that embrace a deep gulf of the sea'.

The works of Homer also provide us with valuable descriptions of harbour sites, not always named (or if

named not always identifiable with known sites) but nonetheless interesting as a portrayal of harbour activities. Homer described the city of the Phaeacians as possessing

> 'an excellent harbour on each side and is approached by a narrow causeway, where the curved ships are drawn up to the road and each owner has his separate slip[1]' (Odyssey VI.263-269).

The evidence that Homer provides is valuable but the period to which these conditions may be ascribed is ambiguous. It seems that the Homeric epics were set down in writing c. 700 BC. However, the interest is `in identifying the chronological period in which the greater part of their material or cultural content can be set' (Sherratt 1990); this is believed to be the Late Bronze Age, but it is by no means a certainty.

Second millennium BC

Surviving documentary evidence from the second millennium BC is far less detailed about harbour facilities and specific routes of trade, but Eblaitic, Ugaritic, Hittite and Amarna texts make numerous references to regional centres and ports of trade used by Bronze Age merchants in the eastern Mediterranean.

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[1] The translation of the word 'slip' is uncertain and can also be translated as 'shed'. Such a translation is interesting in light of the structures discovered at Kommos (#308), Malia (#268) and Nirou Khani (#266) which have been interpreted as shipsheds.

The Ebla archives refer to a number of coastal towns of modern-day Syria. The Eblaite tablet known as 'The Geographical Atlas of the Ancient Near East', or 'Gazetteer', tablet TM 75.G.2231 (Pettinato 1978: 70), mentions the harbour town of Ugarit as the fifth of 279 states of Ebla.

The excavations of Ugarit (#89) by C.F.A. Schaeffer (1939-1978) uncovered thousands of tablets from private and public buildings. The texts of Ugarit, written primarily in Akkadian and alphabetic Ugaritic, refer to events and mercantile transactions that took place in the 14th and 13th centuries BC. Through the evidence of the texts, it is possible to identify maritime connections between Ugarit and Cyprus, Egypt, the Hittite Empire, Asia Minor, Crete and Mycenaean Greece, as well as the coast of the Levant. Numerous coastal towns can be identified as commercial maritime partners of Ugarit, and their function as harbours confirmed. Text PRU VI 136 (RS.19.28) makes reference to maritime operations undertaken at Byblos. Text PRU V 59 (KTU.2.38) contains a letter from the Tyrian king to the king of Ugarit and says

> "your ship, which you sent to Egypt - it is (till now) in Tyre" (Heltzer 1978: 151).

The maritime nature of the Late Bronze Age Levantine cities of Sidon (#122) and Akko (#134) can be inferred from Ugaritic text PRU VI 81 (RS.19.182). In text PRU V 59 we learn about an Ugaritic ship that was anchored in ky (modern Akko). Other Ugaritic texts mention Ashdod (#164),

Ashkelon (#166) and Yavne Yam (Ugaritic Mahhazu/Mhd; #163; Heltzer 1978: 152,162).

Based on a letter of Ammurapi of Ugarit, Keen has identified a number of sites in Lycia as being occupied by the Lukka people during the Bronze Age (Keen 1989/90, personal communication). He believes that from the fifteenth century BC the Lukka spread from Karia in the west to occupy the lands of Lycia. In the letter, Ammurapi sends his fleet to the seas off the Lukka lands. According to Keen's interpretation the text is therefore referring to the coast of Lycia. The Lukka who 'numbered among the Sea Peoples in the reign of Merneptah' (Breasted 1906: 243/579), are also believed to have attacked Alashiya (Cyprus) and Egypt. Strategically the coast of Lycia would have been a far better place than the coast of Karia, certainly for launching an invasion of Cyprus (see Ch.I).

Keen (1989, personal communication) also identifies a number of places mentioned in the Hittite texts (OCD 1970) as being sites in Lycia. One site, that of Sura (ancient Surezi) has been identified as Hittite Suruta (marked as Gökkaya Limani on the Main Map #26; OCD 1970; Annals of Mursili II). Keen (1989/1990, personal communication) attributes the lack of Bronze Age remains discovered in Lycia `to the fact that no proper survey has yet been conducted'.

However, not all the place-names mentioned in the Ugaritic texts in the context of seaports concerned with maritime trade, can be identified with a specific settlement. Publication of PRU IV in 1956 mentions the tamkars, merchants of Ura, who were subjects of the Hittite king and traded with Ugarit (Gordon 1958: 28-31). The site of Ura is referred to on many occasions as one of the major ports of trade in Cilicia. Ugaritic tablet UV 175 (RS.26.158) describes the shipment of grain to Ura, as does UV 33 (RS.20.213). Heltzer (1978: 156) states that one hundred ships in the harbour of Ura were not a rarity, thereby implying that the harbour was of considerable size. Additional reference to Ura is mentioned in the Hittite text fragment BO 2810, where the Hittite king instructs his son to deal with a shipment of grain that he is expecting:

> 'And now my son, send it and in Ura or Lasti they must unload it' (the precise location of Lasti is also unknown).

Garstang (1943: 1-12) believes Ura to have been located in western Cilicia, possibly in the vicinity of Silifke on the Silifke (Göksu) delta. On the other hand, if we accept Heltzer's (1977: 203-211) belief that Ura was 'the real port of entry to the Hittite Empire' then Ura may be better located on the Cilician Delta to the east, which would have been more convenient for contacts and trade inland to the Anatolian Plateau. The actual location of Ura remains unknown.

Textual evidence can also be useful in determining the

period of activity of particular harbours, as it occasionally compliments the available archaeological evidence. In the case of the Ebla archives, for instance, Pettinato (1981: 226) refers to a number of coastal cities involved in the shipment of goods between Egypt and Ebla. They include Byblos (#116; which he believes acted as the pre-eminent harbour and was involved with the shipment of Egyptian gold), Ashdod (#164), Jaffa (#161), Akko (#134), Sidon (#122), Beirut (#120) and Alalakh (#82). The emergence of these sites as maritime commercial centres as early as the middle of the third millennium BC is quite astonishing, particularly in the case of the sites of Sidon and Beirut, where there is little evidence for their function as harbours prior to the end of the second millennium/ beginning of the first millennium BC[2].

The Egyptian texts also reveal information concerning the location and function of harbour sites in the second millennium BC. Of particular interest is the 11th century BC account of the journey of Wen-Amon, an official of the Temple of Amon at Karnak, to Byblos (#116) on the Phoenician coast to procure wood for the ceremonial barge of the god. The text makes reference to a number of ports that he visited including Dor (#145), Tyre (#125) and the 'harbour of Byblos':

'Aren't there twenty ships here in my harbour

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[2] The interpretations of Pettinato should be used cautiously as there is much disagreement amongst scholars as to the accuracy of his translations.

> (Byblos) which are in commercial relations with Ne-Su-Ba-neb-Ded? As to this Sidon, the other (place) which you have passed, aren't there fifty more ships there which are in commercial relations with Werket-El, and which are drawn up to his house?' (ANET: 19/25-29).

Another interesting and informative collection of letters is the 14th century BC tablets of Tell el-Amarna. They were discovered in 1887 in Upper Egypt and largely written in Akkadian (Conder 1894; Mercer 1939; Moran 1987). Again, a number of sites on the Levantine coast are referred to in a maritime context including Akko (#134; EA 111), Tyre (#125; EA 114,149), Alashiya (Cyprus; EA 33-40), Sidon (#122; EA 101,1114,149) and Arwad (#102; EA 104-5):

> 'seize the ships of the men of the city of Arada' (EA 101).

Reference is also made to Misi where the 'ships' of Misi are mentioned (EA 101,110-1). Conder (1894: 46) translates the Miṡi as 'the delta' and believes this to be a reference to the Egyptian Delta, although it might refer to a site on the eastern side of the Cilician Delta, such as the Misis Dağ/ Karataş peninsula. Mercer (1939: 877) associates Miṡi with the Mi-Lim people who are referred to as enemies in the Amarna tablets (EA 101,105,108,111) and are regarded by many scholars as the forerunners of the 'sea peoples' (Säve-Söderbergh 1946: 64-7). The Amarna tablets also refer to Ullaza (Kefr Knullis; #110; EA 104-5), Askalon (#166; 320-6), Byblos (#116; EA 67-142), Simyra (coastal Zumura; #106 or #111 or #108; EA 59,62,104-5), Sidon (#122; EA 92,101,114,149), Beirut (#120; EA 114) and Yaff (Jaffa;

#161; EA 296). In a final comment on the Amarna texts, Condor (1894: 109,ft.nt.1; EA 149) remarks that Tyre was troubled by constant lack of water. In the reign of Ramesses II, an Egyptian traveller (Chabas) speaks of water sent to the island of Tyre in boats (Bezold 1892: 313). This would imply that Tyre was occupied in the 12th century BC and quite possibly functioned as a harbour.

Another text recovered from Egypt written by the captain of a Nile vessel in Upper Egypt in the sixteenth century BC (ANET: 172-5/233-234) makes reference to ships at Memphis (ANET: 173/233-234) and 'fighting on the water in the Canal Pa-Djedku of Avaris' (ANET: 174/233-234). An additional text from the latter half of the second millennium BC recounts the war against the Peoples of the Sea (ANET: 185-6/262-263), and mentions the city of Kode on the coast of Cilicia, yet another example of a coastal town of Cilicia whose whereabouts has not yet been located (ANET: 185, ft.nt.1).

In addition, the Egyptian Onomastikon texts, dating to the Middle and New Kingdom (Ahituv 1984; Gardiner 1947; Faure 1963), contribute to the general geographical perception of routes taken and places visited. From the late Middle Kingdom, the Execration texts (Pritchard 1975: 328; Redford 1992: 87-93) list, largely in geographical order, places in Palestine and South Syria with which Egypt either traded or fought. They include reference to the

coastal sites of Arqata (#109), Ullaza (#110), Byblos (#116), Acco (#134) and Ashkelon (#166). Many texts list the cities conquered during campaigns of the pharaohs undertaken during the New Kingdom, particularly during the reign of Tuthmosis III; they are presented in consistent geographical order. Over twenty of these are known to be Levantine ports (Raban 1991: 133,nt.17).

An additional piece of documentary evidence that makes reference to sites in the Aegean comes from Egypt. The 14th century BC Kom el-Hetan topographical list, found in the forecourt of Amenophis III's funerary temple, mentions `Isles in the Middle of the Sea' (Kitchen 1966: 23-24). The list seems to record a voyage from Egypt to twelve places in the Aegean including Amnisos (#165), Knossos and Phaistos on Crete, and constitutes a possible reference to Amnisos' function as a harbour during this period (Cline 1994; Fig. III.1).

Contemporary documentary evidence therefore attests to the use of a number of coastal sites, particularly on the Levantine coast of the eastern Mediterranean, functioning as harbours in the second millennium BC. Unfortunately, there is limited information on harbour sites in Cyprus and along the coast of Turkey. The Pylos tablets give indications of Mycenaean trade and exchange but do not name the harbours involved (Killen 1985).

Finally, textual evidence contributes to a general understanding of the movement of goods between centres of commerce. Reference to the mercantile activities of different peoples, such as the Keftiu, Ugaritians, tamkaru (particularly from Hittite vassal states) and kbnt (the Byblos navy), helps towards an understanding of who was involved with trade and the various routes along which trade was conducted. For example, during the 1978 excavations of the 13th century BC `government house' at Tell Aphek in the southern Levant, a diplomatic letter from Ugarit addressed to Haya, an Egyptian high official, was discovered. The letter was either destined to Tell Aphek or Jaffa; both sites were under Egyptian control, at least in the first half of the 13th century BC. Aphek's strategic position on the coastal (overland) Via Maris route (see Ch.I & Ch.VI.2) would also have provided an excellent stop-over point for maritime voyages between Syria and Egypt. The text dates from c. 1250 BC and concerns a request by Tukuhlina (Ugaritian prefect) for Haya to return a quantity of wheat which had been sent to Jaffa. The text therefore is an example of trade between Ugarit and Egypt being conducted via Canaan (Owen 1981: 49-53). Linder (1970, 1981: 31-42) cites additional references to numerous other types of maritime transactions of Ugarit, together with the ports and merchants involved in trade. Once again, by having an idea of the routes of trade and between whom goods were traded, we are more easily able to identify potential ports of call.

A final note must be added regarding the naming of particular sites and the origins and cultural influences implied by site names. For example the Classical harbour site of Finike (#29), ancient Phoenius/ Phoinike, on the south coast of Turkey, only appears to have Classical remains. However, Keen (1990, personal communication) believes its name indicates an association with earlier Phoenician traders.

Thus, the extensive maritime activities of the second millennium BC eastern Mediterranean are documented by hundreds of texts written in different scripts (see above). In addition, there are limited Late Bronze Age references to shipyards and harbour masters (Glanville 1931), to lists of ship types and building materials, and, in relation to Byblos in the story of Wen-Amon, reference is made to storehouses (ANET: 20/25-29). However, no doubt partly due to the fact that the principal surviving texts are administrative letters or letters of exchange between rulers, no documents have yet been recovered that include a significant reference to the exact siting of a harbour, and only one text has so far been recovered that gives details of an architectural feature of a harbour in a maritime context; Ugaritic text PRU IV,118 records how a ship belonging to a Ugaritian crashed against a quay (Fensham 1967: 222).

b) Pictorial evidence:

Pictorial representations of Bronze Age anchorages or harbours are limited in number; those that have been discovered do not provide concrete evidence for the location or names of the sites that they depict. However, pictorial, as opposed to documentary, evidence does provide more detail as to the layout and associated architectural features (ie the microstructure) of harbours. The main iconographic depictions of second millennium harbours are in Egyptian tomb paintings and the Thera frescoes.

The Miniature Frieze of a Ship Procession from Room 5 in the West House, at Thera (Akrotiri) (Morgan 1988: 121-143) has provided us with new material for discussion about maritime activities of the Late Bronze Age Aegean, and presents three different detailed views of settlements next to the sea, interpreted as harbours (Shaw 1990). On the south wall of Room 5 (the West House), two harbour scenes are depicted (Fig. III.2). The town on the left (Shaw's second harbour; Fig. III.2.i) is believed to have been located on a river in a similar location to many second millennium anchorages in the Aegean. The third town (Arrival Town; Fig. III.ii), on the right-hand side of the frieze, depicts a harbour with a double anchorage, separated by a rocky peninsula (Shaw 1990: 432). In one anchorage, boats are seen partially beached on a sandy shore. In the larger harbour to the right, boats are depicted at anchor (Shaw 1990: 431,fig.18,19; Fig. III.3).

Raban believes there is also a depiction of a quay built on the water front (Raban 1991: 141). In the frieze on the north wall of Room 5, Shaw (1990: 429) identifies what he believes is a depiction of a ship-shed based on its `immediate proximity to the sea, (and) the uniform width and impressive height of the successive rooms which were apparently open to the shore line' (Shaw 1990: 430). This building can be compared to the Late Bronze Age building 'P' at Kommos (#308), on the south coast of Crete, which M. Shaw (1985) also identified as a ship-shed.

The Thera frescoes provide an impression of the topography and structure of Aegean harbours, and possibly others in the eastern Mediterranean during the Bronze Age. Whether in fact they depict specific towns or harbours, or are simply generic expressions of Minoan art, they are the best examples of coastal harbour layouts and architectural features of this period.

There are many pictorial depictions of Bronze Age quays from Pharaonic Egypt (Marcus 1990), but these are mostly rather schematic and in all cases of the riverine type. The best example of riverine anchorages is from the late 14th century BC tomb of Kenamun at Thebes (see Fig. II.9). The relief depicts Syrian ships moored within an Egyptian harbour basin, probably Thebes (Davies & Faulkner 1947), unloading goods via ramps onto a quay. An Egyptian painting from the tomb of May at Amarna, shows ships moored

to bollards on a quay (Davies 1908: Pl.V). Similar depictions are found in the Eighteenth Dynasty tomb of Viceroy Huy (Landström 1970: Pls.329,330,390; Fig. III.4; Davies 1926: Pl.31,18), and in one scene (Fig. III.4) ships are shown attached by ropes from the bow to mooring stones on the quay. Other representations from the tomb of Viceroy Huy (Landström 1970: Pls.393 & 396) depict gangways between the bow and the quay.

However, the harbours depicted are schematic and conventionalised, with little attention paid to details of architectural design. Pictorial depictions of foreign harbours being attacked by Egyptians are even scantier. No scene shows the shoreline or any details of harbour layout and architectural features. The depiction of the conquest of Ashkelon by Marneptah, from the temple of Amon at Karnak, is a typical example (Breasted 1906: 243/579). Here the fortified town is shown located on a hilltop and none of the associated harbourworks are portrayed (Raban 1991: 133).

Thus, although a general impression of Bronze Age harbours is gleaned, few details of the layout and architectural features of second millennium harbourworks can be ascertained either from contemporary documentary sources or pictorial representations.

### III.1.iii Evidence from post-Bronze-Age harbour sites

Harbour sites, because of the nature of their location and topography, often show continuity of use over centuries or even millennia. For instance, sheltered anchorages used in antiquity are quite frequently still anchorages today, particularly where no drastic change in the coastal morphology has occurred. The implication, therefore, is that anchorages of the first millennium or later may well have accommodated Bronze Age vessels. This type of evidence is presented in Part II, with particular regard to the implications for the use of such anchorages in the second millennium; a short introduction to my theory is presented in the following section. However, without archaeological or documentary evidence, particularly that related to the dating of harbour remains, such hypotheses are impossible to prove.

Continuity in use of anchorage sites for shelter is more likely along steep, cliff-lined coastlines where there has been minimal physical change in the coastal morphology (see Ch.IV.1.b). Apart from localised tectonic movement, these coastlines are more stable as the main factor contributing to any change in their morphology is sea-level rise, whereas along low-lying coasts alluviation also contributes to changes in the coastal topography (see Ch.IV.2). Thus it is possible to infer the use of anchorages along cliff-lined coasts prior to the

construction of later harbour installations.

The use of offshore islands and reefs for anchorage is noted throughout antiquity (see Ch.IV.1.b). Examples of this can be seen along the coast of the Levant during and since the Bronze Age (see Part II). The adaption of offshore reefs along the northern Levant coast, exemplified by such sites as Tyre (#125) and Sidon (#122), is a practice commonly associated with the Phoenicians. However, we know from textual and material evidence that ships plied this exposed coastline during the second millennium and can infer that shelter was sought behind these reefs before rock-cut moorings were established. (The precise dating of the earliest rock-cut moorings along the coast of the northern Levant still arouses much debate and will be discussed later in this chapter.)

Similarly, along the north coast of Cyprus a number of sheltered anchorage sites used in later periods (see Part II) could potentially have been used as stop-over or watering points for vessels during the Bronze Age. Mariners manoeuvring between the Aegean and the eastern Mediterranean or crossing between Cyprus and the south coast of Anatolia, could well have sought shelter in these anchorages.

The fact that particular anchorages were used throughout antiquity can also be a hindrance to the

identification of second millennium BC harbours. Continued use results in rebuilding and modernisation of harbours, and the re-use of old building material quite often completely destroys earlier harbour remains. Bronze Age harbour remains may thus become obscured or buried beneath later harbour works, and details of their construction or layout can be lost forever. Even when there is a possibility that a few isolated remains of ancient harbours survive, excavation has been restricted to the later periods where greater detail of harbour construction techniques can be observed.

Finally, a number of second millennium BC anchorage sites may have since silted up and been entirely buried beneath alluvial deposits. In some cases the harbour was moved in antiquity in response to the destruction caused by the changing geomorphology (see Ch.IV.2.b). Riverine valleys and deltaic outlets are likely to have accommodated Bronze Age anchorages which have since silted up due to a build-up of marine sand and alluvial deposits at the river mouth. Low-lying coastlines of this nature could well have had anchorages in a time when the river was accessible and offered sheltered haven. The Egyptian and Cilician deltas, large alluvial plains and river outlets, are all examples of areas which are susceptible to geomorphological change.

### III.1.iv Evidence from coastal sites that were occupied during the second millennium BC

There are a large number of second millennium BC sites around the shores of the eastern Mediterranean where there is no direct evidence for their use as anchorages or harbours. However, at second millennium sites associated with sheltered anchorages or possible beaching, it would seem reasonable to infer that local seafarers used these natural facilities. After all, the focus of Mediterranean life was then, as it is largely today, the sea.

Small coastal settlements had no need to construct large harbour installations as sheltered anchorage for a small number of fishing boats or coastal traders was all that was required. If small wooden jetties had been constructed in the Bronze Age, it is very unlikely that there would be any trace of such facilities in the archaeological record (see below).

Imported Bronze Age goods or pottery recovered from coastal sites, strongly suggest that these sites were involved, either directly or indirectly, with trade and therefore had a harbour. This is not to deny that some of these sites may have had access to inland routes of trade from whence the imported goods arrived. However, at those sites where access to the hinterland was hindered by the terrain it is quite possible that trade was by sea. After

all, in coastal areas it is often easier and much less expensive to transport goods by sea than overland, as was the case in the British Isles up to the beginning of this century. Thus, coastal settlements involved in maritime trade would probably have had access to anchorages.

Even when imported artifacts are not prolific, or non-existent in the archaeological record, this does not mean that goods were not imported. Many imported goods such as organics or recycled metals leave little or no trace in the archaeological record (see Ch.I).

During field work along the south Turkish coast in 1989, I identified a number of coastal sites (see Part II), many of post-Bronze-Age occupation, that could have provided shelter to vessels in the Bronze Age - some of which have yielded a degree of associated second millennium BC material[3]. For example, at the sheltered anchorage of Kaş, Antiphellus (#16), a harbour greatly used during the first millennium BC, Bass (1989, personal communication) discovered a fragment of a Canaanite jar. Although a mere fragment (of amphora), this find, coupled with the assumption that the Late Bronze Age Uluburun ship (Bass

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[3] It is impossible within the context of this chapter to discuss all potential Bronze Age coastal sites, both along this coast and elsewhere in the eastern Mediterranean, that may have been used as anchorages in the second millennium; the potential of this evidence is explored in Part II, and the proof of this hypothesis can only really be tested through continued field work.

1986; Pulak 1988), excavated to the east of Kaş, was either leaving from, or more probably heading for Kaş when she sank, adds credence to the assumption that the harbour was used in the Bronze Age.

Pirazzoli (1987b: 59), during his 1982 survey of the harbour of Megiste on the island of Kastellórizon (#18), opposite Kaş (#16), indicates that the site reveals 'Middle Minoan and Mycenaean influences'; he gives no indication as to what these second millennium BC 'influences' may be; and as yet there is no firm evidence for the use of Megiste anchorage in this period. However, during this period it may well have acted as a sheltered, offshore harbour serving the settlement of Kaş on the mainland opposite. Similarly, the Classical port of Limyra (#30), now located some distance inland, has been identified as the Hittite site of Zumarri (Laroche 1971), and Late Bronze Age sherds have been discovered there (Mellink 1983: 435), implying its use as a harbour at the end of the second millennium BC[4]. Second millennium material has also been discovered at

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[4] A number of Lycian sites are known from contemporary documentary sources ie Hittite texts, to have been occupied by Lukka peoples c. 1500-1000 BC and to have been centres of maritime activity eg. Patara (#13) served the Lycian capital of Xanthos. However, there is little evidence in the archaeological record to support extensive occupation or maritime activity in region of the Lycian Peninsula. Many of the potential riverine anchorages have since silted up and Coulton (1990, Vienna conference) has suggested that the lack of Bronze Age material in this region is also concealed by the contemporary use of perishables, together with later developments. Bryce (1974: 112) suggests that we 'have to properly search for them' ie Bronze Age remains.

the Classical port site of Soli (#66) on the coast of Rough Cilicia (Schaeffer 1948: 273-278), implying its use as an anchorage in the Bronze Age.

There are numerous other sites around the coast of the eastern Mediterranean where second millennium material has been recovered, that could well have been Bronze Age anchorages. The potential of these sites as anchorages during the second millennium BC is explored in Part II.

### III.1.v Shipwreck evidence

So far, the two Bronze Age wrecks that have been excavated in the eastern Mediterranean, Cape Gelidonya (Bass 1967) and Uluburun (Bass 1986; Pulak 1988), cast only limited light on second millennium harbours. If future study by the excavators of these shipwrecks of the position of the wrecks and the nature of the cargoes yield information on the routes the ships were following, it may be possible to deduce which anchorage and harbour sites were used by these vessels for taking on provisions or mercantile trade en route. Linking the ships' cargoes with imported goods recovered from coastal sites along the vessels' route, could provide insight into the location of second millennium harbour sites of the eastern Mediterranean.

The different shipwrecks also suggest the various capacities and sizes of Bronze Age vessels (see Ch.II.2.iii) and hence give an indication of the berthing and manoeuvring room such vessels would have required within harbours; thus, a vessel the size of that inferrable from the Uluburun wreck would have required either an exceptional natural harbour or a degree of artificial modification, in order to secure safe anchorage.

## III.2 Archaeological evidence for harbour facilities

Although the sample of anchorage sites in the eastern Mediterranean investigated to date does not appear to be fully representative of those actually in use in the second millennium BC, the sources of evidence described above give us a general idea of their distribution. The evidence for related harbour facilities is even more ambiguous, primarily because second millennium BC anchorages did not have the substantial structures that were built in the first millennium BC and later. Even when harbourworks can be identified, it is difficult to establish their chronology.

Despite the paucity of our data, it is nevertheless important to attempt to identify the various types of harbour facilities or methods of mooring that seafarers used in anchorages of the second millennium. Throughout this discussion one should bear in mind the navigational and seafaring skills and achievements of ancient mariners, and never fail to underestimate their ability to find a safe, but informal, haven.

## III.2.i Informal moorings within harbours

### BEACHING

Beaching of craft - steering the vessel to the shore and dragging it up the beach - is dependent upon the nature of the coastline, with rocky, cliff-lined shores being clearly unsuitable, and smooth, sandy beaches with a shallow incline, preferred[5]. Vessels are more easily beached and unbeached with the help of tidal movement (McGrail 1987: 267) which is negligible in the Mediterranean[6]. The shape of the hull, and the size and weight of the vessel are also important to the relative ease of beaching. Our knowledge of hull shapes of Bronze Age vessels is limited (see Ch.II.1). It would seem quite feasible to beach an early Cycladic dugout or reed craft, such as the Syros or Naxos lead models, or the craft depicted in the rock carving from southeast Naxos (Johnstone 1988: 63). Likewise, vessels with straight lines and angled ends, such as those represented in the Thera Ship Procession fresco (Morgan 1988: Fig.70), believed to have been derived from longboats, could feasibly have been

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5 Occasionally the natural surfaces of beaches were artificially reinforced. Flemming (1972: 67) found evidence in Saranda, Turkey, of strips of rubble, described as hard standings, or an area of solid ground, onto which the boats were being hauled ashore. Similarly wickerwork hards have been found in relation to the Bronze Age Ferriby boat (McGrail 1987: 269).

6 Without tides beached boats have to be moved into slightly deeper waters where they will float, rather than waiting for the tide to come in and float the boat, as is the case in tidal coastal zones.

dragged ashore. Even the first plank-built Nile boats could have been beached. However, beaching no doubt became problematic with the introduction of the projecting keel and with the development of rounded hulls such as those depicted on the c. 1600 BC Cretan cylinder seals (Casson 1971: Fig.56; see Ch.II.1).

The custom of beaching craft would therefore be largely confined to small, light, smooth hulled vessels. This task would have been harder to achieve when we take into consideration the deeper hulled, keeled merchant vessels of the later second millennium BC. Ugaritic texts describe vessels of the 13th century BC that were simply too large to beach (RS 20.212). Frost (1973b: 399) has recorded a number of, what she describes as anchors found at Ugarit, some of which were over half a ton in weight and if stored on a ship would have added immensely to the weight of the craft, making beaching almost impossible (Frost 1972: 96). The only vessels that have been excavated from the Late Bronze Age are the Uluburun (Bass 1986; Pulak 1988) and Cape Gelidonya (Bass 1967) shipwrecks. They have been estimated at between 10-20m in length, and carried, in the case of the Uluburun shipwreck, twenty-two stone anchors and a large cargo including over ten tons of copper ingots (Pulak 1994, in press). The immense size and weight of such vessels would have made beaching a problem. Beaching of such vessels would have required aids, such as a system of rollers or the use of animals, in order to drag

the vessels ashore. Evidence for the use of rollers comes from the first millennium BC when Thucydides (3.15.1) describes the Spartans hauling their warships across the Isthmus of Corinth.

Bronze Age vessels are seen beached in front of the third town depicted on the south wall of Room 5 (West House, Thera) (Shaw 1990: Pl.17-19; Ch.III.1.ii.b; see Fig. III.2 & 3). From contemporary Egyptian texts, Goedicke (1975: 126-127) interprets the Egyptian word 't'dmit', referred to in the Execretation Texts (see above Ch.III.1.ii.a), as a landing place on an open beach.

In Homer's Odyssey numerous references are made to beaching or dragging vessels ashore[7]. Hesiod (Works and Days) provides further proof that ancient seamen beached flat-bottomed, light-weight galleys:

> 'Haul your ship on the dry land and make an enclosure of stones about it, to keep out the force of the winds that blow'.

While the practise of beaching vessels is believed to have been common throughout the second millennium, the practicalities of such a method being undertaken, particularly regarding heavier craft, have to be borne in mind.

Alternatively it was not necessary for ancient

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[7] In Homer's Odyssey XVI.325 and VI.263-9 vessels are respectively described as being 'dragged up on the beach' and 'drawn up to the road'.

mariners to beach the whole length of their vessels. Sometimes boats would be dragged up a sloping beach so that their bows were grounded but their sterns were still afloat, as described by Homer (Odyssey XIII.110), often attached to two anchors, one aft and one forward on the beach (Flemming 1972: 66). We have probable evidence for the partial beaching of vessels from the depiction of the small harbour associated with the Third Town in the Ship Procession fresco on the south wall of Room 5 in the West House at Thera (Shaw 1990: 431,fig.18-19; Fig. III.3).

By the mid-first millennium BC, the introduction of false keels, as seen on the 4th century Kyrenia wreck (Steffy 1985: 72-77), is believed to have protected keels from being damaged when vessels were dragged ashore. However, as yet we have no evidence of false keels being used in the second millennium BC.

Thus, problems of beaching vessels appear to have been heightened when vessels were loaded, although when the cargo was well distributed beaching was practicable. Light vessels, such as fishing boats, were therefore preferable for beaching and are still dragged ashore with the use of rollers around the shores of the Mediterranean today (Fig. III.5). However, the main problem encountered in the Mediterranean is the unbeaching of loaded vessels. Thus, if mariners just wished to load or unload their vessels it would seem more logical to do so by anchoring in the

shallows. Whereas warships could be beached and merchant vessels dragged ashore at the end of the sailing season, it would seem less likely that loaded cargo vessels would have been beached because of the weight of the vessel.

Thus, contemporary evidence for the beaching of vessels is limited. In general we should assume that such techniques were practised then as they are today, and that early sailors made the most of the available opportunities.

ANCHORING

Even today it is common practice for boats to anchor some distance offshore or either side of peninsulas in sheltered havens. If substantial docking facilities are unavailable or if inshore waters are too shallow and prohibit boats from approaching the shore, then anchoring can often be the only alternative. The assumption is that from their anchorages ancient mariners would use smaller vessels to get ashore[8]. Such an event may be depicted on the Egyptian tomb relief of Syrian sea-going vessels in an Egyptian port in the tomb of Kenamun, at Thebes, datable to c. 1500 BC (Casson 1971: Fig.18); or on the Theran miniature frieze, on the west wall, Room 5, West House, Thera, where vessels are seen anchoring off a town with stevedores unloading and merchants setting up shop on the

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[8] Frost (1995b: 1) makes reference to observing 'loading by lighter' being practised along the Cypriot coast this century.

beach (Shaw 1990: 431,fig.19; Fig. III.3). Alternatively, mariners could have simply swum or waded ashore, used rafts or have been assisted by animals pulling carts through the shallows and up the beach.

Where surveys have been carried out within harbours or at anchorages, such as at Tel Nami (#144; Marcus 1990) and Tel Dor (#145; Kingsley & Raveh 1994) in the southern Levant, and around the coast of Cyprus (McCaslin 1978,1980; Green 1973; Giangrande et al. 1987), considerable numbers of anchors have been discovered, clearly abandoned by vessels after unsuccessful retrieval. However, we should bear in mind that where there has been heavy siltation of harbour areas, anchors may not be easily detected.

Little is known, however, of the form of anchors or the numbers that were carried on board second millennium BC ships. Honor Frost has outlined three main groups of Bronze Age anchors based on their function. The majority of anchors referred to were recovered from Ugarit (#89) and Kition (#229; Frost 1963b: 13-15, 1970b: 377; McCaslin 1980: 18-20). These comprise:

a. 'Sand' anchors (Fig. III.6.i): small, flat stones, round or rectangular in shape, pierced with several holes. The anchor cable ran through one hole, while the other holes held sticks, acting as flukes, which gripped the sand (Frost 1970b).

b. 'Rock' or 'weight' anchors (Fig. III.6.ii): one-holed stones, usually weighing over 50 kilograms, which anchored the ship by their sheer weight (McCaslin 1980: 18). Alternatively, groups of mini-weight anchors have been found on the seabed, often in a line or string (Green 1973), implying that a 'set-long-line' of weight anchors were used to hold vessels at anchor (Frost 1973b: 405).

c. 'Composite' anchors (Fig. III.6.iii): easily distinguished by the triangular pattern of three holes cut in the stone anchor. These anchors doubled as 'sand' or 'weight' anchors, were round or rectangular in shape, and made of both stone and wood. Ships were kept at anchor by the sheer weight of the anchors and by the addition of wooden flukes, fitted into the two lower holes, that stuck into the ground. Composite anchors, introduced in the Late Bronze Age, would have greatly improved the ability of mariners to moor larger vessels in simpler ways, free of the necessity of using a string of weight anchors.

Many anchors have been found outside a marine context, such as those recovered from Ugarit, Byblos and Kition (Frost 1970b, 1995: 167-8). It is often impossible to differentiate between ancient stone anchors and modern equivalents, which imply a relatively consistent 'basic' form, at least around the coasts of the eastern

Mediterranean[9]. Stone anchors located *in situ* on the 13th century BC Uluburun wreck, southern Turkey, are rounded and rectangular in shape with a single, central hole at the top (Bass 1987). Homer (*Odyssey* XIII.77) refers to the use of stone anchors: 'they cast off the mooring line from the pierced stone'; similarly '... they cast out anchor stones and made fast the stern cables' (*Iliad* I.436).

Alternatively, stone anchors with a line were carried ashore. Sometimes this would result in the partial beaching of the vessel (discussed above). A third method was to use two anchors - one anchor being dropped over the stern approximately 50-100m off shore and the line payed out until the bow was almost aground, and a second line would be thrown ashore (Flemming 1972: 66).

Whatever the nature of the site it was imperative that vessels secured a firm anchorage, undoubtedly anchoring as close to the shore as possible to ensure maximum protection and ease of movement of goods and people between the vessel and the shore.

## MOORING POSTS OR MOORING-STONES

Independent of formal quay structures, mooring posts are difficult to identify. If constructed of wood, there

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[9] The author has observed modern stone anchors pierced with holes, being used by Arabs along the coast of Israel.

would be only a very limited chance of their survival. Even pierced stone mooring-stones or bollards are difficult to identify, if found isolated on a sandy seabed or shore. Mooring posts or stones were fixed to the beach as close to the water as possible and the vessel was secured to the mooring by a firmly attached rope.

Single-holed stone anchors or mooring stones are still seen in use in the Aegean today. The bow of a boat can be attached by a rope to such an anchor fixed, sometimes buried in the beach, just above the waterline, while the stern is often secured by a second anchor thrown into the sea. This method was particularly useful where the anchorage was very deep.

III.2.ii Formal moorings within harbours

As pointed out by Frost (1972: 95-96), the obvious problems of beaching large, heavy merchant vessels led to greater needs for efficient anchoring and mooring ie the bigger the vessel, the greater the draft, the further away from dry land she had to be beached. In particular, this meant the providing of man-made structures or artificial improvements to natural harbours, recognised in the archaeological record primarily in the form of rock-cuttings or quays. Such facilities provided essential shelter on coastlines, such as those of the southern Levant, where the number of natural anchorages were negligible.

However, evidence for such Bronze Age harbour structures does not necessarily survive to be recognised today. There can be no doubt that Bronze Age mariners constructed barriers to the sea and aids to loading and off-loading vessels with the use of organic materials such as wood. Flemming (1972: 67), during a trip to northern Greece in the 1960s, observed the construction of simple breakwaters consisting of two parallel fences of posts interlaced with light strips of wood, with the space between filled with stones. Such a structure would have acted as a substantial breakwater for a small harbour. Similarly, wooden jetties jutting off the shore in sheltered bodies of water, still seen in use around the

shores of the eastern Mediterranean (Fig. III.7), would have provided adequate means by which to moor vessels and load and off-load craft in the Bronze Age. Unless preserved in an anaerobic environment, such structures would however, rot in a matter of decades leaving no trace in the archaeological record. Likewise lines of rough stone jetties would have served a similar purpose in the Bronze Age, as today (Fig. III.8). However, they are almost impossible to date.

ROCK-CUT INSTALLATIONS

There are a number of examples in the eastern Mediterranean where offshore rocks, especially those acting as breakwaters, have been cut and flattened on the sheltered, landward side and used as moorings in the Bronze Age. Such rock-cut installations have been adapted from kurkar ridges or reefs at a number of sites along the Levant coast, including Sidon (#122) and Tyre (#125), as well as at the Egyptian harbour of Pharos (#193). These offshore rocks and submerged reefs no doubt presented a hazard to Bronze Age seamen, but at the same time afforded shelter inshore. Despite subsequent weathering, erosion and even submergence of these offshore reefs, many still yield evidence of having been adapted as shelters for vessels.

The initiative to secure safer moorings by adapting rock-cut installations, no doubt progressed from the simple

custom of securing a vessel to a rock. Rock would be quarried from the inshore side of a reef or small rocky island, creating a flat, dock-like surface alongside which vessels could moor to a stone bollard or anchor and unload their goods. The quarried rock would then have been used to build up a masonry sea wall on the seaward side of the island, so providing additional protection (Frost 1980,1964: 67,fig.1; Fig. III.9). In some examples, such as at Sidon (Frost 1972: 102-107; #122, Fig. # 122.5), large areas were cleared on the reefs, and additional harbour facilities such as storm-proof houses and storerooms were built on them. Subsequent erosion has resulted in the collapse of large numbers of these seawalls, the remains of which are now found scattered beneath the water. The islands of Machroud (#104) and Arwad (#102), which lie immediately opposite the two Bronze Age towns of Amrit (#104) and Tabbat al-Hamman (#105), both display quarrying and rock-cut harbour installations.

Shelter was also sought behind offshore reefs along the essentially exposed coast of the southern Levant. In general the kurkar reefs along this stretch of coastline are smaller, and lie closer to the mainland, than those of the northern Levant; consequently, moorings were more commonly associated with the mainland than with the reefs. Examples of anchorages that were sheltered in this fashion include Achziv (#131), Tel Dor (#145) and Tel Mikhmoret (#153). Many of these installations have now been eroded by

the sea. Alternatively, shelter was sought within river mouths, a number of which were kept silt-free by the introduction of rock-cut channels (Raban 1987: 180-184). The added ability to keep sheltered anchorages silt-free by rock-cut means is evident from as early as the Middle Bronze Age (Raban 1985,1987). Mariners constructed retaining walls or dams, such as at Tell Abu Hawam (#137), and de-silting channels, at sites, such as Tel Mevorakh (#148), Misrefot-Yam (#130) and Achzib (#131), that were particularly prone to silting. Raban (1991: 137) describes the principal of constructing dams and de-silting channels as follows:

> 'The basic solution was to block the natural river course, somewhere upstream [of] the harbour basin, by a solid dam that would keep off the alluvial sediments, and to dig an alternative outlet if necessary. Then it was demanded/ [necessary] to establish the navigational channel, connecting the harbour to the open sea, so that it could be kept free of wave carried silt. Such channels, if confined well enough, by limited width and rocky or stone built retained banks, might have been flushed by the overflow of water above the dam, in order to keep them silt free' (Raban 1991: 137).

Such rock-cut installations are described by Frost (Frost 1972: 95-97) as 'proto-harbours' (pre-Classical), as they provided a feasible form of protection on an otherwise exposed coastline. However, the dating of rock-cut installations is problematic. Many sites possessing rock-cut installations are associated with Phoenician and later occupations, but some, such as Machroud (#104) and Arwad (#102), are related to Bronze Age anchorage sites. Although

some archaeologists dispute that Bronze Age seafarers would have had the capability and technology to construct such vast harbourworks, it was surely not beyond the capacity of Bronze Age mariners to realise that slight improvements to the offshore reefs, behind which they already anchored, would vastly increase the protection they afforded. As Frost (1972: 97) points out,

> 'if the reefs were sufficiently reinforced so that the linear barriers were long enough to provide safe anchorage, then the deep water anchorage between the off-lying ridges and the mainland provided ideal shelter'.

The problems of dating rock-cut installations will be discussed below.

## QUAYS AND JETTIES

The most advanced mooring installations to be developed towards the end of the second millennium were quays[10]. Ships would either berth[11] at a quay stern-to or alongside. Quays developed in a number of areas of the eastern Mediterranean in response to different needs.

Along the Levantine coast, a number of the offshore islands and reefs that were outlined in the previous

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[10] A quay is a projection (usually stone) along the boundaries of the harbour which provides accommodation for ships to lie alongside for loading and unloading (Kemp 1988: 679).

[11] A berth is the place in a harbour where ships ride on their anchors or are secured alongside the quay (Kemp 1988: 80).

section, such as Sidon (#122) and Tyre (#125), also possessed stone quays, made up of ashlar blocks[12], constructed upon the stone foundations that had previously been hewn out of the offshore kurkar islands. Again the dating of these structures is problematic (see below) but a number of these ashlar masonry installations are associated with sites such as Tyre (#125) and Arwad (#102), that are known to have been used as harbours before the Phoenician occupation. The techniques of cutting and quarrying rock, particularly soft sandstone, and the use of ashlar masonry, although not in a maritime context, is evident throughout the eastern Mediterranean for much of the second millennium BC (Hult 1983: 61-62,table IV).

The chronological framework in which Bronze Age mariners progressed from the construction of rock-cut installations to the first adoption of quays, is problematic. However, assuming shelter was sought behind offshore reefs that were later adapted by rock-cuttings, then developing the technology to construct quays and jetties was surely the next step in the evolution of harbour technology. The addition of dressed stone to the hewn offshore reefs would have permitted improved facilities for the handling of cargo and have provided a flat vertical surface alongside which a ship could berth.

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[12] Ashlar blocks are hewn blocks of stone masonry (Hult 1983: 1,91). When in place, the visible face is wrought and is near rectangular in shape. The faces which are not visible are mostly unwrought, and the sizes of the blocks vary considerably.

The Theran Ship Procession fresco outlines possible depictions of quays in front of the Third 'Arrival' Town (Shaw 1990: 431; Fig. III.3). Raban (1991: 142) also identifies quay constructions at Ràs Ibn Hàni (#91) on the coast of Syria, and at Hala Sultan Tekke (#230) and the 13th century bastions of Kition Kathari (#229), in Cyprus (Raban 1991: 142-145), although there is disagreement over these observations and theories.

The main source of evidence for the use of stone built quays, canals and harbour basins during the Bronze Age comes from the harbours of Egypt and from Egyptian pictorial sources (see Ch.III.1.b). Most of the evidence comes from quays in riverine harbours where the physical stresses are obviously not as great as those affecting coastal quay constructions. However, evidence for quays also comes from the coastal harbour of Pharos (#193).

The temples of Karnak, Amon and Montu, at Thebes, erected in the 18th Dynasty, were connected to the Nile by canals and fronted by quays (Baines & Malek 1980: 90-92). Excavations at Karnak in 1970 revealed a stone quay at the western entrance to the Temple of Karnak, built during the reign of Ramesses II and reported to be at least 95m long from north to south (Lauffray et al. 1970: 57-58; Fig. III.10). The quays are seen to be less rectangular in shape than is implied on the relief in the Tomb of Nefer-Hotep (see below). The quay is divided into two major components:

> 'a platform enclosed by a stone parapet, called a 'debarcadere' ie landing stage..., and a true quay at least 2m below the top of the parapet. The quay extends both north and south of the landing platform. The northern extension has a stairway that probably led down to the river level where the transiting of cargo and passengers took place' (Marcus 1990: 22,fig.13; after Lauffray et al. 1970: 57-59,fig.1).

Depictions of the lake connected to the inner T-shaped harbour basin at Karnak, which also links to the river by a canal c. 800m in length, are shown on a panel from the Tomb of Nefer-Hotep (Davies 1933; Fig. III.11). The quay wall and parapeted platform depicted is nearly identical to the temple complex at Karnak mentioned above (Marcus 1990: 57).

The main harbour remains on the west bank of Thebes, Birket Habu, now lie some 2.5km from the present course of the Nile (Kemp & O'Connor 1974). The harbour basin at Birket Habu is believed to have been built in c. 1420 BC. Enormous mounds of sterile sand, earth and gravel lie in the area around the former harbour basin, presumably spoil from the time when the harbour was excavated. The harbour is now filled with alluvial sediment. Birket Habu was originally rectangular in shape and joined by a canal to the old course of the river (Kemp & O'Connor 1974). The length of the canal is uncertain; it is known that the course of the Nile in the New Kingdom was somewhat similar to its present one, but excavations have been unable to trace the course of the river prior to this date (Kemp & O'Connor 1974). The harbour is situated on what was a

natural bay in the river, and the basin is aligned roughly parallel to the desert terrace. The harbour walls were of mud brick and are thought to have been built at a gentle angle, so as to provide structural stability and allow vessels to beach. The harbour covered an area of 2.4 million metres squared and has been estimated as being c. 5.9m deep, based on the amount of excavated material (Kemp & O'Connor 1974: 110,128), making it one of the largest artificial basins of the ancient world. The great size of the harbour basin at Birket Habu must imply its involvement in and contribution to Egyptian expansion of foreign trade and relations of the period, 'for these relations were maintained principally by sea and river traffic implying larger fleets and perhaps larger vessels than existed in earlier periods' (Kemp & O'Connor 1974: 136).

The ancient settlement and palace of Amenhotep III (1417-1379 BC), Malkata (Malqata), lies to the north of the harbour of Birket Habu. It is believed that the two were constructed as one unit. The settlement of Malkata afforded royal docking facilities as well as recreational facilities on the lake. The harbour would not only have allowed the trans-shipment of imported goods but also the delivery of local supplies and building materials, possibly for the construction of the mortuary temple at Medinet Habu 1km to the north. The mortuary temple was constructed by Ramesses III (c. 1194-1163 BC) and used to be connected to the Nile by a canal (Baines & Malek 1980: 98). Marcus (1990: 24)

believes that the canal was constructed prior to the building of the temple in order to facilitate the transportation of building material. Outside the temple enclosure, to the southeast, there is a landing quay which leads to the East gate, sometimes called the 'Pavilion' (Nelson & Hölscher 1934; Fig. III.12). The landing quay was constructed of fine ashlar masonry and is believed to have ended in a T-shaped basin (Hölscher 1951: 12,fig.10 in Marcus 1990: 24,fig.15). At the western end of the basin a stone parapet was constructed which acted as a platform for those awaiting the approaching procession. The surface of the water was reached by two parallel stairways on either side of the quay (Hölscher 1951: 13,fig.12 in Marcus 1990: 25). Little is known about the size of the canal or basin as they are covered by nearly 3m of alluvium (Hölscher 1951: 11-13 in Marcus 1990: 25). At the site of Abydos the remains of an ancient channel which connected the site with the Nile River may still be seen today. The channel leads directly to the front of the temple of Seti I (Bietak 1979: 114,nt.34a).

The tomb of Khaemhat at Thebes displays scenes of a fleet of twenty-one ships anchored at a quay, perhaps Birket Habu (Kemp & O'Connor 1974: 106). However, probably the best known wall painting from Thebes depicting ancient sea-faring is that of the tomb painting (162) of Kenamun, in which Canaanite vessels are depicted moored at an Egyptian port, possibly Thebes (Davies & Faulkner 1947;

Fig. III.13) - The depiction constitutes a clear reflection of Egyptian trade contacts with the eastern Mediterranean, displaying a wealth of material culture paralleled in the eastern Mediterranean, as well as peoples from the Levant and Crete. The relief of Kenamun portrays not only the arrival of foreign vessels, but also depicts ships off-loading at quays with planks and steps for access, as well as associated harbour activities such as quay-side trading, booths and stalls and harbour administration (Davies & Faulkner 1947: 40-46). Finally, the 14th century BC tomb painting no.14 at El-Amarna depicts ships moored to a quay, possibly at either the site of Medinet Habu or at Birket Habu (Kemp & O'Connor 1974).

The evidence for quay construction discussed so far is related to riverine structures or those adapted on offshore reefs where a solid rock foundation already existed to support the quay. In a marine environment, lacking offshore reefs, Bronze Age engineers had to overcome the problems of constructing quays based on sandy bottoms where wave-initiated currents would have an undertrenching effect on the solid masses, due to the vacuum created by water retreating from a vertical wall. Raban (1989: 4) describes how

> 'once a single block has been sucked off the face of the vertical wall by the surge, it is only a matter of a few years before the entire structure is hollowed from its less consolidated fill beyond its façade, and then the ever-widening opening eventually causes a total destruction of the mole'.

To overcome this problem marine structures had to be built in such a manner that each component had a maximum physical integration within the wall. This goal was achieved by the introduction of ashlar blocks laid in a 'header-type' system.

The header system of quay construction involved the use of ashlar blocks ie, long, slim, rectangular hewn stone blocks, with smoothly even faced sides all round. These were carefully laid with their narrow sides perpendicular to the face of the harbour wall (Raban 1989: 4).

> 'They were laid in tight courses with their joints in a very close fit. These joints would be long enough to give maximum drag if any neighbouring blocks in the wall moved, so each individual component would have maximum physical integration with the structure' (Arenson 1990: 61).

This would help counteract the erosive effects of the waves, and produce a far more sturdy, durable structure (Raban 1989). However, the cutting of natural rock to enhance the protection provided by offshore reefs (described above) does not provoke additional silting, whereas walls built directly on the sea floor inevitably obstructed the currents that flowed across them, causing silt to accumulate.

Although limited, there are examples of free-standing vertical sea walls of ashlar headers in the Bronze Age, and it does appear that by the end of this period the technique to build them had been developed. The best example of Late

Bronze Age quays in the southern Levant are the series of quays constructed along the north shore of the lagoon of Tantura at Dor (#145). Here a successive series of quays, built of ashlar blocks in the header system, were laid over earlier structures dated to the 13th and 12th centuries BC - possibly, according to Raban (1983: 236-238, 1987), in response to rising sea level (see Fig. # 145.7).

## III.3 Dating Evidence

Harbour installations or rock-cuttings adapted to form moorings are found in association with sites of many periods. Dating these facilities in order to establish when they were constructed is problematic. In order to establish when an anchorage was first used or when harbour facilities were added, we first have to look to the date or dates of the associated settlement. Contemporary textual references to the existence of a site during the second millennium BC can also be used to support its use as an anchorage in this period.

Harbours may have been built over several periods and comprise several archaeological strata that give variable indications of their date of construction. However, as there is no soil on rock-cut reefs, stratigraphic dating is out of the question. Besides odd fragments of stylistically datable masonry, the only evidence available to ascertain their construction date is geological. Thus, dating second millennium BC harbours may involve geological and biological as well as archaeological analysis.

One method of dating harbour installations is by a comparative estimate of sea-level change. Harbour installations, such as quays, slipways and mooring bollards, were built in relation to the mean sea level at that time. The relationship of these structures to modern-

day mean sea level is therefore an indication of relative sea-level change and consequently the approximate period during which these coastal structures were established. Sea-level changes are not always easy to determine, particularly in tectonically active areas which result in localised changes (see Ch.IV.2). It is generally believed, assuming a relatively stable tectonic environment, that the sea level of the eastern Mediterranean has changed comparatively little over the last two thousand years (Flemming 1969). Thus, a number of harbours which are now submerged must have been built before this recent period of relative sea level stability, assuming that all other factors are constant (other than eustatic sea-level rise) and that silting has not occurred.

In certain circumstances, however, there are more definite clues. Features known as trottoirs, or wave cut platforms, which form as a result of wave action on rocky coastlines, are indications of the previous level of mean sea level. Similarly, pitted natural holes called `solution bases', or marmites, formed by the action of waves joggling a heavy stone on a rock platform until a hole is worn in the soft beachrock of the trottoirs, are also indications of the previous level of mean sea level. As both trottoirs and marmites can only be formed by waves at mean sea level, then any alteration in the mean sea level relative to these formations must indicate a change in sea level over time (Frost 1972: 112). These features, as well as large blocks

of submerged masonry, have been observed on the offshore reefs of Award (#102) and Sidon (#122), on the coast of the northern Levant.

In recent years, other methods of dating using geomorphological indicators of sea-level change have been developed. During the 1960s, geologists and geographers such as Fevret, Sanlaville and Picard (1965, 1966, 1967), working along the northern Levantine coast, realised that an organic concretion of algae and vermetidae molluscs (that can only live at mean sea level) grows profusely in the wave zone ie oxygenated conditions (Safriel 1975: 85-101). Growth is most active in the zone where the waves break over the edge of the abrasion terrace, thus raising the edge and forming a rim, known as a vermetus ring, which encloses a distinct raised pool (Flemming 1978: 42). These vermetid depositions can be radiocarbon dated (Frost 1995b: 8). By dating the vermetid depositions on the edge of the abrasion terrace, it is possible to determine the date at which wave action formed the trottoirs. Consequently, it is possible to date the raised or submerged trottoirs relative to present sea level and any associated archaeological features.

Sanlaville (1972) published a paper suggesting new ways of applying this method to date ancient harbourworks. By analysing the remains of dead vermetidae on oscillating wave notches along the Syro-Palestine coast, Sanlaville was

able to identify two notches at 2m and 1m above the present sea level, called respectively the `Zennadian' and the `Tabarjian' lines. He dates the first notch roughly to the first half of the second millennium BC, and the later `Tabarjian', to between 200 BC and 200 AD. Once the dates of these lines are established, the associated rock-cuttings, quays or harbour installations can be dated relatively. Erosion notches have been identified at Sidon (#122; Frost 1973: 78,fig.4,88-89) under a series of rock-cut mooring bitts or bollards which correspond to the erosion notches identified by Sanlaville and thus imply that 'the bitts must therefore have been cut either during the Early Bronze Age, before this rise [Zennadian], or during the regression between the Zennadian and the Tabarjian levels' (Frost 1973: 89).

Further indications of sea-level change are marine solution notches. Sea water dissolves notches in calcareous rocks even in the absence of wave action. On exposed coasts, notches have been identified cut into the sides of calcareous rocks; these notches measure between 30-50cm in width, and approximately the same in depth into the rock. In sheltered waters, or within caves or rock-cut tanks, two notches may be cut, one at mean high water and one at mean low water. The vertical displacement of these notches can be used to measure relative changes in sea level, and provide indications of the period during which the feature was formed.

Frost (1980) has described how drillings taken by the Compagnie Français des Pétroles (Wetzel & Haller 1945-48) on the reef island of Arwad (#102) demonstrated that after the deposition of the Arwad reef,

> 'the sea rose (relative to land) above its present level, then retreated again, returning towards the end of the Iron Age to a height of 3-4m above present level. Finally it sank once more to its present level. In other words, before the Iron Age the reef would have stood higher above the water than it does now, strongly suggesting that the submerged rock-cut foundation courses must antedate the Iron Age' (Frost 1980: 4).

The dating techniques outlined above offer some additional support towards the dating of rock-cut harbour installations. With regard to the rock-cut installations at sites discussed above, such as Sidon (#122), Tyre (#125) and Machroud (#104) and Arwad (#102), these techniques now indicate that sites, originally believed to have been Phoenician (Poidebard & Lauffray 1951), also belong to a period prior to the first millennium BC (Frost 1972, 1973). The use of such dating techniques are in their infancy and their applications limited. Nonetheless, by combining such techniques with contemporary documentary and archaeological evidence, it is possible to infer that these sites were used as anchorages during the second millennium BC.

Thus, the sources of evidence for determining the existence and date of Bronze Age anchorages are both numerous and diverse, comprising a mélange of material that, when considered altogether, gives some impression of their location and nature. However, it is unfortunate that substantial evidence is negligible and rarely definitive.

Chapter IV

## The physical determinants of anchorage site location

> 'The Mediterranean Sea presented a combination of geographical conditions highly conducive to the early development of navigation. Fertile coastal lowlands and valley plains opening seaward between sheltering promontories drew population to settle on the littoral. Amply articulated coasts with abundant harbours and broad home waters furnished ports and practise grounds for fishermen and maritime traders. Mountain forests rising directly from the littoral provided lumber for shipbuilding, while barring the way to the hinterland and emphasizing the feasibility of maritime communication. The long summers of cloudless days and starry nights, of steady winds and fogless atmosphere provided a favourable season for sailing, when the strong diurnal breezes favoured the out-going and home-coming ships, and the countless promontories and mountain islands, visible in the lucid air, furnished points to steer by before the invention of the compass.' (Semple 1932: 579).

Anchorage site location is determined, and constrained, principally by two criteria: the physical nature and conditions of the coastal configuration, and the socio-political climate prevalent during the period under discussion. The latter factor determined the centres and routes of trade during the second millennium and has been discussed in Chapter I. The former primarily addresses the nature of the coastal topography and prevailing maritime conditions. A consideration of the capabilities of second millennium sailors and their vessels sail performance is an additional concern when considering anchorage site location and has been discussed in Chapter II.

This chapter considers the physical determinants of

anchorage site location and aims to outline the nature of the coastal topography around the shores of the eastern Mediterranean during the second millennium BC, analysing any changes that have occurred during and since the period. A topographical typology of anchorage types will be presented, as well as a synopsis of the prevailing maritime conditions of the region. All the topographical features referred to in this chapter are placed on the Main Map.

## IV.1.a. The topography of the coastlines

The coastal topography of the eastern Mediterranean is extremely diverse, with each section of coastline providing a varying degree and type of protection for vessels. The nature of the coastal topography and the degree of protection it afforded was thus an important factor in determining the location of anchorage sites. This was particularly the case in the second millennium BC when know-how was limited and little attempt was made to enhance, by artificial means (eg groynes, breakwaters etc), what natural protection was offered. The following is a brief outline of the coastal regions of the eastern Mediterranean and the differences in topography. The coastal regions of the east Mediterranean will be discussed in clockwise order starting from southwest Turkey, running east to the coast of the Levant and south to the Egyptian coast. Cyprus and finally Eastern Crete will also be included.

### TURKEY

The southern coast of Turkey, extending from the Bay of Fethiye in the west to the Cilician Delta in the east, is predominantly a rocky coastline with cliffs and many small sheltered bays. This coastline forms the southernmost extent of the mountainous region of southern Turkey. The region is divided by the extensive plain of ancient

Pamphylia (Antalya), some 80km wide. The Lycian Peninsula, an extension of the Western Taurus Mountains, lies to the west and the Taurus Mountains continue to the east (Fig.IV.1). Where the mountains approach the sea, their slopes have been bisected by deep river valleys which have caused the formation of small bays and flat sedimentary plains (Bean 1989).

At the western extent of the Lycian Peninsula is the Bay of Fethiye. The mouth of the gulf trends to the south and fronts the abrupt ends of the outer range of the Western Taurus Mountains. To the east, the Kinik Plain, watered by the River Eşen (Koca/ Xanthos), is the flattest plain in all Lycia (Toksöz 1986: 5). At its mouth is the long, sandy beach of Patara (#13). Beyond, the high rugged coast is deeply indented with a number of sheltered inlets and fringed with islands, the largest of which are Kastellórizon and Kekova. A number of silted river valley bottoms also exist along this stretch of coast. They include the area around Finike, where a delta formation extends as a beach for over 20km from Finike Bay in the west to Cape Gelidonya in the east (see Fig. #29). Beyond Cape Gelidonya the coastline trends north along the western edge of the Gulf of Antalya. At the head of the gulf lies the Pamphylian Plain, the largest example of a silted river basin along this stretch of coast, with access inland to the Anatolian Plateau.

To the east of Antalya the shore is low and sandy, behind which a broad, undulating plain, composed of Quaternary sediments, stretches to the foot of the Taurus Mountains. Several rivers run off the Taurus slopes. It is believed that many of these rivers were once navigable and served inland riverine harbours such as Perge and Aspendos (Akurgal 1985: 333). However, since the first millennium BC these rivers have silted up and the coastline has advanced by 4-5km (Erinç 1978). This low, sandy coast continues east beyond the River Manavagat. At Kara Burun the coastal plain gives way to the forbidding slopes of the Taurus Range which form a steep coastline of cliffs that bar penetration of the interior (Fig. IV.2). This stretch of coastline is known as Rough Cilicia or Cilicia Tracheia, with steep cliffs dissected by deep river valleys, fronted by small bays and alluvial basins (Fig. IV.3). The coastline subsequently runs parallel to the main Taurus Mountains. Thus, although sections of the coast may provide temporary sheltered anchorage in flooded valleys, it is unlikely that major harbours would be concentrated along this part of the coast, as settlements would then exist in isolation with no access to the hinterland. In some areas, such as around Alanya (#43), Gazipaşa (#45) and Anamur (#49), several river valleys have coalesced to form small coastal plains composed of Quaternary sediments. These small coastal plains are bordered by broad beaches; the lower courses of the rivers being cut off from the sea in the summer by arcuate bars (Evans 1971: 387; Fig. IV.3).

Near Silifke the River Göksu emerges from the mountains to form what is at present a spectacular delta whose flat alluvial surface is in marked contrast to the nearby Taurus Mountains. Levées border the river while the delta is surrounded by broad beaches with high dunes on their landward sides. Small lagoons are enclosed by the sand in the southwest of the delta (Fig. IV.4). Access is possible inland from the delta to the Anatolian Plateau. From the eastern flanks of the Göksu delta to a point near Erdemli, Miocene rocks reach the coast forming sea cliffs. Small pocket-beaches are present between rocky headlands and where ephemeral streams reach the coast.

Towards Mersin (#67) the coastal plain broadens and is fronted by a sandy beach formed by a complex of alluvial fans (Evans 1971: 389). To the east of Mersin the coast opens up to the smooth plains of the Seyhan (Çukurova) and Ceyhan deltas, known as the Cilician Plain or Delta, Smooth Cilicia or Cilicia Pedias. The low-lying Cilician plain, ranging between 10-20km in width, is bounded to the east by the Misis Mountains, a high ridge which ends in a rocky, limestone headland to the southwest of Karataş (#71). The area thus enclosed is a Neogene-Recent basin which appears to extend southwest beneath the waters of the Mediterranean and which is continually being infilled asymmetrically by sediment from the north and northeast (Evans et al. 1978).

The Cilician Delta is the product of numerous rivers,

principally the Seyhan, Ceyhan, and, to a lesser extent, the Tarsus rivers, which flow off the Taurus and Amanus ranges and deposit their sediments, silting up the valley to form a fluvial plain. The delta is composed of three slightly tilted fill terraces of Pleistocene age, surrounded at its lower level by a deltaic plain (Erinç 1978: 87-108; Fig. IV.5). Access to the interior plateau is possible here via the Cilician Gates, and through the Amanus Range over the Beylan Pass. The coastal plain is flat and featureless and progrades in a southerly and east-south-easterly direction into the Mediterranean Sea. The low, sandy shoreline of the plain between Mersin and the Karataş promontory, a total distance of 70km, consists of beaches backed by high dunes which enclose a number of lagoons and swamps (Fig. IV.4). The rivers show well-developed meandering with points of bar accumulation and some large channel banks at the back of the delta. The line of the coast is constantly fluctuating and little shelter is provided. Strong currents and low-lying bars along the river courses make navigation difficult.

To the east of the Cilician Delta lies the Gulf of Iskenderun. The gulf extends c. 65km to the northeast from the entrance point at Cape Karataş. It is flanked on the north-western side by the Misis hills. Northeast of Karataş a rocky coastline runs in a north-easterly direction c. 8km to the southern shores of the mouth of the Ceyhan delta, a reedy, lagoon-filled swamp fringed with dunes. Yumurtalik

(or Ayas) Bay is a sheltered E-facing bay that bounds the north side of the delta. The northern shores form the southern flanks of the Misis hills and are cliff-lined with several sandy beaches and backed by a dry coastal plain. Bittern Point projects from the middle of the north shore of Yumurtalik Bay and provides sheltered landing on beaches either side. On a point at the north-eastern end of Yumurtalik Bay is the Classical harbour of Aegae (#73).

From Aegae the coast trends to the northeast and is fringed by reefs for some distance before reaching the sandy shores of the Plain of Adana which lies at the head of the Gulf of İskenderun. The gulf is lined with dunes and shingle on its eastern shores and backed by the foothills of the Amanus Range. The head of the gulf is SSW-facing.

To the south the coast reaches the northern extent of the foothills of the Amanus Range (Gâvur Mountains) at Payas. It then trends southwards along the foothills of the Amanus Range to the sheltered, NNW-facing bay of Iskenderun, which lies at the southern end of Gulf of İskenderun. From İskenderun the coastline trends southwest for 40km to Hinzir Burun and is bordered by a narrow coastal plain and backed by the Gâvur Mountains. Arsuz Bay provides good summer anchorage along this stretch of the coast (Geo. Handbook 1942: 101; #79).

At Hinzir Burun the coastline turns to the south-

southeast along the northern side of Antakya Bay. The southern end of the Gâvur Mountains rises abruptly from the sea, creating a coastline with few long beaches and off-lying rocks. The River Orontes (Asi) enters the head of the bay, with a plain at its wide mouth and beaches on either side (Fig. IV.6). The River Orontes is the first major river on the north-eastern shores of the Mediterranean south of the Gulf of İskenderun and provides access through the Amanus Range to the Antioch Plain to the east. Now heavily silted, the mouth of the river once formed a broad bay which contained the riverine port of the first millennium BC settlement of Al Mina (#81).

NORTHERN LEVANT

To the south of the River Orontes is the headland of Ràs el Basit. From here to Latakia the coastline is made up of a series of low-lying promontories and cliffs. The coastal plain is negligible and the only real shelter is provided by the bays of Latakia (#93) and Minet el Beida (#89) (Fig. IV.7).

The coastal plain is at its widest further south between Tartus and Tripoli. At this point, the plain of Akkar provides the only access inland, the route passing between the Jebel Ansariyeh (Bargylus Mountains) to the north and the Lebanon Mountains to the south, along the River Eleutheros linking Tripoli (ancient Simyra; #111) with Homs on the Upper Orontes (Semple 1932; see Main Map).

Between Tripoli and Beirut, to the south, the high peaks of the Lebanon - rising to approximately 3000m - run down to the edge of the sea, to form a succession of bays and promontories where landing is dangerous. The only safe anchorages along this stretch of coast are in lee of the peninsula at Tripoli (#111), within the southern part of Il Huri Bay (#114), Byblos (#116) and just to the north of Beirut (#120). South of Beirut, the Lebanon Ranges decrease in height and the coastal plain re-emerges to offer a number of sheltered anchorages in sandy coves that alternate with rocky peninsulas. Shelter may also be sought in lee of offshore islands such as Arwad (#102), Sidon (#122) and Tyre (#125), which form the northern extension of the kurkar ridges (see below) of the Southern Levant (the latter two are now connected to the mainland). The majority of anchorages along this stretch of coast are located where the Lebanon, Bargylus, and Amanus mountains have thrust out steep buttresses towards the inshore reefs, providing shelter and protection from prevailing winds.

SOUTHERN LEVANT

The shores of the southern Levant differ quite considerably from those of the northern Levant and are generally not favourable to maritime development because of their low, sandy morphology and lack of natural shelter (Smith 1895). The 220km long coast is characterised by a series of longitudinal ridges of fossilised sand dunes. They run parallel to the shoreline and form discontinuous

reefs, above and below the water, some 150-180m offshore (Galili & Shavit 1994) and their numbers diminish northwards. These ridges are thought to have formed during the interglacial (transgression) periods of the Middle and Upper Pleistocene and are known as kurkar ridges (Ronen 1983)[1]. The basins between them are embedded with clay and mud deposits, and are partly covered in shifting sand (Raban & Galili 1985; Galili & Weinstein-Evron 1985: 37; Fig. IV.8). The only exception to this pattern is along the shores of Haifa Bay where there are no sandstone ridges.

South of Rosh Haniqra the coastline of the southern Levant, modern-day Israel, presents very few natural havens, being an almost completely straight, sandy coastline of relatively low relief (Fig. IV.9). The only two mountains that reach the shore are Mount Carmel and the ridge of Rosh Haniqra. The coastal plain is bound by foothills to the east and is wider in the south but narrows towards the north. The coastal waters are shallow near the shore, with relatively large quantities of quartz sand that shifts along the sea bottom (Raban 1987). Only the upper parts of the submerged kurkar ridges remain relatively silt-free, despite having been subjected to a long process

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[1] The kurkar ridges were once sand dunes that ran along the coastline of Israel during stages of different sea levels. They became lithified as a result of the calcium carbonate being leached out of them by downward percolating of rainwater, leaving cemented aeolian sand, or aeolianite (Evans 1973: 102) which formed a series of parallel kurkar ridges representing different stages of sea level stands.

of abrasion and erosion by waves and currents (Raban 1983b: 217). The rivers or wadis that drain into the Mediterranean along the coast of the southern Levant are small and predominantly ephemeral (Nir 1982: 89). Beachrock[2] has been observed all along the coast with the exception of Haifa Bay (personal observation).

The northern shore of the southern Levantine coast is dominated by the steep, white, chalky cliffs of Rosh Haniqra. These cliffs form the northern border of the region and are the only mountains in the area that reach the sea at such a high elevation. Directly to the south the shore relief is much lower with isolated beaches and remnants of kurkar ridges that form small islands and islets adjacent to the shore.

The coastal plain widens on its approach to the Bay of Haifa. Haifa Bay is the only sizable bay along the coast of Israel. It is a morphological feature directly related to the Carmel horst, to the south, and the Zevulun valley graben, which forms a wide (average 10km) coastal plain to the east (Nir 1982: 87-89; Avnimelech 1959: 103,fig.1; Neev & Bakler 1987: Fig.14). It is virtually the only point at which the straight, sandy shoreline is interrupted. Here the shoreline recedes 4km inland and forms a bay which is

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[2] Beachrock is a rapidly forming rock composed of beach sand and gravel cemented by a calcareous cement of argonite or magnesium-calcite precipitated from seawater (Flemming 1978: 420).

12km long and faces west-northwest. The beaches of Haifa Bay are broad, low and sandy, with no cliff-lined areas.

To the south of Haifa Bay is the large tilted block of Mount Carmel which plunges to the south-southwest and terminates northward at a steep NW-tending fault escarpment which bounds Haifa Bay to the south (Raban 1983b: 216). The Carmel coastal plain is flat and narrow, ranging in width from only a few hundred metres wide in the north to a few kilometres in the south. It is dominated by the Carmel Range to the east. The beaches are narrow and indent in places between the kurkar ridge such as at Atlit (#142) and Dor (#145), forming small sheltered bays and promontories close to the shore. A rocky kurkar ridge also runs parallel to the coast up to 200m offshore and extends above the waterline in places, thereby providing some protection to vessels in its lee. Additionally protection is afforded within river estuaries.

The central portion of the coastline between Beth Yanai and Tel Aviv, the Sharon and Pleshet plains, is dominated by a 20-50m high coastal kurkar cliff, which is fronted by narrow beaches (Neev et al. 1976: 2). These cliffs are subjected to erosion by atmospheric agents as well as abrasion at their bases, causing a high rate of coastal retreat, which has prograded at a rate of c. 0.03m/ annum since 6000 BP (Nir 1982: 96). The low linear escarpment reduces to heights of 10-15m to the south and is

interrupted by several gaps formed by Late Pleistocene rivers. These old estuaries have since been filled by beach, swamp and alluvial deposits (Raban 1983b: 216) which has resulted in the local widening of the narrow coastal plain, particularly in the Pleshet region. Relics of offshore kurkar ridges continue to afford a certain amount of natural shore protection.

In the southern part of the southern Levant the coastal plain becomes considerably wider - up to 40km in the far south. No offshore reefs exist south of Tel Aviv where the coast gives way to a straight, gently sloping shoreline. The low-lying coast is marshy in places and inundated with sand dunes, providing little shelter for vessels.

The problems of geomorphological change and sea-level rise have greatly affected this coastline, particularly with respect to the infilling of inshore ridges by river- and wind-deposited sediments, which has caused the silting-up of numerous ancient harbours (see below Chapter IV.2.b).

EGYPT

The coastal plain of the northern Sinai lies to the east of the Nile Delta and south of the Israeli coast of the southern Levant along the north-eastern coast of Egypt. It presents a smooth, low-lying relief with well-developed sand dunes (Nir 1982: 87). Bardawil Lagoon Bar currently

dominates the coast and is bordered to the east by the bay of El-Arish and to the west by the bay of Eh-Tineh, the only two large bays on the coast. From southern Israel the coast slowly curves southwest before it trends almost east to west to form the shores of the bay of El-Arish. The beaches here are wide and sandy with high dunes on their landward side (Nir 1982: 96). The only river (wadi) along this coast is at El-Arish. To the west the low, narrow Bardawil Lagoon Bar forms the outer barrier between the Bardawil Lagoon and the open sea. It is about 75km in length and forms more than one-half of the northern Sinai shoreline. The lagoon is shallow (1-2m) and is naturally replenished by seasonal flooding over the bar from the sea. The area was previously swamp land offering little sheltered anchorage for Bronze Age seafarers. Between Bardawil Lagoon and the fossilised delta of the Nile's Pelusiac arm to the west, lies the bay of Eh-Tineh. The bay is backed by shallow beaches of low relief. Beachrock is widespread along the wide Sinai beaches (Nir 1982: 90).

The Mediterranean, northern coast of Egypt is dominated by the sandy Nile Delta. Formed as a result of continuous alluvial deposition from the River Nile, this coastline has always caused problems for seafarers as they have difficulty in distinguishing the main branches of the Nile from blind channels, sand banks, marshes, and lakes. As Diodorus Siculus wrote of this coast in the first century AD:

> "A sandbank extends along practically the whole length of Egypt, not discernible to any who approach without previous experience of these waters. Consequently, those who think that they have escaped the peril of the sea, and in their ignorance turn with gladness towards the shore, suffer unexpected shipwreck when their vessels suddenly run aground" (I 31, 3-5).

The coastal perimeter of the delta is described (Butzer 1976) as being a subdelta, made up of beach ridges, bay bars, and brackish lagoons, with an extensive salt marsh to the south. The only protection along this coast is provided by the island of Pharos (Alexandria; #193), and within marshy lagoons, such as Mersa Matruh (#198) on the coast to the west of the Nile Delta. Due to the shallow nature of the mouths of the River Nile and the unprotected lee shore, having negotiated a route up one of the main branches of the Nile (the Pelusiac to the east, the Damietta in the centre and the Rosetta to the west (see Main Map), Bronze Age sailors tended to anchor or beach further up river (Altman 1988; Semple 1932: 159-161). Navigation southward up the Nile was possible (except during the perennial flooding in August) as the river was passable until the first cataract was reached about 879km upstream (Semple 1932).

CYPRUS

Cyprus is the third largest island in the Mediterranean Sea, being approximately 198km long and 70km wide, with about 650km of coastline. However, Cyprus possesses few indentations and natural havens apart from a

couple of low-lying natural embayments and lagoons which have now silted up. Cyprus has two main mountain ranges running approximately west to east across the width of the country. The Troodos Mountains are situated to the southwest, with Mount Olympus rising to 1951m. The Kyrenia Mountains in the north run parallel to the coast. The mountain ranges are separated by the broad inland plain of Messaria which extends from Morphou Bay in the west to Famagusta Bay in the east (see Main Map).

The north coast of Cyprus runs from Cape Kormakiti (ancient Crommyou; #204) in the west, to Cape Andreas (#219) in the extreme northeast. The coast follows the northern rim of the Kyrenia and Karpas mountains. The mountains run parallel to the sea and form steep cliffs along the north coast of Cyprus, fronted by a narrow coastal plain. A small number of anchorages exist along this coastline; they include shelter to the west of Akhiropietos Head (#207), the indentation of the coastline at Kyrenia (#209) and to the east of Cape Plakoti (#215).

The point of Cape Andreas is an extremely rocky and steep peninsula, with restricted anchorage on the southern side except in lee of the promontory of Khelones (#221). The large, broad bays of Famagusta and Larnaca provide the best anchorage on the eastern side of Cyprus. The inland lake of Enkomi (#224), later replaced by the first millennium BC anchorage of Salamis, was the main harbour in

Famagusta Bay.

The Bay of Larnaca fronts a large plain and is headed by a stony beach. On the north side of the bay the land rises slightly and is fronted by a sandy beach. Numerous anchorages existed around this bay including the Late Bronze Age anchorage of Kition Kathari (#229). The Late Bronze Age harbour of Hala Sultan Tekke (#230) made use of the present-day Larnaca Salt Lake that then provided an enclosed anchorage with inlets directly open to the sea. This area is now very marshy and the harbour has silted up. The present coastline is now some distance from the ancient shoreline due to sedimentary infilling.

The southern point of Larnaca Bay is delimited by Cape Kiti (#231). From here westward to Cape Dolos, the Troodos Mountains reach the sea and the coast is extremely rocky and steep with outlying rocks. There is a small bay to the east of Cape Dolos and to its west lies the larger, rocky bay of Akrotiri. Akrotiri Bay is exposed to the southeast and modern Limassol is situated on the northwest shore.

The southern shores of Akrotiri Bay skirt the eastern edge of the peninsula of Akrotiri. The peninsula projects some 8km south of the general coastline and is approximately 6km broad with rocky cliffs at its southern end. In the middle of the Akrotiri Peninsula is the present salt lake of Akrotiri where an ancient harbour site is

believed to have been situated (#237).

To the west of the Akrotiri Peninsula lies the bay of Episkopi. Its eastern shores are low and sandy, while to the northwest cliffs rise up above small bays. From Cape Aspro to Paphos Point in the west, the coastline is generally rugged with sunken ledges and rocks bordering the shoreline. However, shelter can be found to the southeast of Paphos Point (#247), in lee of the Moulia rocks (#246) and in the mouths of rivers.

To the north of Paphos Point, the coastline is low and flat with sunken ledges and islets. To the south of Cape Drepanum some shelter is believed to have been provided either side of the anvil-shaped headland of Maa Palaeokastro (#248). To the north of Cape Drepanum a series of sandy bays are exposed to prevailing westerly winds, although some shelter is provided on either side of Lara Point (#252). North of Lara Point there are a few sandy creeks, but the coastline is essentially harbourless.

To the east of Cape Arnauti is the large bay of Khrysokhou which, despite being low and sandy, is fringed by a rocky offshore reef which makes anchorage difficult. To the northeast lies Morphou Bay which is situated at the western end of the Messaria Plain; this is also quite a rocky bay with few anchorages. The River Ovgos enters the bay on the eastern shore; the town of Morphou is about 7km

inland from the mouth of the river, and is believed to have been used as a riverine anchorage in the Bronze Age (#202).

EASTERN CRETE

The island of Crete or Kríti is traversed throughout its length by a mountain range which is divided into three sections: Madara in the west, Idhri Ori, near the middle of the island and Oros Dhíkti in the east (see Main Map). These mountain ranges determine the shape of the island, which can be described as almost rectangular. Towards the eastern end of the island a broad, flat plain or isthmus runs between the Gulf of Mirabélo in the north and Ierápetra on the south coast, providing the easiest, shortest route across the island. From out at sea the southern margins of the island appear as a serrated and furrowed limestone wall, while the northern slopes are more gradual and the submarine declivities less steep (Geo. Handbook 1945: 204). Two thirds of the island are barren. The island has numerous rivers most of which flow to the north coast. The rivers are seasonal; being swollen in winter and spring by melting snow and rain. Marshy places are common near the mouths of the rivers, areas which are believed to have traditionally been used as anchorages in antiquity before succumbing to silting.

Along the north coast of Crete in the middle of the island, is the Gulf of Iráklion, or Candia Bay. The gulf is limited on the west by the northerly projection of Cape Dia

which terminates in a high rugged coast. Southeast of Cape Dia the coast trends in a southerly direction for 6.5km to the southwest corner of the Gulf of Iráklion and forms one of the notches which mark the coast of Crete and give it its peculiar serrated appearance on a map. Rocky, bold shores line the western edge of the gulf and are fringed in places by rocks. The coast then tends in an easterly direction backed by relatively low-lying, sandy shores until it reaches Iráklion. East of Iráklion the coast runs almost due east to Cape Khersónisos. The whole of this stretch is low and rocky with sandy beaches and headlands, backed with slightly elevated sloping plains.

Approximately 8km offshore within the north-eastern approaches to Iráklion Gulf lies Dia Island. The island is a mass of limestone whose summit reaches 265m in height. The north coast is precipitous and the south coast steep, with four indented bays that provide shelter from N winds (MP IV: 56; #260).

At Cape Khersónisos the coast trends to the southeast to form the western edge of the shallow, rocky, indented bay of Malia. From the head of Malia Bay the coast trends in a north-easterly direction for c. 30km to Trapani Point. South of Trapani Point the coast continues east, gradually becoming bolder and steeper up to Cape Spinalonga, or Cape St. John. To the southeast of the cliffs of Cape Spinalonga lies the Gulf of Mirabélo, which is open to the NNE and is

29km wide. The gulf is bound to the west by towering cliffs which trend in a southerly direction and run parallel to the offshore island of Spinalonga. At the southern end of the 5km long island of Spinalonga, the mainland is joined to the island by a narrow isthmus. The deep, sheltered anchorage of Pórou Bay lies to the south of the island and isthmus (#271). The head of the gulf lies to the south and consists largely of sandy beaches alternating with rocky projections. The eastern shores of the gulf are irregular with steep and often cliff-lined coasts. Pseira Island (#277) bounds the north-eastern point of the Gulf of Mirabélo; beyond it, on the mainland to the east, lies Mochlos Point and the offshore islet of Mochlos, or St. Nikolo (#278).

From Mochlos the indented coast extends in an east-north-easterly direction to Cape Phaneromeni, to the southeast of which lies Phaneromeni Bay which is bounded on its east side by the steep bluffs of Sitía Point. The N-facing Bay of Sitía lies to the south and is c. 5km wide. The bay is backed by a gently sloping sandy coast, which is marshy in places, and fed by a river. To the northeast of Sitía Bay the coast tends north-northeast to Cape Mavro and is indented by three small bays. Between Cape Mavro and Cape Sidhero to the northeast, the coast is again indented by three small bays which are each linked at their heads by a short isthmus to the south-eastern side of Cape Sidhero, giving the impression that the north-eastern end of Crete

is made up of two islands rather than an indented peninsula. Cape Sidhero forms the north-eastern extremity of the island of Crete and is surmounted by a 208m high hill, with shoals off its eastern shores.

Approximately 5km south of Cape Sidhero lies the island of Elasa (#286). This barren, rocky island lies in the north-eastern approach to the gulf of Grándes which is situated to the southwest of Cape Sidhero. The shores of the gulf are indented by several small bays, with rocky peninsulas backed by sandy beaches; offshore there are outlying reefs both above and below water. At the southern extremity of the gulf, the steep-sided peninsula of Cape Plaka juts out into the sea in an east-north-easterly direction, to the north of which lies Grándes Island. To the south of Cape Plaka is Caruba Bay from whence the desolate, limestone coast continues southward c. 10km to Zakros Bay (#290). The coastline in this region is steep and precipitous, with flat-topped ridges and naturally terraced cliffs, occasionally intersected by gorges and ravines (Spratt 1865: 232). To the south of Cape Zakros the coast extends for c. 6.5km in a south-westerly direction to Kavallos Bay.

From Kavallos Bay the inland heights of eastern Sitía Peninsula fall steeply to the coast and the coast runs in a westerly direction and forms the north-eastern edge of the Kuphon Channel. The Kuphon Channel is bound on the

south side by the island of Kouphonisi. Kouphonisi Island (#293) is 61m in height and surrounded by high white cliffs and fringed on its south-eastern shores by a sunken reef. A number of smaller islands lie offshore, both to the north and south.

The Bay of Atherinólakos borders Kuphon Channel to the northwest, its westerly extension forming the steep headland of Cape Goúdhoura. To the northwest of Goúdhoura Cape is a S-facing bight which is known as Makri-Yalo Bay (#294). From here the coast trends in a westerly direction for some 30km until it reaches Ierápetra (#296) headland, and is high, with a narrow coastal plain, fringed by a narrow bank with rocks extending above and below the water. The Ierápetra headland forms the eastern extent of the sandy bottomed, S-facing bay of Ierápetra. Ierápetra stands on a small plain to the west of the bay in an area of marshy coastline. The low-lying island of Gaidaronisi lies c. 13km offshore.

From Ierápetra the coast trends to the west for c. 26km and is fringed with rocks and a couple of small headlands, until it reaches Keraton Bay, beyond which lies Sudsuro Bay. The two bays are divided by the River Anapodiáris which cuts through the mountains via a gorge to reach the sea across a sandy beach. The coast between Cape Sudsuro and Cape Kephala to the west is very indented with some remarkable gorges and backed by the high Asterousia

Mountains which run parallel to the shore. Cape Kephala is a prominent headland fringed with sunken rocks lying close inshore. To the west of Cape Kephala is the long, flat, sandy, SE-facing bay of Kalón Liménon (#305), which is fringed with offshore islands at its western end, shoals at its eastern end and backed by cliffs and valleys. Beyond Kalón Liménon Bay the coast extends westward to Cape Lithinon (Littinos).

Cape Lithinon is a bold and salient, cliffy headland which forms the western extremity of the Asterousia Mountains and the southern end of Messara Bay. The Bay of Messara extends over a distance of 22.5km from Cape Lithinon to the north-western point of Cape Melissa. From Cape Lithinon the cliff-lined coast turns sharply to the north for 8km to Kókkinos Pirgòs. From here the coast runs in a north-north-westerly direction and is backed by the low, sandy, often marshy shoreline of Dibáki (Messara) Plain. The low, fertile plain of Dibáki extends inland and is fed by the ancient River Lethaeus. In the middle of Messara Bay lie the two islets of Paximádhia. Beyond the Plain of Dibáki (Messara) the coast trends to the west-northwest to the valley of Ayios Galinis and then in a westerly direction to Cape Melissa.

## IV.1.b. Topographical Locational Factors

The previous section highlights how dramatically different the coastlines of the eastern Mediterranean are, both topographically and with regards to the degree to which they provide shelter for vessels. Topography is therefore a major factor in deciding anchorage site location.

Prior to the construction of breakwaters, moles, and other artificial harbour installations, we must assume that ancient mariners took advantage of the protection provided by natural coastal features to seek shelter. An ideal natural anchorage should be recognisable from the sea, should have an aspect which is congenial to both entering and leaving the harbour regardless of prevailing maritime conditions, should have an adequate supply of fresh water and most importantly should be sheltered once a vessel is at anchor. All these factors are influenced by, or a product of, the coastal topography. With these conditions in mind, we should never underestimate Bronze Age peoples ability to utilize all available resources in order to secure safe anchorage.

Based on a typology of coastlines outlined by Flemming (Muckelroy 1980: 162-163) in which he identified six main types of natural anchorage, I have established a topographical typology of second millennium anchorage

sites. The following typology is intended to distinguish between the different types of coastline upon which harbours were located and the varying degree of protection afforded by the natural coastal topography of the eastern Mediterranean.

Topographical Typology of Natural Anchorage Sites -

i Straight-line coast (Fig. IV.10.i) - A straight-line coastline is one that offers minimal natural shelter or protection from prevailing maritime conditions. Straight-line coasts are characteristic of both low-lying and cliff-lined coasts. Straight-line coasts when cliff-lined rarely provide shelter, and present a threat to shipping, particularly when winds are onshore. Straight-line coastlines are more often associated with low-lying sandy shores where beaching is possible, such as along the coasts of the southern Levant. However, on such a coastline it would be difficult to maintain a secure anchorage unless the shoreline were modified or adapted in some way. Straight-line coasts do not tend to extend for any great length before they are interrupted by rivers or promontories. No discernible landmarks are present on straight-line coasts unless there is a prominent feature inland.

ii Natural bay (Fig. IV.10.ii) - Natural bays, of which there are hundreds around the coastline of the eastern Mediterranean, are more often associated with cliff-lined, rocky coasts, although natural embayments can form along low-lying shores. Natural bays are basically bights in the coast and therefore are commonly sheltered on three sides, providing safe haven to vessels unless the bay is immediately exposed to prevailing winds. Anchorages in natural bays on cliff-lined coasts are particularly sheltered, except when cliffs create turbulence in the air; however, those in low-lying natural embayments can still leave vessels exposed even when at anchor. Natural embayments on low-lying coasts form due to alluvial and marine deposition of sediments or at a point of weakness, such as a fault line or a section of softer rock which render a stretch of the coast more susceptible to erosion.

In exceptional cases, particularly along cliff-lined coasts, rocky promontories have formed in a way that they almost engulf a bay leaving an almost totally enclosed bay, such as Fethiye on the south coast of Turkey (#6-10; see Fig. IV.10.ii). Such bays provide the ideal location for anchorage as they are extremely protected from prevailing maritime conditions, regardless of direction. Such headlands are rare and typically a product of erosion.

Other well-sheltered natural bays are those located at the head of a larger gulf, such as Antalya (#37) which

stands at the head of the Gulf of Antalya, southern Turkey and Porou Bay (#271) in the Gulf of Mirabélo, Eastern Crete, or bays within larger bays, such as Kition (#229) in Larnaca Bay, Cyprus, or bays that are additionally sheltered by offshore islands, such as Ampelos (#292) in south-eastern Crete. Natural bays, particularly small bays, may present no discernible landmark, unless there is a prominent feature inland, and to sailors out at sea can often appear as a continuous straight-line coast.

iii Lee of a promontory (Fig. IV.10.iii) - Promontories or headlands are typically characteristic of cliff-lined coasts, often a product of mountains that have thrust buttresses into the sea, such as along the coast of the northern Levant or in the region of southern Turkey where the Taurus Mountains reach the coast. Alternatively promontories are formed when coastal erosion is more pronounced along the neighbouring stretch of coast, leaving the promontory isolated.

Promontories invariably lie perpendicular to the coast and therefore along coasts where parallel winds prevail; they provide shelter to vessels in their lee. The degree of protection afforded largely depends upon the height, length, and angle of the promontory. Promontories that present a direct barrier to prevailing maritime conditions can offer complete protection to vessels at anchor in their lee. Promontories on low-lying coastlines provide limited

shelter as winds invariably blow over the top of the headland. Because promontories lie perpendicular to the coast they are often more visible to sailors out at sea. Sometimes these natural promontories are artificially extended to create additional protection for ships.

iv Anvil-shaped headland (Fig. IV.10.iv) - Anvil-shaped headlands are invariably found only along cliff-lined coasts. An anvil-shaped headland extends out into the sea perpendicular to the coast. The land area of anvil-shaped promontories is considerably greater at their seaward ends, creating an anvil shape. Anvil-shaped headlands provide shelter in bays which form either side of the narrow section of land that joins the promontory to the mainland. This narrower section of the promontory usually represents a point of weakness, that is a fault line or band of more easily eroded rock, that has been (and often still is) eroded by wave action. Occasionally this narrower section of land is completely eroded away, leaving the headland stranded as an island, as is the case at Ayios Yerghios (Drepanum; #251) in western Cyprus. Alternatively the narrow section of land is inundated by rising sea levels, as was the case at Mochlos (#278) in Crete. Some anvil-shaped headlands were originally islands which have since been linked to the mainland by a low, narrow isthmus; the isthmus formed as a result of sediments being carried to the island by a process of longshore drift and aeolian deposition, such as the case at Tel Nami (#144) on the

coast of the southern Levant and Elounda (#271) in the Gulf of Mirabélo, Eastern Crete.

Regardless of the prevailing wind, it is possible for sheltered anchorage to be found in bays that form on either side of an anvil-shaped promontory, at any one time. Due to their shape anvil-shaped headlands were undoubtedly used for defensive purposes in antiquity, as was perhaps the case at the Late Bronze Age site of Maa Palaeokastro (#248) in western Cyprus. Anvil-shaped headlands present a very distinctive shape and are therefore a good landfall.

v Sheltered valley/ inlet (Fig. IV.10.v) - Sheltered valleys are generally located on cliff-lined coasts, characteristically formed in a gap between two hills. They are not necessarily associated with a river but were no doubt a product of entrenched valley erosion during the early Holocene and have since silted up. Sometimes a stream flows into the back of the valley and a small alluvial plain forms at the valley head. Good protection is provided in a sheltered valley between the two promontories which enclose it on either side. Sometimes these promontories extend some distance out to sea perpendicular to the coast, forming a sheltered inlet. Sheltered valleys are exposed to lee shore winds and when winds funnel down the valley from inland. Sheltered valleys do not present good landfall as they are characteristically narrow and are therefore indiscernible from the surrounding coastline.

vi Island (Fig. IV.10.vi) - Islands can provide considerable protection to vessels at anchor as it is usually possible to find one point along an island's shore that is protected from prevailing maritime conditions, since one part of the island will always provide sheltered anchorage in its lee. Not all anchorages chosen may be ideal, but at least some shelter is provided.

Islands are often associated with cliff-lined coasts and present varying degrees of protection depending on their height, shape, size and angle to prevailing winds. Island anchorages have the advantage of being isolated from the mainland and are therefore more easily defended. Island anchorages were frequently utilised in the Bronze Age as staging posts for trade, as was the case of the island of Pseira (#277), north-eastern Crete. Frost (1970: 63) states that 'islands would have been the natural site for [Bronze Age/] proto-harbours. Only three lie offshore between Turkey and Africa: Pharos, Tyre, Arwad ...'.

Islands used as anchorages would favour easy access to the mainland, although if the distance between the mainland and the island is too narrow, a point of restriction is formed resulting in strong currents and turbulent waters, making crossing difficult. In some cases the water between the mainland and islands was bridged in later antiquity. The island of Tyre (#125), on the coast of the northern Levant, was connected to the mainland during the Phoenician

period. Islands generally present identifiable landfalls.

Offshore islands or reefs are also present on low-lying coasts. A number of such islets have been identified off the coast of the Levant forming more substantial anchorages in the north, in lee of such sheltered islets as Machroud (#104) and Arwad (#102). Off the coast of the southern Levant they take the form of eroded kurkar ridges. Most of these reefs were too shallow to have been utilised as permanent anchorages in the Bronze Age, despite the relatively lower sea levels. However, there are some examples of these offshore ridges being used as shelter in the Bronze Age, such as the reef off the coast at Tel Ridan (#171). Islands, and especially ridges, can be modified to provide anchorages (see Ch.III.2.ii).

vii Offshore islands/ ridges (Fig. IV.10.vii) - Offshore islands and ridges are associated with both cliff-lined and low-lying coasts. They provide shelter to anchorages that are located on the mainland opposite and are therefore located a short distance offshore. A coastline with offshore ridges or islands, for example the series of kurkar ridges off the southern Levantine coast, provides a measure of protection dependent upon their size, height above sea level prior to sea-level rise, and angle to prevailing maritime conditions. Where they afford substantial protection, the fetch factor can be eliminated and wind and swell strength considerably reduced. However,

if the coastal reef is not easily visible from the sea, they are considered to be a hazard to navigation. Islands and offshore ridges can provide additional protection to bays and sheltered valleys. Examples of this can be seen along the Lycian coast of Turkey and in Eastern Crete. Offshore islands and ridges only provide shelter to anchorages on a lee shore; if the prevailing winds run parallel to the coast or blow off the land, then the offshore island becomes ineffective. Offshore islands and ridges generally present identifiable landfalls depending on their height above sea level.

viii River mouth/ river embayment (Fig. IV.10.viii) - River mouths present a relatively sheltered body of water for anchorage and when large they can form embayments which afford a number of anchorages or small bays within the river estuary, which thus provide anchorage to vessels in variable maritime conditions. Such anchorages were located on low-lying and cliff-lined shores alike, although they were more generally utilised on low-lying coastlines.

River mouth and river embayment anchorages were popular anchorages for second millennium sailors, especially in eastern Crete and along the coast of the southern Levant where limited alternative shelter was available. River mouth anchorages have the advantage of being located on an obvious route of communication for trade inland. The coastline of Israel in the Middle Bronze

Age has many examples of river mouth anchorages that were linked with riverine anchorages up stream, or routes further inland (Raban 1987). The majority of these anchorages were located on the north side of the estuaries, upstream of the wave-carried sand that travelled in a northerly direction up the coast depositing sediment at river mouths, forming bars that hampered navigation into the river (Raban 1991: 137).

However, river mouth or river embayment anchorages are not necessarily stable. Depending on the sediment load and water discharge of the river and movement of longshore sediments, river mouths are liable to change location and form, particularly as a result of siltation of the river bed and mouth. In some cases the river mouth becomes marshy and large volumes of sediment accumulate behind coastal sand bars, as was the case along the south coast of Turkey at the harbour of Patara (#13), eventually cutting off the anchorage from the sea - similar problems are encountered with deltaic anchorages (see below).

Shelter within the river mouth and more particularly entering and leaving the river, is very much dependent upon the direction of the winds. Diurnal and parallel winds are most favourable. Unless a wide river mouth is surrounded by high promontories, river mouths are not easily identifiable out at sea, although sediment discharge, if great enough, can indicate the presence of the river before it is

actually visible, as in the case of the Nile Delta.

ix Riverine anchorage (Fig. IV.10.ix) - Riverine anchorages (anchorages located up river) are generally associated with low-lying coastal plains, as the river gradient increases and the rivers tend to narrow considerably the further inland you go up rivers situated on steeper coastlines. Riverine anchorages obviously provide ideal shelter for craft as maritime conditions are negligible upstream. However, such anchorages, although accessible from the land, are not always immediately or easily reached from the coast due to problems of riverine siltation, meandering, shallows and currents. Problems are also encountered if the anchorage silts up due to riverine siltation or if the river changes its course, thereby rendering the anchorage obsolete.

Riverine anchorages are generally located at the lowest bridging or crossing point or the highest navigable point on the river for different sizes of boat (by draught). Often, as in the Middle Bronze Age along the coast of the southern Levant, the main trading emporium was located upriver but was served by a smaller anchorage at the river mouth. In some cases the riverine conditions may have necessitated a change of vessel from sea-going to riverine type.

Some rivers, such as the River Pedhieos in Cyprus and

the River Orontes in Turkey, debouched into inland lakes. Invariably these lakes silted up during or since the Bronze Age, but prior to siltation they would have provided ideally sheltered, inland anchorages with ample room for manoeuvring and anchoring.

x Deltaic anchorage (Fig. IV.10.x) - Deltas are located in low-lying coastal environments. The largest delta in the eastern Mediterranean formed at the mouth of the River Nile (see Ch.IV.2.b (Egypt) for delta formation). Other examples are found along the south-eastern coast of Turkey and include the Cilician Delta. Deltas provide a degree of shelter particularly further upstream. Protection provided by deltas is similar to that provided by rivers, except the river courses on deltas are more prone to shifting and silting. Shelter is sought behind sandbars and in coastal lagoons, but the very low-lying nature of deltas means that protection is limited; thus anchorages located further upstream where the river channels are more stable and prevailing maritime conditions negligible, are preferable. Most Bronze Age anchorages located on deltas have since silted up, such as Tell el Dab'a (#183) on the Egyptian Delta and Kazanli (#68) on the Cilician Delta. Large deltas are a visible landmark particularly noticeable by their sediment discharge; however, small deltas and particular navigation channels can be very difficult for sailors to identify.

xi Lagoonal anchorage (Fig. IV.10.xi) - Lagoonal anchorages are typically associated with low-lying, sandy coastlines, quite often characteristic of deltaic environments. Lagoons enclose a body of water that has been partially trapped behind a coastal sand bar or dune system that formed as a process of longshore drift across a river mouth or bay. Along the coast of the southern Levant lagoons formed when water was trapped behind the coastal kurkar ridges. These lagoon systems have since silted up, due to processes of alluvial and aeolian deposition, and form part of the coastal plain; however, in the Middle Bronze Age they were utilised as anchorages, as was the case at Dor (#145).

Lagoons afford shallow, sandy-bottomed anchorages, prone to silting and flooding when waves break over the sand bars that separate the lagoon from the open sea. Many lagoons that functioned as anchorages in the Bronze Age are now identifiable by salt lakes, such as Hala Sultan Tekke (#230) and Akrotiri (#237) in Cyprus, or as marshy hollows, such as Malia (#268) in eastern Crete. The degree of protection afforded by lagoonal anchorages is dependent upon the height of the coastal sand bar and the position of the lagoon with respect to prevailing maritime conditions. Some lagoons that were used as anchorages in the Bronze Age still exist today - Mersa Matruh (#198) is such an example. Due to the low-lying nature of lagoons they are only visible from the sea when there is a landmark inland.

From the above typology it is apparent that there are many different types of topographical settings for Bronze Age anchorage site locations[3]. It also appears that harbours were predominantly located on two types of coastline: cliff-lined, and low-lying coastlines. Anchorages located on cliff-lined coasts, such as large parts of the Turkish coast, the northern Levant and parts the coast of Cyprus, can potentially, due to the nature of the coastline, still be identified and even utilised as anchorages today. Those anchorages located in low-lying coastal environments, are however, less discernible in the archaeological record. Flat lowlands have always proved attractive for settlements because of their morphology, proximity to the sea, ease of movement, and possibility of both land and water transport (Evans 1973: 89).

All coastlines are greatly affected by the rises and falls of sea-level. However, due to the nature of low-lying coastlines, it is apparent that anchorages located on flat coastal plains have been impacted more greatly by the processes of geomorphological and sea-level change than anchorages located on cliff-lined coasts, during and since the second millennium BC. The lateral displacement of sea-level rise greatly affects low-lying coastlines, as does the process of sedimentary deposition. Sedimentary

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[3] See Table 2: List of Bronze Age anchorages of the eastern Mediterranean, identified by site number, as defined by their topographical typology.

deposition is particularly pronounced in river mouths of insignificant perennial flow, and changing river courses, particularly when we consider that tidal amplitudes in the eastern Mediterranean are minimal (c. 0.33m) and therefore there is no mechanism to assist in the movement of deposited coastal sediments out to sea. Thus, in general, the morphology of low-lying coastal environments has changed quite dramatically since this period.

As a result many Bronze Age harbours are now submerged beneath the sea or alluvial deposits. We have to look beneath the alluvial valley, upstream of the prograding delta, in order to identify anchorage sites that were located on low-lying coastlines during the second millennium BC. All these factors must be considered when attempting to identify the location of Bronze Age anchorages, as the following section illustrates.

## IV.2. Changing Topography of Coastlines

The analysis of the location of ancient harbours thus accepts that coastal topography is dynamic and that modern images of a coastline can be misleading. This is particularly apparent when considering the location of Bronze Age harbours. Harbours, after all, are located on the water-line, and 'one must keep in mind that almost everywhere along the eastern Mediterranean coastline, the present waterfront is not what it used to be in the past' (Raban 1995: 139). Therefore a consideration of Bronze Age coastal topography cannot ignore subsequent topographical change. Much of the present topography of the eastern Mediterranean was shaped by changes associated with the last glaciation and has since been modified by four interrelated natural processes: (1) eustatic sea-level rise; (2) regional or local tectonic activity, which has shifted land sufficiently to prevent detailed application of worldwide sea-level fluctuation curves to the solution of local palaeogeomorphological problems; (3) sediment deposition and infilling; (4) and climatic change, which has altered hydrologic and vegetation regimes affecting erosion and deposition (Kraft et al 1977: 941).

## IV.2.a. SEA-LEVEL CHANGE AND TECTONIC ACTIVITY

The last glacial maximum (Ice Age) peaked around 18000 BP, when the mean sea level in the Mediterranean basin is believed to have been about 120m lower than present (Shackleton et al 1984). Subsequent melting and retreat of the ice peaks began as a consequence of global warming; the sea level rose dramatically to approximately 35m lower than present by c. 9000 BP (Flemming & Webb 1986). Glacio-eustasy, the rise in the sea level due to melting of the world's ice-caps, is the major cause of sea-level change in post-glacial times. The period since c. 11000 BP is known as the Holocene or Flandrian transgression. Although a number of colder phases have interrupted the retreat of the ice since then, a general pattern of sea level rise has emerged.

Since the start of the Holocene sea level is believed to have risen at a rate of between 0.6-1m/ century up to 7000-5000 years BP (Godwin et al. 1958; Jelgersma 1966). This is a general pattern of sea-level rise for the Mediterranean basin. However, after about 6000 BP the rate of sea-level rise became more gradual. A number of patterns have been suggested for the rate of sea-level rise after 6000 BP. Shephard (1963) suggested that the sea-level rise was continuous but that the 'rate of rise diminished with time'. Mörner (1971) and Fairbridge (1958) believe that the rate of sea-level rise oscillated up to the present (Fig.

IV.11). Inman (1983: 6) outlines a rise of about 0.1m/ century to present. Flemming et al. (1973) and Psychoyos (1988) propose a slightly more complicated pattern for overall sea-level change in the eastern Mediterranean, but one which fits more closely with the archaeological data: according to their analyses, sea level rose throughout the second millennium up to the Late Bronze Age, reaching possible maximum heights of up to 0.8m above present mean sea level. After this date, it shrank rapidly to depths of -1m (relative to modern sea level), reaching its lowest around 800 BC. Starting around 500 BC the mean sea level rose and then returned to comparable levels to those of the present day (Raban & Galili 1985: 347,fig.26). Flemming et al. (1973) believe that the regression was not quite so drastic (c. 0.3m below present) and that the sea level did not begin rising again until AD 500. Raban (Raban & Galili 1985) records similar events for the Levant, but interprets them as occurring 300 years later.

It is apparent therefore that there are several theories regarding the relative periods and rates of sea-level rise in the eastern Mediterranean since the last Ice Age. These theories are modified yet further when we consider the physical and archaeological evidence for changing sea levels on a localised scale. Even along one stretch of coastline, sea-level change does not appear to be consistent. We can only begin to comprehend the true pattern of the changing topography of the coastline of the

eastern Mediterranean when we consider eustasy in combination with climatic, geomorphological and tectonic changes. Eustatic sea-level fluctuations are difficult to separate statistically from local tectonic and isostatic deformations of coastal regions (Newman et al. 1980).

On a global scale the rate of sea-level rise fluctuates as the lithospheric blocks of the earth (tectonic plates) respond to both the released stress of unloading due to ice sheet melting (isostasy) as well as the applied stress of meltwater (eustasy). Thus sea-level curves differ depending on their location and their relative proximity to the ice sheets. For this reason the effects of isostasy are negligible in the eastern Mediterranean. However, the movement and changes of tectonic plates and resulting seismic activity have localised effects on sea-level change and are equally essential to an understanding of the coastal morphology of the Mediterranean basin.

It is believed that tectonic movement and seismic activity has had the most dramatic effect on localised changes in sea level of the eastern Mediterranean, certainly since 1500 BP. In fact, Flemming (1969) proposed that there had been 'no net eustatic change in sea level in the last 2,000 years to within an accuracy of $\pm$0.5 metres', and that all displacement during that period was due to geomorphological change or seismic activity.

The Mediterranean Sea is on the boundary of two major tectonic plates. For the last 50 million years the African continent has slowly been rotating about the focal point of Gibraltar (Pirazzoli 1987). The two large Eurasian and African-Arabian plates are separated from one another by two small plates - the Turkish plate which underlies most of Turkey, Cyprus and the intervening sea floor, and the Aegean plate which forms much of western Turkey, the Aegean, Crete and part of Greece (Evans 1971: 385). The resulting collision between the African and Eurasian plates, believed to be converging at a rate of c. 0.25m/ annum (Flemming 1974: 157; Pirazzoli 1987), is forming a subduction zone in the seabed to the south of the Aegean called the Hellenic Trench (Fig. IV.12). The borders of the Aegean constitute some of the most seismically active regions in the world (Flemming 1972b, 1978). The Aegean plate is moving south-westwards to overthrust the Mediterranean floor, south of Crete (Evans 1971: 385). Whilst the Turkish plate encroaches on the Aegean from the east (Flemming 1978: 454), slow subsidence is occurring along the main axis of the south Turkish coast at a rate of 1-2m/ millennium (Flemming 1972b). Movement of the Turkish plate is also manifested in an additional subduction zone (Flemming 1978: 451; Fig. IV.13) which trends southeast from Antalya on the Turkish coast to western Cyprus and back into the Gulf of İskenderun (Mackenize 1970; Flemming 1972b: 197), producing frequent and widespread tectonic activity in the eastern Mediterranean basin. Marginal

boundaries have also been identified tending north-south along the coast of the Levant and continuing down into the Red Sea (Flemming & Webb 1986: 25; Fig. IV.14).

The process of sea-level change as a product of eustatic and tectonic activity is therefore a complicated one and the effects can vary quite dramatically along a short stretch of coast. Attempts to determine sea-level change at specific sites is therefore problematic and can be further complicated by subsequent adaption or destruction through physical or human modifications. When changes in sea level are apparent it is often difficult to distinguish between effects of eustatic change, tectonic movement and sedimentation. It is important, however, to try to ascertain how these various processes have altered the appearance of the shorelines of the eastern Mediterranean during and since the second millennium BC.

## TURKEY

The effects of sea-level rise and tectonic activity upon harbour sites along the southern Turkish coast are fairly localised. The steeply sloping nature of most of the coastline, typical of a collision coast (Inman 1983: 4), is such that any eustatic rise in sea level since the second millennium BC would have had a negligible effect on anchorage and harbour sites. The predominant factors affecting anchorages would therefore be tectonic movement

and, to a lesser extent, geomorphological change (see below Ch.IV.2.b). A survey by Flemming et al. (1973) in 1967-69 along the southwest Turkish coast revealed that, as a result of eustatic change, sea level was within a few centimetres of present level in 3000 BP, dropped slowly to about -0.5m around 2000 BP, rose again to -0.3m around AD 500, and finally rose to the present level (Flemming 1972b: 198, Flemming et al. 1973: 1). However, combined with the effect of tectonic activity, relative displacement of archaeological sites was much greater, varying from a relative uplift of 3m to submergence of 5m. Often movement was so localised that sites of comparable date showed different patterns of sea-level change.

The south-western coast of Turkey between Fethiye and Cape Gelidonya is situated on a plate boundary and is slowly subsiding along the coast parallel to the sea (Flemming et al 1973: fig.1/III; 1978: 406). Particular stretches of this coast appear to be subsiding at different rates. Between Gemili and Phaselis Flemming (1978: 434) noted subsidence of 2m/ millennium and between Kaş and Kale a uniform depression of 1m/ millennium. To the east of Antalya the land is stable to within 0.25m (Flemming 1978: 434). An additional plate intersects the Rhodes/ Fethiye region from the area of Istanbul in the north (Flemming 1972b: 198). The resulting effect of this longitudinal subsidence, coupled with the minimal effect of eustatic sea-level rise, has caused the flooding of eroded valley

outlets and the submergence of harbours by up to 2m.

The picture of topographical change along the Turkish coast is therefore quite localised and dependent upon many varying factors. Seismic activity around the Kekova Roads (#20-25), for example, has submerged Lycian ruins which date from 5th century BC to the Roman period, to depths of up to 3m below present sea level. At the 6th century BC harbour of Phaselis (#35), sea-level rise has caused the submergence of the ancient breakwater of the 'South Harbour' by up to 3m. The base of the 'Central Harbour' foundations, which are likely to have been in use until the 1st century AD, are at a depth of 1.5m below sea level (Blackman 1973).

Finally, a note should be made regarding the low-lying sections of the southern Turkish coast - the Pamphylian Plain, the Silifke (Göksu) and Cilician deltas, and the Orontes River basin. Due to the nature of these coastlines, the effects of lateral displacement of water due to sea-level rise was much greater than the vertical displacement, causing the flooding of river outlets and largely preventing the deposition of sediments and deltaic progradation throughout much of the Holocene up until the reduction in the rate of sea-level rise around 6000 BP. After this period alluvial deposition took some time to build up to the water level, as the offshore littoral was very deep. It was not until the second millennium BC that

deltaic progradation commenced. During and since this period it is apparent that the low-lying coastlines of the southern Turkish coast have been more greatly impacted by the processes of geomorphological change (see below Ch.IV.2.b). This is particularly apparent on the Cilician Delta. A survey by Seton Williams (1954: 121-156) confirms the location of Bronze Age settlements as being largely restricted to the higher ground of the Pleistocene terraces that surround the delta to the northwest and north, and to the Karataş/ Misis Dag promontory. It was not until the Roman period that greater numbers of sites were established on the delta and closer to the shore, implying coastal progradation in the intervening period followed by increased delta stability.

NORTHERN LEVANT

Limited detailed research has been undertaken with respect to sea-level change along the coast of the northern Levant. Large sections of the coast present steep, cliff-lined shores which undoubtedly have experienced some rise in sea level relative to land during the Flandrian transgression. A number of offshore kurkar ridges and islands have been identified in the south, representing the northern extension of those seen along the coastline of the southern Levant to the south (see below); these are believed to have been utilised to provide shelter for vessels during the Bronze Age. Eustatic sea-level rise is known to have eroded platforms that had been cut on these

ridges to provide additional moorings for vessels. Erosion rates increased progressively once the reefs weakened. Examples of this can be seen on the island of Sidon (#122); likewise, the anchorage at Tabbat al Hamman (#105) replaced the offshore island anchorage of Machroud (#104) after it became submerged due to sea-level rise (Braidwood 1940). Similarly, sections of the ancient breakwaters of the islands of Tyre (#125) and Arwad (#102) are now partially submerged (Frost 1972).

In the north of the region sea-level change would undoubtedly have had an impact on the low-lying coastal plains of Latakia, Akkar and the plain to the south of Beirut. As elsewhere, it is probable that these coastal plains prograded seawards in response to increased sedimentary deposition after the reduction in the rate of sea-level rise. However, no detailed research has been undertaken to determine the geomorphological processes that have affected these coastal plains.

Tectonic activity along this stretch of the coast is believed to be in the order of less than 0.5m uplift in the last two thousand years (Raban 1995: 143). A tectonic plate boundary known as the Pelusium Line (see below), runs between Latakia and the Damietta branch of the River Nile in the NE Nile Delta (Stanley 1988: 497; Stanley et al. 1992: 35). However, limited information is available regarding tectonic activity along this coastline and

seismic activity is thought to have been negligible since the Bronze Age.

SOUTHERN LEVANT

The minimal gradient and low-lying nature of the shoreline of the southern Levantine coast means that the effects of eustatic sea-level rise are quite pronounced. Gradual sea-level rise since the last glacial period has resulted in the submergence of the coastline, including a number of the parallel kurkar ridges, leaving the present shoreline some 300-400m east of its original location during the Neolithic period (Raban & Galili 1985). The southern Levantine coast has also been subject to tectonic activity during this period as it lies on the eastern edge of a north-northeast tending compression zone known as the Pelusium Line. The Pelusium Line lies 60km offshore and forms a sharp divide between two tectonic plates.

> 'Three WNW tending fault lines have also been recognised in the offshore area west of the Pelusium Line. These fault lines are related to the NE tending fold system of Israel and northern Sinai, developed at least since the Jurassic, and trend perpendicular to the contemporaneously developed tensional elements of the Levant, such as Mount Carmel' (Neev et al. 1976: 1-3,fig.1).

Conflicting theories exist to explain the pattern of sea-level rise during the late Holocene period and to what extent tectonic activity has contributed to this pattern. Neev et al. (1973, 1987), based on findings from seismic stratigraphy and drill hole analysis, identify tectonic activity as being the major contributor to sea-level

change. They identify what is described as repeated oscillatory tectonic movements of the continental side of the coastal fault, which has resulted in the continued vertical differential movement of the coastline. In brief, this amounts to the general uplift of the coastal land belt and subsidence of the offshore belt of Israel. Neev et al. (1987: 97-99,fig.35) describe the pattern and cause of these oscillatory downward and upward tectonic movements, and identify five phases from 4000 BP to the Mamlukian period when such movements occurred across the coastal fault. At the end of each phase the coastal cliff is believed to have returned to approximately its original (pre-movement) structural elevation.

Mazor (1974), Flemming (1978), Raban (1986) and Nir & Eldar (1987), on the other hand, believe that the coastal belt east of the coastal cliff has remained tectonically stable since 2500 BP or even 3100 BP. They recognise erosional and depositional factors as having contributed to the changing morphology of the coastline since historic times (see below), ignoring, according to Neev et al. (1987: 97), the transverse dimension of tectonic activity that has contributed towards substantial movement of the coast up until the present. Although it is apparent from archaeological evidence that sections of the Israeli coastline have been subject to submergence in historic

times[4] it would appear that these were localised cases with movement restricted to the Carmel-Qishon graben zone rather than direct effects of plate boundary movements (Flemming & Webb 1986: 25). There is a much stronger case for the submergence of sites along the coast of Israel being due to Flandrian sea-level transgression, as witnessed at Neve Yam (Ronen 1983) and other Neolithic-Chalcolithic sites that have been submerged in the nearshore zone along the coast. Flemming et al. (1978) have shown that the vast majority of post-Early Bronze Age sites correlate to within 1m of present sea level, indicating minimum eustatic sea-level change and tectonic activity during the past 4000 years. These conclusions directly oppose those of Neev et al. (1973, 1987). Gifford and Rapp (1989: 206) state that

> 'this "coastal neotectonics" controversy has momentous implications for the correct interpretation of all coastal archaeological sites in Israel ..; it revolves around (1) artificial vs. natural deposition of elevated pelecypod shell beds and (2) depositional environments of various recent coastal sediments vis-à-vis their present elevation above sea level'.

A general pattern of eustatic sea-level change along the coast of the southern Levant emerges as follows; however, it must be noted that there is some disagreement regarding the details of this outline (Fig. IV.15):

The sea level rose during the Flandrian transgression from

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[4] Evidence for submergence along the Israeli coast in historic times has been identified at the sites of Caesarea and Ma'agan Michael (Raban 1986: 104).

c. -8m to -5m in Neolithic times (Flemming et al. 1978; Raban 1981, 1983), to c. -3m to -2m in the fourth millennium BC (Flemming et al. 1978). This was apparently followed by a rapid period of sea-level transgression with sea level exceeding its present height by +0.5m to +0.8m towards the end of the Middle Bronze Age (Raban & Galili 1985: 343-349,fig.26). Evidence for this comes from beachrock found well inland in the area of the Bronze Age harbour at Tel Akko (#134). It is unclear whether sea levels actually rose to such an extent or, more probably, that the counter effects of the reduced rate in sea-level rise since this period resulted in the siltation of a number of coastal sites due to increased alluvial deposition. It is, however, clear that sea levels were lower than at present at the beginning of the Late Bronze Age, and rose during this period to heights possibly in excess of the present by the end of this period, causing the abandonment or reduction in size of many Late Bronze Age anchorage sites, such as Tel Nami (#144), due to encroaching seas. Raban (1983) believes that the increase in the number of coastal settlement sites in the Bronze Age, and the subsequent silting of the harbours, provides evidence that not only did they make use of the wave-abraided shelves of the coastal ridge, estuaries, and entrenched river valleys formed during the retreat of the ice cap, but also that the later gradual abandonment of coastal Bronze Age settlements and subsequent submergence of sites, proves that the final stages in the rapid rise of

the sea occurred right up to 1000 BC.

After c. 1000 BC, sea levels regressed slightly, a phenomenon that has also been attributed to coastal uplift of c. 0.5m (Lewy et al. 1986; Tooley & Shennan 1987; Raban & Galili 1985). Sea levels transgressed during the Roman period and fell again to -1m around AD 1000. After this period sea levels are then believed to have risen gradually to present levels (Raban & Galili 1985). Others believe the rise of sea level to have been gradual after the Bronze Age (Flemming et al. 1978). Since the Bronze Age, rates of alluvial deposition increased dramatically and counteracted the effects of sea-level rise, silting up the marshy, coastal depressions.

As already indicated, the area around Haifa Bay follows a slightly different pattern. Drilling and offshore seismic profiling (Flemming et al. 1978: 50-51) reveal that the valley of Qishon is a graben (defined below) which has been sinking relative to Mount Carmel, to the south, and the hills of Galilee, to the north, at least since the Tertiary period. Avnimelech (1959: 103) proposes that the floor of the Qishon valley has subsided rapidly within 5-10km of the sea, and is still subsiding. He believes that during the Neolithic period the sea extended several kilometres inland relative to the present shoreline, and that the River Qishon flowed close to the foot of Mount Carmel. The present shoreline of the bay is an extremely

flat plain of alluvium and beach sand, that has silted up predominantly since the decreased rate of sea level rise. On the western reaches of the plain a line of Bronze Age settlements curve back from the present shoreline some 3km from the sea. The tell site of Zivda is the northern most of five Bronze Age tells and one khirbet that lie in an arc across the alluvial plain of the Qishon between Tel Akko and Haifa. No Bronze Age tells occur seaward of this line; therefore, Prausnitz (1975: 24; Fig. IV.16) believes that the line of tells is approximate to the Bronze Age shoreline. The Roman road follows a similar trend, and in fact the modern road from Haifa to Akko also follows a course well back from the shore.

EGYPT

From research undertaken in the Nile Delta region of northern Egypt it appears that the effects of sea-level rise, certainly during and since the Bronze Age, have been largely counterbalanced by alluvial deposition. Holmes (1993: 402) has suggested that the sea level rose in the process of the Flandrian transgression to a level 16m below present by c. 8000 BP. From an extensive series of radiocarbon-dated drill-cores taken on the delta, it is possible to show that the present Nile Delta started prograding from around 6500-5500 BP, as it was only when the rate of sea-level rise decreased, and the river gradient became sufficiently reduced, that the deposition of silt-rich deposits from the Nile River begin to

counterbalance the effects of sea-level rise (Holmes 1993: 402). Butzer (1976) believes that the sea level reached its present height by c. 4000 BC and that prior to this the northern third of the delta consisted of swamps and lagoons. Subsequently rapid alluviation occurred (around 0.2m/ century) and covered the delta in a thick sheet of mud and silt. Isostatic subsidence and sediment compaction has also contributed to the continued lowering of the delta plain, resulting in the submergence of many archaeological sites, particularly along the northern reaches of the delta, at minimum rates of 1-5mm/ year (Warne & Stanley 1993).

The process of siltation and subsequent shifts in river courses is believed to have constituted the main cause for harbour abandonment and relocation on the Nile Delta. The weight on the delta sand of the heavy harbour installations and urban settlements to which they were attached is also thought to have resulted in the sinking of some of the structures, putting harbours into disuse. The only exception is a harbour at the western mouth of the delta, the ancient site of Pharos (#193), which was subject to partial submergence due to eustatic sea-level rise.

CYPRUS

Cyprus, although located on the southern edge of the Turkish plate, has been subject to negligible seismic movement since the last major period of uplift during the

Quaternary. Due to local variations in the relative uplift and submergence of the island, it is difficult to determine reliably the rate of sea-level rise and to delimit the exact position of the Cypriot shoreline at any given point in time during the Holocene. Flemming and Webb (1986) analysed tectonic and eustatic changes in the sea level for Cyprus, and placed relative sea level at about 6m below present in around 5000 BP.

Generalised palaeogeographic maps of the Cypriot coastline are presented by Gomez and Pease (1992: 3-4; Fig. IV.17) for the periods c. 9000 BP and 5000 BP. I would dispute their modifications to the reconstruction of the Cypriot coastline in the low-lying areas of the Larnaca Lowlands (see Gifford 1978) and the Akrotiri Peninsula. The southern shore of the Akrotiri Peninsula is believed to have been an island or at least a large coastal embayment open to the sea on the east side, prior to sedimentation and subsequent isolation from the sea (#237). I would also add the region of the Morphou Basin to this list of lowland areas that were substantially modified during the late Holocene (#202).

Poole and Robertson (1991) argue for limited Late Pleistocene and Holocene relative uplift of the island, and do not accept the arguments of Vita-Finzi (1990) and Giangrande et al. (1987) that Cyprus has been subject to neotectonic or rapid uplift during this period. However,

some local anomalies exist (Turner 1971; Flemming 1978).

A survey by Flemming (1978; Fig. IV.18) identified the northern block of Cyprus, particularly between Cape Kormakiti and Ayios Marina, as being a stable block of land with no indication of significant sea-level change relative to the present (Flemming 1978: 406,434). The south side of the island, on the other hand, seems to be subsiding in a somewhat irregular fashion (Flemming 1978: 406, 435,fig.12). The southern coastal edge of the Karpas Mountain Range and the south-western shore of the island appear to be subject to subsidence rates of -1m/ millennium, while the coast east of Cape Greco and either side of Khrysokhou Bay in the northwest, rates of -0.25m/ millennium have been noted.

In general, it appears that the south coast of Cyprus, particularly the low-lying areas, are more subject to both sea-level rise and geomorphological change than the north coast; although, geomorphological processes have contributed more greatly than sea-level rise to the changing shape of the coastline of Cyprus since the second millennium BC (see below this chapter).

EASTERN CRETE

A clear relationship between coastal sites on Crete and the present sea level is often not apparent, particularly in the case of Bronze Age sites, because that

relationship has been altered during the past five thousand years by a combination of neotectonic activity and eustatic sea-level change (Gifford 1992: 23).

The island of Crete has suffered considerable seismic displacement as it is situated on the southern edge of a lithospheric block known as the Aegean plate (Evans 1971; Tooley & Shennan 1987). The Hellenic Trench is located to the south of the island and forms the boundary between the Aegean plate and the Mediterranean Sea (Fig. IV.12). The Hellenic Trench extends between the Ionian Islands and the Anatolian coast, and has affected the stability of the islands of Kythera, Antikythera, Crete, Kassos, Karpathos and Rhodes (Pirazzoli 1988: 157). The African plate is approaching the Aegean plate at a rate of 0.25m/ annum and is under-thrusting the Aegean plate in the zone of the Hellenic trench. The position of Crete in the Hellenic arc-trench is important to the understanding of the various deformation mechanisms and the evolution of the Hellenic arc-trench system. 'Crete is not only adjacent to the Hellenic arc, but is also a place where the arc changes direction from NW-SE, on the western side, to NE-SW in the east' (Lagios & Hipkin 1986: 166,fig.1; Fig. IV.12). The principal causes of sea-level change around the shores of Crete during and since the Bronze Age are thus tectonic rather than eustatic movements, and Crete is notorious for its earthquakes.

Spratt (1865) first commented on the tectonic instability of Crete when he noted ascendent removal and old shorelines in western Crete and submerged ancient monuments in the east. Between 2000 BC and AD 200 the west of Crete underwent a number of separate phases of subsidence which resulted in a series of stepped shorelines totalling a subsidence of c. 1.5m (Pirazzoli et al. 1982: 39; Fig. IV.19/A). It appeared that eastern Crete remained stable throughout this period. Around AD 400 this westerly lithospheric block (Pirazzoli et al. 1982: 39; Fig. IV.19/B) was uplifted by about 10m and inclined north-eastwards in a single event, causing the emergence of the late Holocene shorelines in this area[5]. Flemming (Flemming & Webb 1986; Flemming 1995) believes, based on the lack of historical data for a single catastrophic event, that this uplift was not a single event but occurred as a series of separate stages of uplift. Flemming (1972) calculates the tilting to have caused sites in the west to have risen by at least 1m.

Crete, in fact, has many active fault lines and is divided up into a series of grabens and horsts which have been outlined by Lagios and Hipkin (1986: 167-8; Fig.

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[5] Pirazzoli et al. (1982: 32-33) believe this uplift occurred as a single event based on evidence provided by marine biological data, petrographic analysis and radiocarbon dates.

IV.20)[6]. Tectonic movement of Crete does therefore not occur in a uniform block but rather as a number of horsts and grabens, which have dictated the relative topography of the island. The movement of the land relative to the sea in Crete can therefore be summarised as follows: Crete appears to be tilting about a NE-SW axis approximately on a line between Heráklion and Tymbaki, near Ayia Galini (Lagios & Hipkin 1986: 167,fig.2; Fig. IV.20), with the western part of the island rising and the eastern part subsiding. Uplift in western Crete is more pronounced in the southwest, rising at rates of 4-5m/ millennium (Flemming 1978: 430,fig.9/c-d). While the north-western end of the island tilts towards the north at rates of 2-3m/ millennium (Flemming 1978: 430,fig.9/c-d; Fig. IV.21). The central part of the island is in parts uplifting and elsewhere subsiding. The Heráklion and Ierápetra graben basins are both subsiding, while the south coast remains relatively stable (Pirazzoli 1988: 173-4; Flemming 1978: 430,fig.9/c-d). There is disagreement over the movement in the area of Malia (Pirazzoli 1988: 173; Lagios & Hipkin 1986; Flemming 1978). To the east of the Ierápetra graben the Sitían Peninsula appears to belong to a block of lithosphere (Pirazzoli et al. 1982: 39; Fig. IV.19/C) which has been affected by long-term tilting to the northeast. Submergence in this area is clear, increasing from west to east and from south to north (Pirazzoli et al. 1982; Pirazzoli

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[6] A graben is a downfaulted sedimentary basin, and a horst is a block of upthrust older rocks (Kraft et al. 1977: 941).

1988). Flemming (1978) describes the submergence of sites in the northeast as occurring at a rate of 0.5-2m/ millennium. The land is stable in the area around Zakros while uplifting has been noted on the extreme south-eastern edge of the island and on the Island of Kouphonisi to the south. Coupled with the effects of eustatic sea-level rise Minoan shorelines in north-eastern Crete lie several metres below present (Gifford 1992: 23).

The nature of Minoan harbours, generally situated on low-lying coastlines in lee of offshore islets or peninsulas or in small coves adjacent to river mouths, implies their vulnerability to sea-level rise and tectonic depression. The offshore reef at Kommos (#308) that provided some shelter to the anchorage, is now submerged, so too is the isthmus that connected the island of Mochlos (#278) to the mainland and provided shelter to vessels in the Bronze Age.

## IV.2.b. GEOMORPHOLOGICAL CHANGE

The coastlines of the eastern Mediterranean have also been subject, in some cases significantly, to geomorphological change, during and since the second millennium BC. The effects of changing geomorphology have had a much greater impact on low-lying coastlines, particularly those fed by rivers or in marshy locations, than on cliff-lined coastlines.

Numerous factors contribute to geomorphological or topographical change, all of which involve the deposition of sediment. The most significant suppliers of sediment to the coast are undoubtedly rivers. Cliff erosion is of minor importance except where the coastline is formed of soft deposits. Erosion and reworking of the immediately adjacent sea floor are also processes that supply sediment. Such sediments can be deposited as a result of fluvial outwash, or carried by wind (aeolian), waves and currents, while others are products of volcanic fallout[7]. River-borne

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[7] Volcanic coastlines experience progradation directly, when lava or ash is deposited on the shore, and indirectly, when large quantities of sediment are fed into the rivers. The most devastating volcanic eruption (or series of eruptions) that is recorded in the archaeological record relating to the second millennium BC, was at the island of Santorini in the Cyclades, generally believed to have erupted c. 1500 BC. (There is much controversy over the dating of this event (see Thera and the Aegean World I 1978, III 1990). Its eruption is known to have completely altered the topography of the island of Santorini (Thararinsson 1978; Thera and the Aegean World III 1990), burying the Bronze Age sites of Thera beneath volcanic tephra. The volcanic ash fallout also

sediments include soils eroded by the actions of man. The location and rates of sedimentary accumulation are affected by, and affect, topographic gradients.

However, it is not always the case that sediment once deposited in a coastal environment necessarily remains in the same place. In most near-shore environments of the world, including the eastern Mediterranean, the dominant agents of sediment movement, as opposed to sediment supply, are wave action and wave-induced currents, particularly in the form of longshore drift (Inman 1983: 10; Evans 1973: 99). Longshore drift is created when waves or currents approach a coastline at an oblique angle (Evans 1973: 100).

Wind action, or aeolian transportation, is another major agent of sediment movement. Most of the sand dunes around the coasts of the eastern Mediterranean are formed as a product of aeolian transgression, particularly when the wind blows off arid land areas such as those bordering the eastern and southern shores of the Mediterranean (Evans 1971: 403). The action of wind and waves carrying sedimentary deposits has contributed greatly to the formation of coastal dunes, sand bars and spits. Coastlines are particularly vulnerable to the agents of sedimentary

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travelled considerable distances over the eastern Mediterranean, apparently as far as northwest Cyprus, where quantities of pumice have been recovered in Late Bronze Age contexts and the effects of the eruption are believed to have contributed to the abandonment of numerous Late Bronze Age sites (Åström 1978).

movement during periods of low sea level, when areas of the coast are exposed, or times of increased rates of sedimentary deposition.

Three fundamental factors (tectonic, climatic and eustatic) are clearly identified as having determined the natural rate and distribution of Quaternary marine sediments in the eastern Mediterranean (Fairbridge 1972). Earth movements and sea-level change alter sill levels, reduce or increase the rate of supply of sediments and deposition at the coast, and create or destroy topographic basins (Flemming 1972: 190). In general, the rate of sediment supply on the eastern Mediterranean littoral is affected by: the type of sediment; bottom slope; fetch of winds; and coastal morphology.

As a result of glacial outwash from melting ice caps at the end of the last Ice Age, from about 12000 BP the coastal plain of the eastern Mediterranean was deeply entrenched by rivers, resulting in stream incision of valley bottoms. Narrow, deep valleys formed, as for example seen along the south Turkish coast. Towards the end of the Holocene, sedimentary deposition rates increased, creating alluvial coastal plains and deltas. There is some controversy over the cause and dating of the increased rates of alluvial deposition.

Butzer (1971) believes that the increased rate of

alluvial deposition was primarily the product of human impact on the environment, in the form of soil erosion due to cultivation and deforestation. The aggradation ceased when the soil-mantle of steep slopes had been largely removed. This seems to be a more persuasive position than that of Vita-Finzi (1969), who saw geomorphological change as being solely climatically linked.

Vita-Finzi (1969) outlined two major phases of sedimentation: the Older or Pleistocene Fill, which was deposited before the Holocene; and the Younger Fill, deposition that occurred during the Holocene (Bintliff 1977: 56-57; Fig. IV.22). The Older Fill was deposited during a period when the sea level was considerably lower than at present (Fig. IV.22/Stage 1). The Older Fill was therefore a product of a glacial environment and deposited as a process of alluvial aggradation, resulting in the steepening and smoothing out of stream profiles. Older Fill sediments are characterised by red soils and angular rocks. Due to the seasonal nature of this deposition, which disrupted the sediment supply and transportation, much of the Older Fill never reached the coast.

The warmer and wetter climatic conditions of the Holocene brought more stable deposition rates as the melting of the ice cap ensured higher rainfall and constant fluvial outwash, less erratic than under glacial conditions. This resulted in the reduction of stream-bed

gradients and the incision of narrow, deep valleys into the Older Fill (Fig. IV.22/Stage 2). Sediment from this process was deposited near the coast, forming alluvial plains and prograding deltas, and is known as the Younger Fill (Vita-Finzi 1969). Younger fill sediments are characterised by well-bedded silts with regular courses of gravel that were eroded from the Older Fill.

Vita-Finzi (1969) believes that the deposition of Younger Fill sediments continued to the late Roman period, c. AD 250 (Fig. IV.23). Butzer (1971), on the other hand, believes that the deposition terminated somewhat later, c. AD 500, and that the overall effects of this sedimentary process were quite localised. Butzer interprets the effects of climate on sedimentary deposition as being more changeable and less dramatic over the last two thousand years and attributes sedimentary accumulation since this period predominantly to increased rates of soil erosion brought about by deforestation and intensified cultivation and grazing induced by human impact on the environment. It is indeed a fact that human impact on the environment intensified during the Hellenistic and Roman periods. Contemporary accounts by Plato (Critias, III, D-E) and later Pausanias (Frazer 1898) bear witness to this fact. However, it could be argued that humans have merely hastened this process rather than been its cause.

Whatever the cause of sedimentary deposition over the

last 2000 years, climatic or human, the effects were to have a huge impact on the coastal morphology of the eastern Mediterranean, particularly low-lying coastal regions. It is apparent that from possibly as early as the second millennium BC coastal settlers would have encountered swampy flood plains, unstable river courses and ultimately problems of harbour siltation (Bintliff 1977: 37; Bothwell & Dimbley 1981: 18). During the early/ mid-Holocene the rate of sea-level rise was too rapid for alluvial deposition at the river mouths to accumulate fast enough on the offshore sea bed or indeed to build up above the water-line in order for alluvial infill to keep pace. This was especially true where the basin was deep, often a characteristic of Older Fill coastal plains (Bintliff 1977: 49).

However, once the rate of sea-level rise decreased, c. 7000-6000 BP (ie 5000-4000 BC), the lower parts of river courses ceased to be drowned by rising sea level and subaerial delta sediment was able to accumulate. This process was variable throughout the eastern Mediterranean, as the rate of sedimentary accumulation and progradation was dependent upon the depth of the offshore basin, the stream bed gradient, and, most importantly, the amount of sediment load. Most deposition occurred possibly as early as the first millennium BC (Bothwell & Dimbley 1981: 20) and certainly no later than early Medieval times (Bintliff 1977: 36), ultimately burying numerous second millennium BC

anchorages. Vita-Finzi (1969: Fig.2) identified a second phase of aggradation in the Medieval period, during a climatic phase known as the Little Ice Age, that temporarily limited delta expansion (Fig. IV.22/Stage 3). However, the overall effects on second millennium harbours remain basically the same. As Evans (1973: 100) states,

> 'The infilling and decline of many harbours is thus almost an inevitable consequence of their construction ... Natural processes ... prove to be too great in magnitude for man to be able to combat them, particularly in earlier times when large-scale excavation or dredging techniques were not available.'

Hence, traces of harbours in deltaic and alluvial regions are often slight and require large-scale excavation to be unearthed. Only when rivers began to settle into more established plains did sediment deposition cease to be a threat and sediment became more generally available for cultivation (Bintliff 1977: 37).

The main regions affected by the processes of sedimentary deposition and geomorphological change are those where rivers run into low-lying coastal areas. In the same way that deltas formed once the rate of sea-level rise decreased, so too sedimentary deposits accumulated in low-lying riverine estuaries and marshy lagoons, often silting up Bronze Age harbours. It is evident that a number of second millennium BC harbour sites around the eastern Mediterranean have been greatly affected by the processes of geomorphological changes. In some cases, such as at anchorages along the southern Levantine coast, the Cilician

Delta or Cyprus, precautions to prevent siltation were taken during the Bronze Age or harbour sites were relocated or abandoned (see Part II).

In the subsurface lies the record of sedimentation throughout the Holocene epoch. These sediments contain many clues as to the nature of the landscape at various times during the Holocene. It is important to correlate these clues with the times of occupancy of archaeological sites in order to understand the pattern of geomorphological change at a site (Kraft et al. 1977: 941). Archaeological evidence is able to provide some indication of depositional chronology through analysis of buried structures, interbedded pottery and radiocarbon-dated organic inclusions that have been uncovered throughout the eastern Mediterranean (Bintliff 1977: 36).

TURKEY

Along the coast of southern Turkey the effects of geomorphological change are principally recognised on low-lying areas of intermittent prograding deltas (Bird 1985) such as the Cilician Delta, the Pamphylian Plain and the deltaic regions of the River Göksu (Silifke) and the Erdemli-Mersin plain.

The Cilician Delta is a product of deposited sediments from the Seyhan, Ceyhan and Tarsus rivers. The deltaic

plain is believed by Erinç (1978: 87-108,fig.3) to be of post-glacial date prograding at a rate of 150-300m/ century, not necessarily a gradual or continuous process. Strabo (12.2.34) noted the rapid progradation of the delta in the first century BC. According to the surveys by Seton Williams (1954), the delta was formed although not occupied by the Neolithic period. This deltaic growth is believed to have increased during the first millennium BC in response to a reduction in the rate of sea-level rise, 'the effects of subsidence [thereby being] overcome by those of alluviation' (Russel 1954: 378, 382). Deltaic growth is likely to have either landlocked any harbours that functioned prior to this date, or buried them beneath deposits of alluvial sediment. The prograding nature of the delta is evidenced by the silting up of many of the Bronze Age harbours located on and around the edges of the plain, for example the riverine/ lagoonal harbours of Tarsus (#69), Kazanli (#68) and possibly Domuz Tepe (#72), that are now completely cut off from the sea due to deltaic progradation (Bird 1985: Fig.96; Seton Williams 1954; Gilbert 1991, personal communication). Effects of the prograding nature of the delta are clearly seen at the mouth of the present and previous course of the River Seyhan where a series of three dune systems, the still-existing Tuz lagoon, and two other infilled lagoons, have been identified (Evans 1971: 390-393; Fig.IV.24).

Similar processes affect the Silifke (Göksu) delta.

The shape of the delta and the point at which the River Göksu enters the sea have shifted continually since the second millennium BC. A characteristic of rivers on prograding delta environments is continually to seek the shortest route to the sea (Evans 1973: 91). Because of this process, coupled with the effect of prevailing winds and waves at the mouth of the delta, which encourage the formation of spits and longshore drifts of sand dunes, the morphology of deltas is constantly changing.

As a result of the prograding nature of the delta, any anchorages that were once utilised on the delta or which served the town of Silifke (#59) must be located some distance from the present course of the river or buried under alluvial deposits. The river is known to have been navigable at least until the time of Strabo. The river currently enters the sea on the south-eastern side of the delta while the current carries the sand and alluvial material along the shore in a westerly direction. Evans (1971: 388) believes that during the Bronze Age the River Göksu flowed into the sea at the extreme south-western part of the delta. Sea breezes have also affected the morphology of the deltaic coastline.

The effect of increased alluviation in response to the reduced rate of sea-level rise, has resulted in a number of other valleys, such as the Finike Plain, the valleys associated with Ayas (#64) and Susanoğlu (#61), and the

Pamphylian Plain, being infilled with Younger Fill sediment. Such valleys are characterised by flat fertile valley bottoms of gravel, sand and silt, or by alluvial fans which have built up during the Holocene within lagoons created behind coastal sand bars, and which are often dry in the summer (see Fig. IV.3).

Other more localised areas of silted riverine valleys are seen in southwest Turkey. In Lycia, the ancient harbour of Patara (#13) is now a lagoon, completely enclosed by a sand bar that has formed by a process of longshore drift across its entrance (Flemming et al. 1973: 54,fig.51; Toksöz 1986: 82-89). The plains of Limyra (#30) and Demre (#27) are also examples of this phenomenon. Other harbour sites affected by siltation along the Turkish coast include Dalyan (#02) and Side (#39)[8]. Finally, the Antioch Plain which is drained by the River Orontes, is thought to have silted up since the Bronze Age. At the river mouth the shifting channel courses and stretches of sedimentary deposition have isolated the 9th century BC harbour of Al Mina (#81).

Fig. IV.25 highlights those low-lying areas of the south Turkish coast that have been subject to sedimentary alluviation.

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[8] Side fell into disuse because it became covered in aeolian sands (Evans 1973: 100).

NORTHERN LEVANT

The coast of the northern Levant has undergone limited geomorphological analysis. It is possible however, that the low-lying coastal plains of Latakia, Akkar and the Damur plain, to the south of Beirut, are at least partly the product of increased rates of alluvial deposition that occurred in response to reduced rates of sea-level rise in the latter part of the Holocene. No doubt the coastline of these plains was located somewhat to the east of its present position in the second millennium BC. In order to identify anchorages of this period we need to look beneath the alluvial valleys and upstream of the prograding plains.

SOUTHERN LEVANT

Second millennium BC harbour sites along the southern Levantine coast were frequently located at river mouths and were therefore particularly susceptible to geomorphological change. The natural process of siltation along this shoreline has been ongoing since the Holocene. The coastline was deeply entrenched by rivers in the early Holocene, c. 12000 BP. These river valleys were flooded during the Flandrian transgression and formed estuaries or rias and marine embayments in lee of the kurkar ridges on the coastal plain, so offering ideal shelter to vessels. With the principal reduction in the rate of sea-level rise c. 6000 BP, and the lack of tide to remove coastal sediment, the drainage system of the plain was affected and the marine embayments began to silt (Raban 1983: 217,fig.2,

1978; Fig. IV.26). Winter floods carrying silt from the hinterland, combined with wind- and wave-borne material deposited on the shores, formed sand spits along either side of the estuarine mouths. The formation of sandbars by the second millennium BC accelerated the infilling process and created brackish lagoons behind the kurkar ridges on the coastal plain. Barrier islands formed by partially submerged offshore kurkar ridges promoted this process as they prevented sediment being carried out to sea (Raban 1985: 12, 1991: Pl.XXXIII.a). Raban (1989 personal communication) believes that rivers on the coastal plain were navigable during the Middle Bronze Age but by the end of the Late Bronze Age many of the coastal lagoons and embayments that functioned as anchorages for second millennium BC vessels, had silted up, particularly those in the north of the region.

As a result of sedimentation, numerous riverine harbour sites located on the coast of the southern Levant, such as Tel Akko (#134) and Tel Mor (#164), became silted up. Although various methods were adopted to try to prevent sedimentary build-up at the entrance to estuarine anchorages, a number of sites, particularly Middle Bronze Age sites, along the northern stretch of coast were eventually abandoned. These include Achzib (#131), Misrefot-Yam (#130) and Tel Mikhmoreth (#153). The coast is believed to have reached an equilibrium between sea-level rise and alluvial deposition by the end of the second

millennium BC (Raban 1983: 217).

A number of additional agents of sedimentary deposition affected, and continue to affect, the shores of the southern Levant. The beach sands of Israel are largely derived from the Nile River (Emery & Neev 1960; Breslau & Edgerton 1972; Bird 1985); an impressive quantity if one considers that most of the coast of Israel, particularly the southern two-thirds, is made up of sandy beaches. Quartz silt is carried in suspension by surface currents (Mediterranean current) as a process of longshore drift from the Nile Delta northwards up the coast of the southern Levant, occasionally as far as the Lebanese-Syrian border (Evans 1971: 402; Breslau & Edgerton 1972). Large amounts of this suspended silt are deposited on the beaches of southern Israel, much of which is then transported inland by aeolian agents - hence the extensive stretches of inland sand in the southern Levant. The coast between Bat Yam and Hadera in central Israel is composed of kurkar cliffs and although some deposition of wave-carried sediments is encountered, the predominant geophysical action along this stretch of coastline is that of erosion by wave-induced currents (Emery & Neev 1960). Longshore currents continue the transportation of sand northwards, but due to the curvature of the coast in the north-central region of Israel, some sand is carried back in a southerly direction towards the southern and central sections of the coast. As a result, the stretch of coast between Hadera and the Bay

of Haifa is affected by both the processes of erosion and deposition (Emery & Neev 1960; Fig. IV.27). Emery and Neev (1960) believe that a similar process of sand distribution has existed along the coast of Israel since the Pleistocene.

Not all the sediments transported along the coast of the southern Levant are derived from the Nile Delta. Alluvial sediments are also transported seaward by rivers that flow from limestone foothills to the east. Material is also derived from the erosion of kurkar cliffs and offshore ridges, and from sediments carried across the Mediterranean basin as a product of fetch (Flemming 1983: 148; Fig. IV.32; see below Ch.IV.3). The overall effect of sediment transportation was until recently, prior to the excavation of sand from beaches by man, one of equilibrium - the beaches were not depleted of sand while the sand protected the coastal archaeological remains from wave action (Flemming 1983: 148,fig.5).

EGYPT

The Mediterranean coast of Egypt is largely composed of the Nile Delta. The delta area of the Egyptian Nile is the largest delta in the Mediterranean and subject to constant geomorphological change. The average sediment discharge of the Nile Delta (6 million metric tons/ annum (Evans 1973: 89,table 1) is so great that after about 6000 BC any effects of sea-level rise have been largely counter-

balanced by deposition (Holmes 1993: 402).

Deltas form at the fluvial/ littoral interface as a result of prograding sedimentary deposition. Rivers that flow across broad coastal plains deposit sediment on their banks and if the sediment load is great enough they form levées or raised banks. Occasionally the levées are breached and flood, depositing coarse-grained sediment on the floodplain. On reaching the sea these coarser-grained sediments are deposited as bars around the river mouth. The finer-grained sediments are deposited on the seabed at the mouth of the river (Evans 1973: 90-91). Sediment is subsequently moved laterally along the shore by prevailing winds and currents and forms spits and dune ridges which ultimately restrict alluvial deposition on the seabed forcing sediment to build up behind the bars and infill the deltaic plain. Rivers that run over deltas will constantly strive to find the shortest route to the sea. The resulting effect is that the area at the mouth of the delta is very swampy and marshy. Conditions at the mouth of deltas are therefore unstable and impracticable for anchorage.

The banks of the levées on the River Nile flood seasonally, in August, inundating the river plain with alluvial deposits. As a result, a degree of natural infilling occurs. This process is variable and spasmodic, depending on flood levels (which are believed to have been particularly high at the beginning of the second millennium

and again in the 9th-7th centuries BC), the rate of sediment discharge (averaging about 0.2m/ annum after 400 BC), and the direction of channel progression. Accumulated sediment also contributes to the subsidence of the northern Nile Delta, with subsidence rates of between 0.2-2.2mm/ year which systematically increase from south (inshore) to north (offshore) (Warne & Stanley 1993: 718). As a result, a number of prehistoric sites, such as S-44 (#190), are undoubtedly buried beneath the Nile deposits that now cover the delta in a thick sheet of mud 10-40m thick (Butzer 1976)[9].

The unstable nature of the delta, with shifting Nile courses and deposits of huge volumes of silt, has undoubtedly obscured numerous Bronze Age harbours, such as the harbour of Tell el Dab'a (#183; Bietak 1979). The sheer weight of the harbour constructions and the associated settlement, sinking slowly into their sand foundations, could be another explanation for the lack of remaining evidence for second millennium anchorages in the region. We can conclude that Bronze Age settlers within the Nile Delta were constantly forced to relocate their harbours, due to silting and ever-shifting river systems.

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[9] Until the beginning of this century the discharge of sediments from the Nile exceeded the potential erosion and the Nile Delta built seaward. Since the construction of barriers and dams on the Nile since 1903, the pattern has changed to one of erosion. The erosion rates in some sections of the delta are extensive - average rates of 143m/ annum were recorded between 1943 and 1973 on the delta beaches east of Ras el Bar (Nir 1982: 90; Bird 1985).

Beyond the Nile Delta only one anchorage of any significance has been identified on the Mediterranean coast of Egypt, and that is the Late Bronze Age harbour of Mersa Matruh (#198). We are not sure why the lagoonal anchorage of Mersa Matruh was eventually abandoned, but due to the nature of the site it was undoubtedly subject to geomorphological change.

CYPRUS

Stretches of the coastline of Cyprus have been extensively affected by geomorphological change, particularly those on low-lying coastlines. Towards the end of the second millennium BC siltation of a number of coastal and riverine harbours and those located on the edge of inland lakes connected to the sea, occurred due to increased rates of alluviation. Many of these Bronze Age harbours were abandoned as they could no longer function due to sedimentation. Some of these anchorages were replaced by harbours located downstream or along the coast. The Bronze Age harbour of Enkomi (#224) on the southeast coast was replaced by the harbour of Salamis after the lake anchorage silted up and access to the sea via the river was no longer possible. Toumba tou Skourou (#202), a riverine anchorage site on the northwest coast, eventually became silted up due to increased rates of alluvial deposition (Collombier 1987). Within the Bay of Larnaca the Bronze Age harbour of Kition Kathari (#229) and the lagoonal anchorage of Hala Sultan Tekke (#230) were finally abandoned after

increased rates of alluviation due to sea-level rise resulted in the formation of a longshore bar across the harbour mouths, which eventually cut them off from the sea (Gifford 1978). Pyla Kokkinokremos (#228), on the north coast of the bay, was also abandoned due to increased rates of sedimentation, attributed to reduced rates of sea-level rise (Dikaios 1971). It has also been suggested that the area of the modern Akrotiri Salt Lake (#237) once housed a Bronze Age anchorage in a lagoon or marine embayment, until it was eventually abandoned due to increased rates of alluvial deposition from the River Kouris and aeolian sedimentation, which caused the lagoon to silt up (Stanley Price 1980; personal observation).

A number of river valleys along the south coast of Cyprus are believed to have been navigable during the Bronze Age prior to riverine siltation. The Maroni, Vasilikos, Kouris and Dhiarrizos valleys were all downcut by up to 6m during the early Holocene (Poole & Robertson 1991: 918). This was followed by a period of alluviation by Younger Fill sediments. Several further stages of downcutting have also been identified resulting in terracing on the valley side and narrowing of the valley floor (Poole & Robertson 1991: 918; Gomez 1987). Since the Bronze Age all of these valleys have accumulated sediment at the valley mouth making them impassable by boat. A number of potential Bronze Age harbours believed to have been situated at valley mouths, such as Zygi in the

Vasilikos valley (#235) and Tsaroukkas at the mouth of the Maroni valley (#234), are thought to have been abandoned due to siltation.

EASTERN CRETE

One of the typological characteristics of Minoan harbours is that they were very often located at the mouths of rivers. It is therefore likely that a number of anchorages on the island of Crete have been affected by riverine siltation. However, because of the lack of stream drainage basins to most of the Cretan coast, alluvial deposition is minimal (Gifford 1992: 23). There are, however, noticeable exceptions, particularly along the north coast of the island and the Messara shore. The Bronze Age anchorages of Zakros (#290), Palaikastro (#288) and Amnisos (#265) all fell into abandonment at the end of the second millennium BC due to increased rates of alluvial deposition in the river mouth anchorages as a consequence of decreased rates of sea-level rise. The low-lying, hollow, marshy area believed to be one of the anchorages of Malia (#268; Raban 1991: 139) was connected to the sea by a rock-cut channel and is thought to have eventually been abandoned due to siltation.

On the south coast of Crete the rivers do not deposit large amounts of sediment and as a result fewer Bronze Age anchorages have been subject to siltation. However, the area of the Messara Plain has been subject to

geomorphological change since the Bronze Age, although the amount of sediment deposited is no longer thought to have been so excessive as to have landlocked a riverine anchorage at Phaistos; nonetheless, alluviation certainly reduced the navigable length of the river and resulted in the progradation of the Messara Plain westward (Fig. IV.28).

## IV.3. Maritime conditions and their relation to land

In addition to topography and topographical changes, another factor important in the determination of anchorage site location is that of the prevailing maritime conditions. In order to ascertain anchorage site locations, especially with respect to harbour aspect, it is essential for archaeologists to have an understanding of the maritime conditions affecting particular coastlines of the eastern Mediterranean. A broad outline of the prevailing maritime conditions that affect the varying coastlines of the eastern Mediterranean is presented below based on the assumption that maritime conditions of the second millennium BC were comparable in direction and strength to those that prevail and are experienced by mariners in the area today (Hydrographic Office).

### Currents and Tides

The tides and tidal streams of the eastern Mediterranean are negligible, c. 0.33m, and are predominantly influenced by storm and wind movement. Currents seldom exceed 1-2 knots (nautical miles/ hour), but their effects are more noticeable closer to the shore.

The prevailing current in the eastern Mediterranean is counter-clockwise, a product of the Coriolis effect which causes a counter-clockwise movement of fluids in the earth's northern hemisphere. The result is that the current

runs from the Nile delta up the Levantine coast, and thence in a westerly direction along the south Turkish coastline, flowing back southwards once it reaches Eastern Crete (Fig. IV.29). Throughout the year this current varies from 0.25 to 1.25 knots in intensity and is generally over 1 knot 30% of the time, with little variation in direction (MP V 1976: Diags. 1.132.1-2). This circular motion of the waters would have been one factor affecting maritime movement in antiquity, although its overall influence is minimal, and in fact the effect of wind is far more important, often over-riding the effect of the current (see later this section); as seen when the meltemi winds induce east-going currents of between 0.5-1 knots (MP V 1915).

Localised currents that occur at points of constriction can in fact, considerably affect maritime movement. Straits between islands, or between islands and the mainland, channel the flow of water and create localised currents such as at Kekova in southern Turkey and between Rhodes and Karpathos, where a southerly current runs in the summer months. Points of constriction also occur where rivers and straits flow into the sea. The best example of this would be the entrance to the Dardanelles, in northwest Turkey, where the currents flowing into the Aegean Sea are so strong (3-4 knots) that ships making passage to the northeast must wait until maritime conditions are favourable ie occasional periods of S and W

Winds, in order to enter the narrow straits [10]. Similarly counter-currents are formed at the mouth of the Nile and the Gulf of İskenderun as a result of the force of the river's discharge.

Winds

Winds are the single most important factor to affect maritime conditions in the eastern Mediterranean. Winds are a product of a pressure gradient, moving from high to low pressure areas. They are also affected by the deflecting force of the earth's rotation, which in the northern hemisphere, causes them to be deflected to the right (Neumann 1986). The predominant influence on the movement of surface water is the wind.

There are two principal seasons of winds in the eastern Mediterranean, the predominant winds being from the northwest in the summer season. The Mediterranean basin is in a transitional zone between the northern margin of the trade winds of Africa and the southern margin of prevailing westerly winds. In the summer season the warm trade wind belt moves northwards from the equator, forcing the rain-bearing westerlies to retire to Middle Europe. The low barometric pressure conditions that result suck in winds from the high pressure belt of Middle Europe (Semple 1932).

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[10] Smaller vessels may try to manoeuvre close inshore where counter-currents are sometimes experienced in order to assist their passage to the northeast.

These are known as the Etesian winds or meltemi winds which blow from May/ June until October and form part of the larger pattern of Northeast trade winds. The winds blow down the Aegean and in an easterly direction across the eastern Mediterranean. They are strongest in July and August, often reaching force 6-7. The Etesian winds start in the early morning and have sometimes reached gale force by early afternoon; by the evening they have died down again.

In the winter season the heat belt shifts southwards again and allows prevailing westerlies to move into the low pressure area over the Mediterranean (Semple 1932). Barometric variations are minimal, and cyclonic conditions can develop with clashing winds from both the north and south. Hesiod (Works and Days: 663-665) urged sailors to 'stay away from the sea except for fifty days after the Summer solstice'. Although this may be a little over-cautious, it is obvious that in the winter season conditions were simply too unpredictable for long voyages. Changeable winds, short days and the lack of visibility due to cloud cover, made navigation difficult and sailing conditions dangerous. Therefore it is thought that little maritime activity was undertaken during the winter months apart from small-scale fishing trips. We assume that in anchorages that were exposed to winter storms, boats were drawn up high on the beaches or stored away.

The predominant sailing season was therefore from late spring to early autumn, with caution practised during the height of the summer (July/ August), when the winds were strongest. Bronze Age sailors took advantage of the strong, regular Etesian or meltemi winds, the clear skies which provided good visibility of land, and the regular, more predictable, maritime conditions. The prevailing NW winds blow down from the Aegean and cross the eastern Mediterranean, following the south coast of Turkey (Fig. IV.30). They decrease in force beyond the gulf of Finike and on reaching the Gulf of İskenderun they back south-westerly. They also pass north and south along the coast of Cyprus and across to the Levantine coast, and on down to the Egyptian Delta. However, the force of the Etesian winds is considerably reduced by the time they reach the Levantine coast. In this region a second wind system, that associated with the Persian Trough, affects the direction of prevailing winds. Thus, in the summer along this stretch of the coast, winds prevail from the southwest, veering to the northwest by the latter part of the day.

Local winds also affect sailing conditions in the eastern Mediterranean basin. These can arise when winds cross from high mountain ranges to low coastal plains, or when they are funnelled down deep valleys and deflect the basic direction of the prevailing winds. They can also be a product of the terrain over which they have just passed - the sirocco wind (also known as the hamsin wind, or the

sharakia along the coast of the southern Levant, and will be referred to as such in the text) is a product of warm dry southerlies that blow over from North Africa and affect maritime conditions around the Nile Delta and Levantine coast with the result that southerly winds can blow offshore from these coastlines in the spring. Winds also fluctuate within the twenty-four hour cycle and are known as diurnal or land and sea breezes. At night the temperature inland drops considerably as the earth cools, causing an offshore breeze. This is reversed during the day as the temperature increases inland and draws the colder air in from the sea. The effects of land and sea breezes 'can be felt for 20km from the coast... and thus permit navigation against the direction of the dominant wind' (Rougé 1966: 34). Such winds are strongest at the hottest times of the year and can be observed all around the eastern Mediterranean. Diurnal winds can be used when making headway in the opposing direction to the prevailing winds, particularly when the effects of the meltemi die down around sunset. Lastly, winds running close to the shore tend to follow the contours of the coastline, as is particularly evident along the Cypriot coast (Fig. IV.31).

Wind direction and predictability was the single most important maritime condition that determined the pattern of Bronze Age seaborne activity. As McKee (1983: 19) points out, 'In the days of sail the boatman was concerned with those winds that let him work, that is those that were

neither too little nor too much'. As a result, nautical activities were mainly restricted to the summer months. Those ships travelling due southeast during the summer sailing season could generally expect a rapid voyage thanks to the prevailing north-westerly winds. However, the return journey would not be as simple - difficulties in attempting to sail against the Etesians were outlined in the early decades of the 3rd century BC in the 'astronomical poem' of Aratus (Neumann 1986: 361-362). On this basis it can be assumed that anchorage sites would have been selected where there was protection against prevailing winds. It is important to have an understanding of the prevailing maritime conditions in the eastern Mediterranean when considering the capabilities of early mariners.

Two other factors that affect the state of the sea and influence anchorage-site location are fetch and swell. Fetch is the distance of open sea to windward of a place and influences the effect of the wind on the sea. Swell, on the other hand, is a product of the wind and is approximately proportional to the square-root of the fetch. Winds create swell, a rhythmical heaving of the sea. The force of the wind, the duration of time over which it blows, and the length of the fetch, determine the length and height of the swell, which continues even after the winds themselves have died down.

In general, the greater the fetch, the greater the

swell it induces and the longer that swell persists. The effects of fetch are proportional to the 'distance of open water over which the wind has blown' before it reaches the coast (up to 300 nautical miles; McKee 1983: 26). Fetch governs the height of the waves generated (McKee 1983: 26). This means that a 1km fetch could produce waves that are more than three times as high as those produced if the fetch were only 100m. A useful illustration can be found in Flemming (1983: 147,fig.4; Fig. IV.32), who identifies the fetch that affects the coast of the southern Levant.

Coastlines that are exposed to long fetches and considerable swell may not be ideal for harbour location as it is difficult to manoeuvre a ship when the swell is high (swell being particularly intense inshore), or where the aspect of the harbour is exposed to a long fetch. Two further factors, both resulting from the combination of wind, fetch and swell and the resulting onshore waves, can give trouble to sailors. Firstly, wave fronts are altered by headlands so that both flanks are attacked as well as the point of the headland. Secondly, waves striking cliff-lined coasts fall back into oncoming waves to produce a confused sea capable of swamping an open boat (McKee 1983: 27). Unless some protection, for example off-shore islands or a peninsula, exists, harbours can be very exposed to prevailing maritime conditions.

It is possible to analyse the suitability of

particular anchorages in the provision of shelter by considering the general aspect and characteristics of a harbour in relation to fetch and the sea state; these are essentially a product of the direction, strength, and duration of the prevailing wind[11].

Both fetch and swell are products of, or relate to, the wind. The prevailing wind at any given time will affect shorelines of varying aspect in different ways. McKee (1983: 23) points out that a boat's performance varies depending on the angle of its intended track to the wind. When relating the track of a boat to the land and the prevailing wind, McKee (1983: 23-26) considers four coastlines: the 'lee shore', the 'exposed shore', the 'sheltered shore', and the 'weather shore'.

It must be taken into consideration that McKee's standards apply to boats that could be relied upon to sail within 6 points off the wind (including leeway) with the wind 2 points (22.5 degrees) forward of the ship's beam (McKee 1983: 23). This was highly unlikely to have been the case in the second millennium BC. We have seen from Ch.II that the precise capabilities of Bronze Age seafarers to sail their vessels into the wind is difficult to determine, although their performance was obviously dependent upon how

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[11] The suitability of particular anchorages in the provision of shelter depending on the prevailing maritime conditions is analysed for a number of sites outlined in Part II.

close they were to the wind. For the purposes of this discussion we will assume (as concluded in Ch.II) that they achieved a maximum of 1 point (11.25 degrees) to windward, that is, 7 points (78.75 degrees) off the wind (including leeway). However, unlike the vessels discussed by McKee, Bronze Age boats could not necessarily be relied upon to perform to such standards. I have therefore modified McKee's standards in order to outline four basic coastal aspects that apply specifically to winds (predominantly NW winds) that prevail during the summer sailing season in the eastern Mediterranean (Fig. IV.33).

McKee Type (1) - A shore that is exposed to the prevailing wind 'is one that lies across and facing up into the prevailing wind' (McKee's (1983: 23) 'lee shore'). Lee shores are generally given a wide berth by mariners because of the dangers of not being able to sail clear of them. With such an alignment of the shore to the prevailing wind we can assume access into the harbour on the prevailing wind. However, such an exposed shore accommodates much broken water and if the sailor makes a mistake the ship is in danger of being stranded by being blown onto the shore. Furthermore, in order to leave a lee shore harbour under sail much sea room is required and tacking may be necessary. In certain circumstances it may not be possible to leave before a change in the direction of the wind.

McKee Type (2)/(3) - A shore that is aligned or lies

parallel to the prevailing wind. Both the approach to, and departure from such shores are far more controlled using a beam wind ie wind on the beam. This will be described as a shore that is exposed to parallel winds.

McKee Type (4) - A shore that lies, as it were, 'with its back to the wind' (McKee's (1983: 26) 'weather shore'). This shore offers considerable shelter from the prevailing wind, and calm water will tend to stretch some distance out to sea. There is less surf during launching and beaching, but if the immediate hinterland is hilly the winds off the land may be gusty (McKee 1983: 26). It is relatively easy to leave a harbour on a 'weather shore' with the wind astern, however, mariners approaching the harbour sail into the prevailing wind. If ancient seafarers had not developed the ability to tack or they were unable to resort to rowing, then heading straight towards a 'weather shore' would have been almost impossible under sail and the mariner would have had to resort to rowing (itself difficult in a headwind) or to anchor and wait for the wind to shift.

Assessing the precise effect of wind along a stretch of coastline has its difficulties. The coastline itself may run in an overall direction, but the aspect of each harbour can contrast drastically. Prevailing winds can also take the form of diurnal breezes and therefore can change quite dramatically within the twenty-four hour cycle along

stretches of the coastline. In addition, quite localised maritime conditions can exist along a stretch of coastline and must also be taken into account. The following is an attempt to outline regional variations around the coastlines of the eastern Mediterranean. Applying the four basic coastal aspects outlined above, an attempt will be made to identify the ideal shelter along each stretch of coastline, based upon the effects of general and local prevailing winds of the summer sailing season. Throughout the discussion two factors will be taken into consideration: that of ease of entry and leaving the harbour, and the degree of shelter attained once the vessels is at anchor in the harbour.

TURKEY

The south coast of Turkey trends generally from west to east and as a result many of the harbours are S-facing, with a number of anchorages being protected by peninsulas and offshore islands. Along this coast the meltemi winds have decreased in force and back mainly from the west; therefore the winds run parallel to the coast. The coast would be described as Type (2)/(3) by McKee's definition. However, the predominant winds along the south coast of Turkey and the Gulf of İskenderun during the summer sailing season are land and sea breezes. The prevailing sea breezes are south to south-westerly, and the land breezes blow from the north and continue into the morning, thus providing

favourable conditions for movement along the coast as well as in and out of harbours (Fig. IV.34). These winds rarely exceed Force 5, and sea mist is common on summer mornings (Heikell 1989: 22).

When the meltemi blows, the Lycian coast can be described as a coast exposed to westerly winds, and therefore anchorage sheltered from the west is preferable. Winds back to the southeast between Cape Gelidonya peninsula and Kemer, which can therefore be identified as a 'lee shore' (McKee Type (1). Further north along the coast, the shore runs parallel to the edge of the Taurus Mountains in a northerly direction up to the Gulf of Antalya. Here the effects of the meltemi die off and during the day sea breezes bring mild S/SW winds. Thus places with shelter on the southern side are preferable for anchorage. In the morning sea breezes prevail from the north and morning mists are common (Heikell 1989: 22-23,202).

From Antalya to Anamur, the low-lying coast of the Pamphylian Plain trends in a south-easterly direction, and is subject to sea breezes blowing onto a 'lee shore' (McKee Type (1). As a result, there are very few harbours along this exposed shoreline, with a number of exceptions to the west of Anamur Burun, where the southern base of the Taurus Mountains provides some protection from onshore winds.

From Anamur to Silifke the coast is essentially S-

facing. When sea breezes prevail the coast is described as a 'lee shore', McKee Type (1). Westerly winds also prevail along this coast. Sheltered anchorage is provided by valleys that form the southern base of the Taurus Mountains. From Silifke the coast turns north-eastward and the prevailing S/SW winds run parallel to the low-lying shore, so that this can be described as a shore exposed to parallel winds (McKee Type (2)/(3). Ideal shelter would be a bay with a north-easterly aspect; however, because of the low-lying nature of the coastline, little shelter is provided. Diurnal winds are also experienced along this stretch of the coast.

On the Cilician Delta the position of Bronze Age riverine harbours is not as important as the aspect of the mouths of the river channels that access the delta from the sea. During SE winds the delta can be entered easily (Geo. Handbook 1942: 100). Prevailing winds are light and south-westerly in nature, and blow up into the Gulf of Iskenderun. In this case, the best landing place would be one protected from the south. Northerly winds occasionally blow off the Anatolian Plateau.

South of İskenderun the most sheltered anchorages are along the River Orontes. Their locations would have been affected by the maritime conditions that prevailed at the entrance to the river. Here the winds blow mainly from the west; thus, approaching from the north at a slight angle to

parallel would make entry to the river mouth possible. Strong easterly gales known as raghieh, followed by strong W winds, occasionally blow down the Orontes into the Bay of Antioch (MP 1976). Entrance to the River Orontes is also affected by N winds that occasionally blow off the Cilician Delta.

NORTHERN LEVANT

The general aspect of the northern Levantine coast is W-facing and is therefore exposed to prevailing W winds. The ideal position for anchorages along this exposed McKee Type (1) coast would be in the lee of an off-lying island or promontory that provides shelter from the west.

Winds can sometimes be unpredictable along this stretch of the coast, particularly in the winter but also during the summer sailing season. As the westerlies finally reach land they rise up over the Lebanon Range. At the same time, winds cross from the Lebanon Range down to the sea, often funnelled along deep valleys causing unpredictable local wind conditions all down this coast. This area of coastline, particularly along the Syrian coast in the north, is also subject to the effects of an additional local wind that blows off the Anatolian mountains which can cause northerly gales.

In the north, low-lying cliffs and promontories that deviate from the general north-south alignment of the

coastline provide some shelter in bays. For example, Latakia (#93) and Ugarit (#89) are exposed to the southwest and northwest respectively, and provide considerable protection to vessels at anchor. Their positions, at slight angles to the prevailing W winds, allow relative ease in manoeuvring in and out of the harbours. Nevertheless, only a handful of bays offer this sort of protection.

Between Tartus and Tripoli the wide open, W-facing coastal plain offers little protection against prevailing winds, except at the mouths of rivers. Some shelter is provided at Tripoli (#111) as the harbour's aspect is at right angles to the prevailing wind. Protection is also provided in the lee of the islands of Arwad (#102) and Machroud (#104), where since the second millennium sailors have sought shelter from the prevailing winds. They, in fact, offer the best anchorage along this exposed stretch of coastline.

South of Tripoli the western extent of the Lebanon Range meets the Mediterranean Sea. Little protection is offered, except in the occasional bay such as those of Juneh (#117) and Byblos (#116). Although these are very sheltered to the north, south, and east, their aspect is also NW-facing. From Beirut southwards, the aspect of the coastline is continuously exposed to the west-northwest, so that any shelter is generally sought in the lee of promontories or offshore islands (parts of the offshore

kurkar ridges that run parallel to the coast), as at Sidon (#122) and Tyre (#125).

SOUTHERN LEVANT

The coast of the southern Levant continues along a roughly north-south axis with total exposure to prevailing W winds along a McKee Type (1) shore. Winds associated with the Persian Trough system also blow along this stretch of the coast. They prevail from the southwest and veer to the northwest by the latter part of the day. A few cliffy promontories and the offshore kurkar reef system provide some shelter from prevailing winds. Alternatively, shelter can be sought in river mouths. But how did Bronze Age sailors enter and leave river mouths on an 'exposed' shore? Presumably ancient mariners overcame this problem by taking advantage of diurnal breezes which also prevail along this stretch of coastline and are particularly strong in the hot summer. Vessels would leave their anchorages very early in the morning with the aid of the dying offshore breezes and would return late afternoon on the westerly sea breezes. Finally this coastline is also affected by the southerly sharakia winds (a product of the hamsin weather) that blow from the Sahara desert in the south.

The only sizeable, sheltered bay along the coast of the southern Levant is Haifa Bay, which is sheltered to some degree by the north-westerly reaches of the Carmel Mountain Range, providing protection to the harbour of Tell

Abu Hawam (#137). Otherwise, except where offshore islands or ridges can provide shelter, or in bays with northerly or southerly aspects, the Levant coast is not ideal for anchoring. Nevertheless, the political and economic environment of the second millennium BC required ports of trade to be located along this basically harbourless coastline. Sites such as Dor (#145), Yavne-Yam (#163), and Achzib (#131) provide us with examples of how Bronze Age mariners took advantage of the natural topography to secure sheltered anchorage.

EGYPT

The deltaic coast of Egypt is essentially N-facing, exposed to the northwest and northeast, and thus, a McKee Type (1) 'lee shore'. The only protection provided on this low-lying sandy coast is behind beach ridges and in lagoons, for example at Pharos (#193) and Mersa Matruh (#198). The effects of the meltemi, prevailing from the northwest, are much reduced by the time they reach the Nile Delta. However, the effects were still strong enough to assist early craft in sailing upstream along the Nile River. The low pressure system over the coast of North Africa also produces SW winds which blow off the delta and up the coast of the Levant.

The coast of Egypt experiences land and sea breezes and is also susceptible to the effects of the sirocco wind (hamsin), southerlies that flow from North Africa. They are

at their strongest in the spring and affect conditions on the Nile Delta, making manoeuvring into the delta hazardous. As a result, few anchorages exist along this exposed shoreline. Ideal anchorage would be upriver or behind offshore ridges, such as Pharos Island, and lagoons on the coast. East-flowing currents prevail along the north coast of Egypt, especially when enhanced by strong W winds.

CYPRUS

While the island of Cyprus is subject to a number of different winds during the summer months, the prevailing winds are westerly. The westerlies are a product of both the meltemi wind, which blows along the north and south coasts, and diurnal winds, which are experienced regularly in the summer due to intense summer heat. The effects of the sea breeze and meltemi winds increase into the afternoon and can reach between force 3-6 (being strongest in July and August; MP V 1976, 1915; Heikell 1989: 223). The W wind usually dies down in the evening and by night a cool, gentle land breeze lasts until dawn (Denham 1964: 164). Away from the coast the wind blows from the west and southwest, but closer to the coast the wind tends to follow the contours of the shore (Heikell 1989: 223). Winds from the southwest with a long fetch produce a swell around the west and south-western shores of Cyprus (MP V 1976). They also generate a longshore current along the south coast of the island. Although gales are rare in the summer, they occasionally blow from the southwest. Warm N winds which

blow off the Anatolian Plateau are also experienced along the north coast.

Sea fog occurs often along the south coast in the summer. It appears in the early morning and has usually dispersed by mid-day. It can reduce early morning visibility to c. 1km (Heikell 1989: 223).

The currents around the coasts of Cyprus, particularly in the north, are induced by the prevailing winds. As a result, an eastward flowing current of between 0.5-1 knot is experienced off the north coast during the summer months (MP V 1915; Heikell 1989: 223), although sometimes the anti-clockwise Mediterranean current is predominant (MP 1976). The current along the south coast also flows towards the east-southeast and backs to the north around the south-eastern corner of the island. It seldom exceeds 0.8 knots (MP V 1976; Heikell 1989: 223) and therefore had little effect on the movement of Bronze Age vessels.

The north coast of Cyprus trends generally east-west. Westerly winds prevail along this stretch of the coast during the summer months, strengthened, particularly in the latter part of the day, by sea breezes. During the night the winds drop off quite considerably and negligible land breezes are experienced. Between Cape Kormakiti and Cape Andreas the coast is mainly N-facing and can be described as a McKee Type (2)/(3) shoreline. Shelter is provided in

the lee of promontories, inlets and offshore islets. North-easterly winds are occasionally experienced in the summer mornings, blowing from the Turkish coast to the north. Where no shelter is available the north coast of Cyprus is left exposed.

The north-eastern extremity of the island is marked by Cape Andreas. To the south of the cape the shore is protected from predominant W winds. However, S winds are also moderately frequent, particularly in the afternoon, and thus anchorages sheltered from the south may be preferred. This shore can also be affected by offshore winds blowing off the Cilician Delta to the northeast. The south side of the Karpas Peninsula is, however, completely sheltered from prevailing westerlies and can be described as a McKee Type (4) shore.

To the south, the Bay of Famagusta is E-facing. The Mediterranean Pilot V (MP 1976) records varying winds in the bay including light N and NE winds in the summer, which become quite strong E winds in the early morning and blow directly onshore. Sea breezes also affect this stretch of coastline; they start in the morning from the southeast and veer to the southwest-west by the afternoon. Negligible W winds are also known to blow off the Messaria Plain down across the head of the Bay of Famagusta. The variable winds make navigation into and out of the Bay of Famagusta reasonably straightforward, as throughout the day there

will invariably be a wind that will aid manoeuvring.

From the Bay of Famagusta the coast trends in a westerly direction and is essentially a S-facing, McKee Type (2)/(3) shoreline, running parallel to Larnaca Bay. Sea breezes blow onshore into the Bay of Larnaca from the south-southwest (Heikell 1989: 223), the products of which can be seen in the process of longshore drift which deposits sediment along the southwest shores of the bay. The head of the bay is E-facing and is situated on a McKee Type (2)/(3) shore. North-westerly winds are also experienced in the early morning (MP V 1976).

South of Larnaca Bay the coast trends to the west-southwest and the prevailing W winds follow the contours of the coast. Shelter is mainly sought along this McKee Type (2)/(3) shoreline in river mouths. At the Bay of Akrotiri the coast trends to the south and winds prevail from the west and southwest. Conditions are generally calm and sheltered, and the coast can be described as Type (4) shore by McKee's definition. During the Bronze Age, prior to the formation of the Akrotiri Peninsula (#237), it is possible that sheltered anchorage was provided within a E-facing lagoon or embayment that once lay between the mainland and Akrotiri Island to the south.

From Akrotiri Peninsula the coast is S-facing and W winds run parallel to the shore. Shelter is sought in small

bays and the mouths of rivers. The coast can be described as a McKee Type (2)/(3) shoreline. At Paphos (#247) the coast begins to trend to the north; anchorage here is sheltered in lee of a promontory which lies on the west side of the S-facing bay.

The west coast of the island of Cyprus is exposed to prevailing W winds. Little shelter is afforded on this McKee Type (1) 'lee shore', except in the lee of offshore islands and promontories. Cape Arnauti in the north provides some shelter in its lee, but W winds blow straight into Khrysokhou Bay which lies to the east, leaving exposed McKee Type (1) shorelines.

To the north of Khrysokhou Bay the coast trends to the east and forms the southern shores of Morphou Bay. Morphou Bay is open to the northwest and therefore lies exposed to prevailing winds; it can be described as a McKee Type (1) shoreline. Sheltered anchorage is afforded in the mouth of rivers and at the back of the bay.

EASTERN CRETE

During the summer months the prevailing winds around the coast of Crete, particularly on the north coast, are almost always from the north. However, gentle land and sea breezes are often combined with the meltemi winds and as a result 'local winds are of great variety and importance in the island' (Geo. Handbook 1945: 210). Although the high

mountains of Crete can act as a barrier to the gentle sea breezes, strong winds from the north or south will sweep up their windward slopes and, surmounting the crest, rush down the lee side, often with great force. The south coast of Crete is particularly susceptible to severe squally winds that rush down between the valleys and make anchorage in valley mouths dangerous. In addition, S winds, known as livas, blow across from Libya during the summer months (Watrous 1992: 177).

The north-eastern coast of Crete trends generally east-west, only intersected towards the eastern end by the Gulf of Mirabélo. Northwest meltemi winds prevail along this stretch of coast during the summer months, strengthened, particularly in the latter part of the day, by sea breezes. The strengthened onshore breeze is known as vorrás (Geo. Handbook 1945: 209). During the night this onshore breeze is replaced by offshore land breezes which can be felt some 16km out to sea. Anchorages along the north coast of Crete are mainly N-facing and therefore exposed to the prevailing NNW winds on a McKee Type (1) shore. A number of offshore islands, islets and short promontories provided a degree of shelter to some anchorages, while other anchorages were located in river mouths or sheltered behind promontories. Currents along this north-eastern coast flow to the west.

The most sheltered stretch of water along the north-

eastern coast of Crete is on the western side of the Gulf of Mirabélo, particularly in the lee of Spinalonga Island (#270). Anchorages along this shore have their backs to the prevailing wind and would be described as Type (4) shorelines by McKee's definition. The back of the gulf is more exposed with winds rushing across the low isthmus that breaches the north and south coasts of Crete. Anchorages on the east side of the gulf face directly into the prevailing wind and would be described as being on a McKee Type (1) shore. The most sheltered anchorages are sought in lee of islands, such as Pseira (#277) and Mochlos (#278).

Further east the coast trends in a north-easterly direction and the winds back WNW, rendering most of the coast exposed to the prevailing wind on a McKee Type (1) shore. Little shelter is provided along this stretch of coast apart from on the western side of Sitía Bay (#279) and in lee of the occasional northerly projecting promontory. From the Gulf of Mirabélo to the eastern end of the island, currents flow to the W and therefore favour movement from east to west.

From Cape Sidhero the coast trends to the south, thereby sheltering anchorages from the prevailing W winds. However, the terrain is extremely steep and barren along this coast, which is dissected frequently by deep ravines down which strong winds are funnelled. When not affected by squalls this coast is well sheltered and would be described

as a Type (4) shore by McKee's definition.

From Kavallos Bay which marks the south-eastern corner of Crete the coast trends to the west and runs in an almost continuous westerly direction to Cape Lithinon. The coast is S-facing and subject to strong squalls which blow down from the mountains, particularly when N winds prevail in the summer months, when the coast can be described as a McKee Type (4) coast. Thus there are few sheltered anchorages particularly at the mouths of deep ravines. This phenomenon is particularly noticeable between Zakros and Ierápetra. To the west prevailing winds are westerly. Strong S winds also occasionally blow up from the Sahara (sirocco wind) along this coast. Unless the winds are light or shelter can be sought off small bays, this coast is an exposed McKee Type (2/(3) shoreline. Some advantage may be taken of diurnal winds to manoeuvre in and out of harbours. Currents along the south coast run from east to west.

At Cape Lithinon the coast trends to the north again, running along a W-facing shoreline to the northern point of the Bay of Messara. Again the coast is quite exposed to prevailing NW winds and defined as a McKee Type (1) shoreline.

Thus the physical determinants of anchorage site location are outlined and will be discussed in more detail relative to particular sites in Part II. Their importance cannot be over emphasised, as an understanding of the coastal topography, the effects of sea-level and geomorphological change, and the prevailing maritime conditions along the coasts of the eastern Mediterranean, provide archaeologists with an indication of the prior location of Bronze Age anchorage sites.

# Chapter V

## The functions of harbours and their relation to systems of Bronze Age trade

### V.1 Second millennium harbours and their levels of functioning within society

Harbours of the second millennium, as today, performed different roles within society, offering varying facilities depending on the needs of the community and the type of seafarers that they served. As McGrail (1983: 311-12) points out:

> 'The seaman, the trader and the political authority may each have different views on what constitutes the ideal landing-place... The seaman requires one with nearby natural features which make good landfall and can be readily distinguished... and the landing-place itself should have an aspect such that it is sheltered from the predominant wind and swell...The trader requires a landing-place close to a settlement where he can find shelter, food and water, where he can meet buyers and possibly assemble a return cargo. Such a site has been called a 'port of trade' (Polyani 1963) or a 'gateway community' (Hirth 1978). This site should ideally be at the centre of the regional economy or with good access to it... The political authority requires a well-defined, possibly defended, site... where traders can be segregated, protected and supervised'.

The following section attempts to discriminate between the many functions of harbours. This is not to say that a single harbour had only one function, or that its role did not expand over time, thus making it difficult to identify the precise function of a particular harbour. Anchorages

can simply offer anchoring or watering facilities, or act as a haven for small fishing communities; or, at the other end of the scale, can act as centres of international trade.

The following typology is an attempt to categorise the varying functions of anchorages and their characteristics:

V.1.i. Anchorage that served as a temporary shelter for craft (ie landing place) -

A fundamental requirement of any sailor is an ability to be able to make fast his craft when the need arises. Many small bays or stretches of beach became locations for the mooring and beaching of craft on a short-term basis. When the necessity arises to shelter from gusting storms, or to rest for a few hours during a short fishing trip or longer voyage, such temporary havens are essential. Such an anchorage would not necessarily have provided permanent shelter or associated mooring facilities, so that temporary anchorages are difficult to identify in the archaeological record. The only clues that may indicate the use of such a haven are abandoned stone anchors in the waters just offshore. Modern-day examples of temporary or informal landing-places without fixed structures are known throughout the eastern Mediterranean.

V.1.ii. Anchorage that functioned as a stop-over and watering point -

Such anchorages would have provided two basic functions: to provide fresh water, and possibly food; and to offer shelter for vessels for overnight or extended 'stop-overs' at suitable points en route between destinations[1]. Being more permanent than temporary anchorages, additional protection, and possibly limited mooring facilities, would have been provided at stop-over points. Many vessels were either too small or loaded up with cargo or crew to be able to carry more than a day's supply of water, and consequently fresh water was needed on a regular basis. As a result stop-over and watering points were often located in sheltered bays, fed by small streams or rivers. As in the case of temporary anchorages, abandoned stone anchors may provide the only clue, if any, to the use of such an anchorage in the archaeological record. In time, many of these anchorages may have encouraged the settlement of small shoreline communities in order to cater for the needs of sailors seeking temporary shelter.

Numerous anchorages carrying out such functions would no doubt have existed throughout the eastern Mediterranean particularly in areas such as the south Turkish coast,

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[1] Homer provides evidence in the voyage of Ulysses, of boats mooring or beaching at stop-over points to take on water and rest for a while (Odyssey X,30-166, IX,546).

where coastal population densities were low and larger, more permanent harbours were few and far between.
In addition, such anchorages may well have served as hide-outs for (or alternatively hiding places from!) pirates; possibly the function of the Classical harbour of Antiochia (#46) on the south coast of Turkey.

V.1.iii. Point where vessels wait for favourable maritime conditions -

This category of anchorage includes those points where vessels were forced to shelter behind promontories or in bays during storms or high seas; as well as points where obstacles, such as adverse maritime conditions, had to be tackled. Such anchorages include bays situated near the entrance to straits where the currents are known to be periodically strong in the opposing direction of intended travel, or at points along a route of passage where the coastline changes direction dramatically, such as at capes, and where a wind-shift was needed before the cape could be rounded. Mariners would utilise such anchorages in order to await favourable conditions for onward passage.

At the entrance to straits where strong currents flow in the opposing direction to intended travel, natural counter-currents often exist at the edges of the straits that could be used to make progress against the predominant current. However, Bronze Age mariners could not always rely

on counter-currents as they did not always exist, were not strong enough, or were simply unknown to the mariner. Anchorages are often established at the entrance to straits to serve the needs of mariners waiting to pass through the straits or possibly to supply a pilot to guide vessels through the straits. An example of such an anchorage would be the harbour of Troy on the north Aegean coast of Turkey, at the entrance to the Dardanelles Straits. The currents of the Dardanelles run in a south-westerly direction at speeds of up to three knots, and are aided by the predominant north-easterly winds. The absolute necessity for boats to stop and shelter either in the Trojan Bay (now silted) or in Beşik Bay to the south and wait for slack in the straits (Severin 1987: 39,map 2) encouraged the growth of Troy as a powerful city, ultimately controlling access to the Sea of Marmara and countries further east around the shores of the Black Sea. More limited examples of such anchorages are encountered in the eastern Mediterranean.

Conversely, numerous examples of anchorages either side of capes are encountered in the eastern Mediterranean. McCaslin (1980: 3,fig.1) has identified a number of such anchorage points around the coast of Cyprus where stone anchors have been recovered from the waters around capes, indicating that sailors laid anchor here in order to await favourable winds before rounding the cape. Facilities at such anchorages would be limited, not necessarily providing an adequate water supply.

V.1.iv. Anchorage that served the immediate needs of the community -

The most obvious example of an anchorage that exists to serve the needs of the associated community is a fishing harbour. Good fishing grounds, sheltered anchorage and an ample fresh water supply would have been all that was necessary for the growth of a small fishing community. Such an anchorage would serve a population of fishermen and farmers, depending on the season, and communication along the coast (and possibly access to the interior) would have been an additional attraction to the establishment of such a site. Such anchorages would also have been used as stop-over points, providing food, water, rest and possibly boat repairs, to passing sailors and merchantmen.

Documentary and archaeological evidence for Bronze Age fishing communities is limited, but their existence along the shores of the eastern Mediterranean is not in doubt. Coastal sites where local second millennium BC plain wares have been discovered (numerous examples in Part II), particularly when not associated with imported goods or evidence of more sophisticated lifestyles, would indicate small communities dependant upon local resources such as farming and fishing. Discoveries of quantities of fish-net weights in houses, such as those found associated with the anchorage of Ayia Varvara, at Malia (#268) in Eastern Crete, would also imply fishing practices.

V.1.v. Anchorage at the highest navigable point upstream/ lowest bridging point -

Anchorages of this nature are essentially riverine and exist in response to either of the following situations:

a) Lowest bridging point or ford, ie the point on a river or estuary which is as close to the coast as possible, but where it is feasible to cross depending on the prevailing technology.

b) Highest point to which it is possible to navigate otherwise essentially sea-going vessels upstream. Such up-river anchorages are restricted by the reduced depth of water and the draft of the vessel. (In many instances goods were transferred to riverine craft inside the estuary mouth and then transported to the settlement or up-river anchorage).

Harbours located at such points provide more sheltered anchorages than on the coast; they are usually closer to the areas of manufacture and exchange of products; and they allow more room for expansion and growth of the associated communities. They invariably developed as centres of trade and municipal power, frequently served by coastal anchorages at the river mouth.

Second millennium BC anchorages of this nature have been recognised along the coast of the southern Levant (see Ch. VI.1.e) and in deltaic environments, such as those

identified in the Nile Delta region and along the coast of the Cilician, Göksu and Orontes river deltas (see Ch.VI.1). The site of Tarsus (#69) on the Cilician Delta was accessible by boat from the sea via the River Tarsus, but was also served by the coastal site of Kazanli (#68). Evidence from textual sources refers to the use of a type of barge or Nile-boat that transferred cargo from the coastal littoral of the Nile Delta to deltaic settlements up river (UT 319; UT 2085; Papyrus Harris 1 in Breasted 1907: 151-412; Herodotus II,96).

V.1.vi. Anchorages that served as outlets for the distribution of raw or manufactured materials -

A number of harbour sites appear to have been established primarily as an outlet for the distribution of raw or manufactured materials, particularly metals such as copper or tin. On the island of Cyprus a number of second millennium BC copper mining areas have been identified, particularly around the foothills of the Troodos Mountains, in association with copper smelting sites. Outlets for the export of the manufactured copper were established at anchorage sites along the coast (see Ch.VI.1.e).

V.1.vii. Anchorage that functioned as a small scale trading post or nodal point -

It would be misleading to suggest that all trading

ventures in the eastern Mediterranean during the second millennium BC were conducted on a large scale, over long distances, of the kind documented in contemporary texts. We must assume that short-haul trading operations were much more frequent, and were undertaken in conjunction with inter-regional and long distance trade (Hopkins 1983: 84-109). Small-scale merchants or coastal tinkers, utilising modest merchant craft, would no doubt have made regular trips along a limited stretch of coast, supplying local markets with basic staple commodities, such as food[2].

Inland communities would visit the coastal trading post in order to purchase, and possibly exchange, goods from and with the travelling maritime merchant. Such a small scale trading post would provide basic facilities for Bronze Age mariners and may also have functioned as a fishing harbour.

V.1.viii. Coastal or offshore anchorage serving alternately located centre of trade -

Coastal or offshore anchorages operating in conjunction with an alternatively located centre of trade would constitute a point where foreign traders and seafarers could readily be segregated and supervised

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[2] Comparisons may be drawn between such small scale, local traders and mobile grocery vans that serve the needs of the immediate local community today.

(McGrail 1991b). Such an anchorage can be described as a 'foreland' location. Such anchorages would include:

a) Coastal anchorages situated at river mouths or some distance from an inland trade emporium.

b) Anchorages located on offshore islands or islets handling goods which were then distributed at trade centres on the mainland.

c) Anchorages on peninsulas that are connected to the mainland by an isthmus, and thus afford an anchorage where goods were received and exported, which is separate from the main centre of trade.

Such anchorages were located so as to provide easy access for seafaring traders and, particularly in cases a) and b), maximum protection to the actual centres of trade, thereby ensuring a greater degree of distance and separation between the anchorage and centre of distribution. Anchorages were often located at river mouths and served emporia upstream that were inaccessible to sea-going vessels. They therefore provided a handling centre for goods which were off-loaded into riverine craft and transferred to separate centres of trade and distribution upstream. Such anchorages may have provided mooring facilities, means to off-load cargoes, or warehouses on the shoreline for the temporary storage of goods. Although primarily a point at where merchandise was transferred,

such harbours had the potential to develop into the actual centres of trade.

Examples of anchorage type a), would include river mouth harbours (see Ch.IV.1.b.viii) along the coast of the southern Levant (see Ch.VI.1.e), Pharos (#193) on the western shores of the Nile Delta, and palatial harbours of Eastern Crete, such as Kommos (#308) and Katsambas (#264), all of which can be described as goods-handling centres serving inland settlements upstream (see below & Ch.VI.1.e).

Examples of anchorage type b) include a number of islands or islets off the northern Levantine coast, in particular Sidon (#122) and Tyre (#125) and the islands of Arwad (#102) and Machroud (#104) that serve Marathus (#103) and Tabbat el-Hamman (#105) on the mainland opposite. Although sheltered, these rock-cut islets did not have a natural fresh water supply. On the south Turkish coast the islands of Kekova and Kastellórizon could well have served settlements on the mainland, such as Üçagiz (#23) and Kale Köy (#24), and Kaş (#16), respectively. The island of Pseira (#277), off the north coast of Eastern Crete, functioned as a 'gateway' harbour handling imports to mainland settlements. There are few examples of anchorage type c) the best known being the site of Mochlos in Eastern Crete. Mochlos (#278) was once connected by an isthmus to the mainland and acted as an inlet for Minoan imports.

V.1.ix. Harbour that acted as a staging-post/ junction/ entrepôt/ intermediary point en route to a final destination -

Some maritime centres emerged due to their location in sheltered anchorages en route between two major centres of international trade. Merchants involved in inter-regional or long-distance trade not only required stop-over points where they could take on water and supplies, but would also have stopped at intermediary points to exchange goods and take on additional cargo.

A number of examples of staging-posts or entrepôts have been identified around the shores of the eastern Mediterranean during the second millennium BC, and are particularly evident along the major routes of trade and communication, and on islands, such as Cyprus and Rhodes, that served as a stepping stone or staging-post, between east and west. Anchorages performing this function would provide all the essential facilities Bronze Age mariners required, from basic supplies, to storage areas, rest houses, and mooring and, possibly even, docking facilities.

Examples of staging-post harbours include anchorages on Rhodes, which acted as a junction or crossroads between the Aegean Sea and the eastern Mediterranean; anchorages along the north coast of Cyprus used principally during the Middle Bronze Age as staging-posts between the Aegean and the Levant; and Mersa Matruh (#198), on the northwest coast

of Egypt, which may also have served such a purpose for Late Bronze Age mariners en route between Crete and Egypt. Similarly, a number of harbours along the coast of the Levant acted as staging-posts between Egypt and Ugarit.

V.1.x. Harbours directly concerned with trade; Emporia, destination/ departure points -

Most of the major harbours of the second millennium BC acted as trade links between the different political and economic centres, and a wealth of documentary and archaeological evidence exists to confirm their existence. Within this category a number of types of harbours are recognised:

a) Coastal harbours that were located at the interface between inland and maritime trade routes, often providing an outlet for particular traded commodities, ie foreland location providing outlet for hinterland.

b) Harbours that developed due to their geographical location at the first convenient landing place or departure/ destination point, for vessels involved in inter-regional or long-distance trade.

c) Harbours that were attached to major political centres, that developed as trading emporia serving the needs of the political centre.

Hinterlands connected with such anchorages would have been extensive, stretching far beyond mere harbour facilities, with some sites, such as Birket Habu (Thebes), Tel Dor (#145) and Malia (#268), possessing berthing facilities such as quays.

(a) Such harbours developed primarily at the mouths of large rivers, or close to mountain passes, to facilitate contacts inland. Examples along the south Turkish coast include Antalya (#37) at the head of the Pamphylian Plain, and the harbours of Tarsus (#69) and Mersin (#67) on the edge of the Seyhan delta, that provided a link through the Taurus mountains via the Cilician Gates to the Anatolian Plateau. Links were also made from Antioch (#82) on the River Orontes to the Amuq Plain (see Ch.VI.1.a).

Along the coast of the northern Levant, the harbour of Minet el Beida (#89) linked Ugarit to the interior through the Ansariyeh Mountains via the Bdāmā Pass (Ch.VI.1.b). Byblos (116), in the south, developed as the primary centre involved in the export of Lebanon cedar timber to Egypt at the beginning of the second millennium BC. Numerous sites on the southern Levantine coast have already been mentioned as supplying goods to centres of trade and administration up stream, most notably Tell Abu Hawam (#137) and Tell Qasile (#159; Ch.VI.1.e; see below). In Cyprus the site of Enkomi (#224) dominated the head of the Messaria Plain, and controlled access into the interior, as well as providing

an outlet for copper ore being extracted and exported from the foothills of the Troodos mountains.

(b) A prime example of such a destination point, would be Zakros in eastern Crete. Zakros (#290) developed primarily as a 'gateway' harbour to Crete, providing the initial link from Rhodes, Cyprus, and further east. The strategic importance of Zakros is seen in the establishment of a Minoan Palace, the purpose of which was to control the import and export of goods from the east. Kommos (#308) performed a similar role as the major outlet point for goods along the south coast of Crete. Enkomi (#224), in eastern Cyprus, was the nearest contact point between Cyprus and the northern Levantine coast, a factor that must have contributed to its established location. Similarly, many Cypriot goods have been found at Ugarit, the closest sheltered anchorage and destination point of vessels travelling from Cyprus to the northern Levant.

(c) Harbours associated with centres of government or palatial control were obviously established to serve the needs of the ruling elite. Ugarit, on the northern Levantine coast, was a major centre of power and a palatial centre, particularly during the Late Bronze Age, served by a number of anchorages, the most important <u>emporium</u> being Minet el Beidha (#89). In the southern Levant, the harbours of Akko (#134), Ashkelon (#166), Tel Mor (#164; serving Tell Ashdod), Tell Abu Hawam (#137), and Tel Dor (#145),

were all established at important political and economic centres during various periods of the second millennium BC (see Ch.I). The palatial centres of Minoan Crete possessed associated harbours, such as Kommos (#308), Katsambas (#264) and Amnisos (#265), although, all were located some distance from the inland palaces. The palaces of Malia (#268) and Zakros (#290), on the other hand, utilised harbours within their immediate vicinity.

Egypt, however, exemplifies most conclusively how the importance of particular harbours rose and declined in accordance with the dominant political and religious centres. For example, when Amenophis IV relocated the Egyptian capital from Thebes to Tell el-Amarna, in the latter part of the 18th Dynasty, the associated harbour of Amarna (#188) increased in prosperity at the expense of the Theban harbour at Birket Habu.

V.1.xi. Military anchorages[3] -

Harbours or harbour basins established solely for military purposes were not established until the first millennium BC, when sea battles were more common[4]. During

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[3] Military anchorages only began to develop in the latter part of the second millennium and were basically further elements incorporated into existing anchorage sites particularly during troubled times.

[4] The first recorded naval battle, depicted on the Medinet Habu relief, occurred in c. 1200 BC, fought between the forces of the Egyptian fleet of Ramesses

the second millennium BC military might was mustered when and where it was needed and required, and there is no evidence for the establishment of military docks specifically for naval vessels. However, there may have been 'military vessels' based at, for example Troy, to restrict entrance into the straits and perhaps enforce a toll (see below), although not requiring special facilities in the port.

Tuthmosis III is known to have transported his troops by ship prior to 1200 BC, and to have utilised the harbours of Tell Abu Hawam and Akko, on the coast of the southern Levant, to accommodate his naval force (Artzy 1994: 130,nt.17). However, naval encounters prior to this period were primarily defensive operations, such as warding off pirates that threatened merchant vessels. In fact, despite extensive campaigns of the pharaohs during the New Kingdom, administrative texts from Egypt do not give an impression of a drastic growth in the number of military ships (Linder 1973: 318). Thus, it is unlikely that permanently established military harbours existed in the second millennium BC.

Harbours were however, established with the sole purpose of surveying an area. Such anchorages would have

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III and the Sea Peoples (Sandars 1987: 124-131). Hittite text KBo XII 38 also refers to a sea battle between Alaŝhiya (Cyprus) and the Hittites (Güterbock 1967: 80).

been established at advantageous points, for example at the entrance to straits, between islands, or on offshore islands in sight of the mainland, in order to monitor and perhaps, control, maritime traffic of the region.

V.1.xii. Political and economical anchorages[5] -

In some instances, harbours associated with centres of political and economic importance are known to have monitored trading vessels within their sphere of influence. Comparable to the extraction of duties from the Old Assyrian merchant-colony traders (Larsen 1967), tolls and customs duties were extracted from merchants entering harbours or inland waterways, as evidenced at Ugarit (Linder 1981). The Amarna letters also refer to the extraction of tolls from foreign ships entering the Nile Delta (Castle 1992: 245).

While this typology describes the range of functions that can be inferred for anchorage sites and harbours of this period, it is generally impossible to attribute particular coastal sites uniquely to any one category, as a number of their roles overlapped to a much greater extent

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[5] Political and economic anchorages only began to develop in the latter part of the second millennium and were basically further elements incorporated into existing anchorage sites particularly during troubled times.

than they did in Classical and later Medieval times. As a result, the nature, frequency, size and importance of Bronze Age harbours shows marked contrasts during the second millennium.

## V.2 The relation of harbours to the different systems of Bronze Age trade

The differing functions of harbours (discussed above) give some indication as to their range of roles within the system of maritime contacts of the Bronze Age. Smaller natural anchorages with limited harbour facilities may be seen as functioning primarily within a smaller sphere of contact and exchange, providing shelter for local traffic undertaking short-distance, often coastal, voyages. However, even within these smaller, localised trading systems we have identified harbours that performed more important roles in Bronze Age trade. Some acted as inlets and outlets for goods in transit to inland routes of trade, via mountain passes or river valleys (see above & Ch.VI.1); and others acted as major emporia within larger networks of international maritime trade (see above & Ch.VI.2). These harbours were more attractive to mariners and merchants as they provided harbour facilities, sizeable markets and links with the interior hinterland; and they often acted as departure or destination points for long-distance trade.

A number of factors have thus been identified that are fundamental to the role and location of Bronze Age anchorages: ship size and capacity; scale and nature of trade, as well as the type, volume and value of commodities in transit; and the character and incentives of the mariners and merchants utilising the harbours. The relative

importance of all these factors varied over the period of the second millennium BC, but of consistent importance was the nature of trade. Within the system of maritime activity and exchange of the second millennium, it is evident that a number of different types of trade were operating.

The nature of Bronze Age trade in the eastern Mediterranean is a subject that has undergone considerable debate (Polanyi 1957; Webb 1974; Van Seters 1979; Earle & Ericson 1977; Harding 1984; Renfrew 1972; Wiener 1991). Through a consideration of theoretical principles, archaeological remains and contemporary documentary evidence, various theories have been proposed to explain the different types of trade and the systems in which trade was conducted. However, the pattern of second millennium exchange in the eastern Mediterranean suggests that trade was not solely undertaken by royal or state-sponsored enterprises (Renfrew 1972; Cline 1994: 85), as the initial picture may suggest.

From the evidence of the Amarna tablets it would appear that much of the elite trade between Egypt, the Near East and Cyprus during the second millennium BC, was conducted under the guise of 'gift-exchange' or reciprocity, involving both state-employed merchants (such as the tamkaru or commercial agents of the state) and the participation of state-sponsored, private merchants. Other trade mechanisms suggest centralised, political control

over exchange, whereby the bulk of trade was administered by the central authority or palatial centre, one possible scenario to describe the trade processes of Minoan Crete. In addition, goods were often transferred as tribute from conquered states to imperial powers, for instance the tribute extracted from the Levant after the campaigns of Tuthmosis III (Van Seters 1979). The images of the Keftiu in the Theban tombs also imply tribute to Egypt. Alternative trade mechanisms, such as were evident at Ugarit and possibly, Enkomi, presented localised control of single polities, with intermediaries or emissaries serving to link different nodes.

Examples of all these types of trade mechanisms were witnessed during the second millennium BC. However, over this period we are increasingly aware of the element of freelance, commercial or entrepreneurial, profit-motivated ventures, that were introduced to the system and are believed to have reached a peak by the end of the Late Bronze Age. Commercial trade ranged from private merchants conducting trade on both an international (long-distance) and regional (short-distance) level, often with the use of their own vessels (Castle 1992: 250); to commercial agents of the state undertaking additional, private exchange alongside the primary cargo trade, described by Artzy (1994: 127) as 'Sailor's trade'; and wealthy individuals sponsoring private merchant ventures.

> 'Private enterprise is not nearly as visible as palatial initiative in either archaeological or

> documentary evidence yet there is no doubt that it existed along side state-level trade' (Knapp 1993: 338-9).

Thus, independent merchants operated within the framework of diplomatic links and state controlled trade and gift exchange, and were often subject to taxation by the state or palace.

Some independent merchants are believed to have 'tramped' the seas, undertaking multiple transactions at numerous harbours along the route. As Braudel (1972: 107) describes it:

> 'Tramping' also made it possible to take on cargo. It gave ample opportunity for bargaining, and for making the most of price differences... merchants or their representatives would travel with their wares. The round trip, which could last several weeks or months, was a long succession of selling, buying, and exchanging, organised within a complicated itinerary. In the course of the voyage, the cargo would often have completely altered its nature.'

Thus 'tramping' represents the indirect trade of goods between areas. On the other hand, 'directional commercial trade' involved the transaction of goods passed between two places, to a specific harbour destination, similar to trade conducted by the Old Assyrian merchant-colonies (see Ch.I), or demands made in the Amarna letters (EA 105, 35-40). Alternatively, merchandise was transferred to trans-shipment points such as Ugarit and selected harbours in Cyprus, from whence it was redistributed.

The varied nature of Bronze Age trade is well

illustrated by an analysis of the cargoes recovered from Bronze Age shipwrecks of the eastern Mediterranean. The Cape Gelidonya wreck is thought to represent a form of private trade, a private merchant venture (Bass 1991: 73), handled by an independent entrepreneur, who was 'tramping' the Mediterranean, tinkering and recycling - as demonstrated by the large quantities of chipped ingots, which could also have been used as cash, and broken metal tools (see Ch.I). The Uluburun wreck, on the other hand, is believed to represent a cargo of goods intended as royal gifts (Bass 1991: 76) as the makeup of the cargo is very similar to that displayed in the Kenamun tomb painting (Davies & Faulkner 1947: Pl.VIII) and to cargoes referred to in the Amarna tablets (EA 33-35). Finally, the Point Iria wreck, which possesses characteristics of both Mycenaean and Cypriot 13th century BC transport vessels (ENALIA 1995: 15), is implicated as being involved within the framework of long-distance, international trade but contains a less prestigious cargo than the Uluburun. Thus, it could be a vessel belonging to either a private merchant or one involved in state controlled trade.

Bronze Age trade, its nature, the volumes of commodities transported and hence the routes of trade, all became more complex over the period of the second millennium. The demand for harbours and their varying levels of functioning increased accordingly.

> 'Exchange systems in the Mediterranean were in a continuous process of transformation, wherein consumer (or supplier) demand and maritime technology increasingly enabled regional exchange networks to be linked to a wider, common circulation system that moved commodities as well as high-value goods (notably metals) between participating units' (Knapp 1993: 340).

Thus, during the Late Bronze Age, trade on an international scale came into being. The evolving scales of inter-regional exchange networks, particularly during the 14th and 13th centuries BC, coupled with the increased activity of independent traders, brought about an expansion in maritime activity and heightened the need for additional numbers of harbours and larger harbours with improved facilities.

Chapter VI

## The network of anchorage sites within the framework of second millennium contacts and trade

A brief account of the political and socio-economic events that occurred in the eastern Mediterranean during the second millennium was given in Chapter I and some suggestions were made as to the main centres of production and exchange, between which contacts were established. A number of harbour sites were suggested as important outlets of trade, including Byblos (#116) and Ugarit (#89) on the northern Levantine coast, Kition (#229) and Enkomi (#224) in Cyprus, Tarsus (#69) and Mersin (#67) on the south Turkish coast, and Kommos (#108) and Zakros (#290) in Eastern Crete. Others, such as Ura in Cilicia, are known from textual sources but have not yet been identified with sites in the field (see Chapter III.1.ii). All harbours known to have been utilised in the second millennium BC, together with other possible anchorage sites, have been listed in Part II (Appendix I). The following chapter aims to identify the more active trade emporia, and to link them with both maritime and overland routes of trade. Mention will also be made of the relatively minor harbours serving peripheral exchange networks, and those anchorages that provided temporary stop-over points en route along the major arteries of trade.

## VI.1 The relationship between harbour sites and overland routes of trade

One of the main functions of coastal harbour sites is to provide an outlet for inland centres of production and trade, and an inlet for imports to inland settlements. A number of overland routes linked to harbour sites have been identified around the shores of the eastern Mediterranean. Of special importance, within the network of second millennium trade, are those overland routes which link the eastern Mediterranean with centres of power bordering the Mediterranean. Particularly important in this respect is the north-eastern coast of the Mediterranean, a prominent area of exchange and contact between the eastern Mediterranean and Northern Syria and Mesopotamia. A number of these overland routes are discussed below.

Routes linking the coastal interface of the eastern Mediterranean with inland centres of trade:

a. Orontes River Delta - Northern Syria
b. Northern Levantine coast - Mesopotamia
c. Cilician Delta - Hittite Empire
d. Nile Delta - Lower/ Upper Egypt
e. Harbours serving single inland settlement/ centre

VI.1.a Route 'a' - Orontes River Delta to Northern Syria

(Fig. VI.1.a)

Access inland from the north-eastern corner of the northern Levantine coast to northern Syria is barred to a large extent by the Amanus Mountains to the north and the Ansariyeh Mountain range to the south, both of which run parallel to the coastline. However, it seems that during the second millennium BC this north-eastern corner of the Mediterranean was an extremely important area of exchange and contact between the eastern Mediterranean, including the Nile Delta, and Northern Syria and Mesopotamia. The Orontes River Delta provided an access point between the mountains for contacts between these areas (see Fig. #82). A number of sites along the Orontes River have been identified as being occupied during the second millennium BC. However, evidence for the role of the Orontes River sites as anchorages in the Bronze Age is far from conclusive.

Woolley became interested in the coastline of North Syria, after Braidwood's first survey of the Amuq Plain (1937), where a large number (over one hundred and eighty) pre-Classical tell sites were discovered. Woolley's excavation of the Bronze Age tell of Atchana, the royal city of Alalakh (#82), also on the Amuq Plain (Woolley 1936), reinforced his belief that this area was an important route inland from the coast of North Syria, with obvious links between the Mediterranean and cultures to the

east up the Orontes River. Woolley also perceived, predominantly from the architecture at Tell Atchana, 'affinities' with the Minoan culture (Woolley 1938 :4). As a result Woolley looked to the Orontes Delta for a harbour or inlet for contacts with the Plain of Antioch, and set out a programme of research, the object of which was

> 'the tracing of connections, if such existed, between early civilisations of Aegean, ... and more ancient cultural centres of Asia' (Woolley 1938: 1).

There are numerous reasons to suppose the existence of a harbour in the vicinity of the mouth of the River Orontes. Apart from the densely populated Amuq Plain, no doubt a market area for Bronze Age merchants, the outlet of the Orontes River was the only practical point along the coastline of the northern Levant where access between the interior and the coast was possible. As McCaslin (1980: 91) states

> 'the harbour at Alalakh (Tell Atchana) was probably somewhere along the banks of the river Orontes, perhaps at Sabouni, near the coast'.

The mouth of the Orontes, which winds across the modern river-plain, afforded a safe, sheltered anchorage throughout the second millennium BC,

> 'where ships could tie up against the high banks, while the river itself was in those days navigable as far as the site of Antioch' (Woolley 1938: 3).

Access to Antioch was undertaken by boat. From Antioch the route to the east followed the course of the river

through a gap in the Amanus Mountain Range to the Plain of Amuq. The Amuq Plain acted as an interim market on the overland route. From the Amuq Plain, access to Aleppo is possible by a 'level pass' through the hills, and then on past Carchemish to Assur (Woolley 1938: 4). From this point it is possible with the use of donkey caravans, to join the Kanesh caravan route at Bâlis, or follow a route down the Euphrates to Babylon (Woolley 1953: 20-21,fig.2). Bevan (1902) has suggested an alternative route from Antioch reaching the Euphrates at Bâlis, via the Chalus Valley at Beroea.

The mouth of the Orontes River is dominated by Mount Casius which is visible from Cyprus, therefore providing a good landfall for vessels approaching the harbour[1]. To the north, the Amanus Mountains was a source of a valuable raw material, cedar wood. The texts record the import of wood by the Kings of the Euphrates and Tigris from 'the Amanus, the cedar mountains' (Woolley 1938: 3,nt.5). Additionally, contacts between Antioch and the eastern Mediterranean are attested through a number of tablets. Two texts recovered from 18th century BC levels at the palace of Yarimlin at Alalakh refer to people from Alašiya (Cyprus), one in connection with the distribution of grain; others relate to contacts during the 15th century BC (Wiseman 1953; Georgiou 1979: 86). Linder (1981) believes that the Orontes River

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[1] Albright (1950) cites a Ugaritic text that refers to the use of Mt. Casius as a landfall in the Bronze Age.

Delta was a possible departure point for merchants from Ura carrying grain (RS 20.212, 219-226) from Mukiš in the lower, navigable stretches of the Orontes valley.

Al Mina (#81) is presently located some 200m from the northern banks of the mouth of the Orontes River but is believed to have been on the river bank in the Late Bronze Age. Woolley (1938) discovered Bronze Age remains, together with Middle and Late Cypriot and Mycenaean pottery at Sabouni, a small tell to the north of Al Mina, believed to have been the residential area attached to the port site of Al Mina. Woolley's (1938) interpretation of the archaeological evidence at Al Mina supports this theory, as only storehouses and commercial premises have been uncovered there ie. non-residential properties, presumably belonging to merchants engaged in the import and export of trade goods between Asia and the Mediterranean.

Woolley (1938) was convinced that Al Mina was the harbour of Alalakh, supporting the transfer of goods between the eastern Mediterranean, the Amuq Plain and the east[2]. However, Boardman (1973) argues that there is no

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[2] Woolley (1938: 28-29) believed Al Mina to be ancient Posideium as the site lies on the modern and ancient boundary between Cilicia and Syria. Woolley based this assumption of the location of the site on a description by Herodotus who defines the fifth province of the Persian Empire as the 'country reaching from (the) city of Posideium (built by Amphilochus, a pre-Homeric hero) on the confines of Syria and Cilicia, to the borders of Egypt' (Herodotus III.91). Woolley (1938: 30) believes that as Amphilochus, was a pre-Homeric hero of the war of the

substantial evidence for Al Mina's use as a port until 8th century BC. Regardless of the accuracy of the identification of Al Mina as being the port of Alalakh, the River Orontes undoubtedly served as an inland route to the densely settled Amuq Plain and beyond, during the second millennium BC. The Amuq Plain presently houses a large lake, known as Lake Antioch, and it has been suggested that not only was the River Orontes navigable up to Antioch (#82) during the Bronze Age, but in fact the whole area up to and including Lake Antioch, formed a large coastal embayment, open to the sea, in this period. The distribution pattern of sites bordering the area of the lake supports this theory (Braidwood 1937), the upper courses of the River Orontes having silted up and a delta having formed at the mouth of the river since the Bronze Age. Many of the sites on the Amuq Plain reveal a wealth of imported goods, including Minyan ware, Cypriot milk-bowls and Late Helladic wares (Braidwood 1937), all supporting the commercial nature of this area throughout the second millennium BC.

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Seven against Thebes, that Posideium must therefore antedate the Trojan period and was thus settled sometime in the second millennium BC. Boardman (1973) however, has identified Ràs el Basit as Posideium.

VI.1.b Route 'b' - Northern Levantine coast to Mesopotamia

(Fig. VI.1.b)

Undoubtedly, the most important harbour site in the eastern Mediterranean during the second millennium BC was the port of Ugarit, Minet el Beidha (#89). Ugarit's involvement with trade and exchange in the second millennium is unquestionable (see Chapter I). Situated just north of Latakia in the northern Levant, Ugarit controlled a number of harbours within a 50km vicinity, the main harbour was Minet el Beidha (White Harbour) which lay on the coast c. 1km west of Ugarit. Other harbours within Ugarit's catchment area include Tell Sukas (#97) and Jebeleh (#96) to the south of Latakia (Astour 1970: 114,fig.).

Ugarit is situated to the west of the Ansariyeh Mountain Range, which runs parallel to the coast, making access to the interior difficult. However, contacts between Ugarit and Yamhad, centered upon Aleppo (Halab) in North Syria, were established, with the use of donkey caravans, through the Bdāmā Mountain pass by way of the River Kabir. One course of the River Orontes flows to the east of the Ansariyeh Mountains, linking the eastern reaches of the Ansariyeh Mountains with the Amuq Plain and beyond.

From textual evidence it is known that from the end of the third millennium/ beginning of the second millennium BC, Ugarit had established trading contacts with Asia Minor

in the east, and commercial maritime relations with ports all over the eastern Mediterranean (discussed later in this Chapter VI.2; Redford 1992: 94). In reference to inland trade routes, Ugarit is mentioned twice in documents from Mari. Mari is situated on the upper courses of the Euphrates River and had established strong trading connections with the Babylonian capital of Babylon, on the lower Euphrates. Mari document A.1270 (Dossin 1970) refers to the shipment of tin from Elam (modern Iran) to Aleppo, via Mari. Further documents refer to the export of tin from Mari via Ugarit, particularly with reference to the purchase of tin by Cretan merchants at Ugarit (Dossin 1970; see Chapter I & III.1.ii). After the destruction of Mari c. 1700 BC contacts between Mesopotamia and the northern Levant are believed to have been rerouted via Halab (Yamhad) to Ugarit (Heltzer 1989: 26). Archaeological evidence supports trade links between the Old Babylonian kingdoms of Mesopotamia and Ugarit (Malamat 1971; Burney 1977: 95).

Further evidence to support the importance of an overland route from Ugarit to the east, is found in the fact that donkeys were more expensive in Ugarit than sheep, cows, or oxen; as they were in Old Assyrian Cappadocia; whereas in more agriculturally based societies, such as Nuzi or Hittite Asia Minor, such a price difference was not observed (Heltzer 1977). This implies the importance placed upon the mainstay ie donkeys, of overland trade in centres

such as Ugarit, whose primary concern was trade.

In the Late Bronze Age, texts from Ugarit, PRU VI,14 (RS.19.50) and UV 57 (RS.20.227), reveal that overland, caravan trading existed between Ugarit and Hittite Asia Minor, with Emar in the southern most part of the Euphrates bend, and with Qadesh on the Orontes River.

Thus, it would appear that an inland route between Ugarit and the Upper Euphrates, centred around Mari in the earlier part of the second millennium BC, acted as an axis of trade along which goods where exchanged between Mesopotamia and the eastern Mediterranean. Ugarit was an important 'gateway' harbour site in this complex exchange network.

VI.1.c Route 'c' - Cilician Delta to Hittite Empire

(Fig. VI.1.c)

As discussed in Chapter III, limited archaeological investigation has been carried out in the Cilician Delta region. However, from textual and limited archaeological evidence, we know that the Cilician Delta played an important role in communications between the Hittite Empire of central Anatolia and the eastern Mediterranean. In addition, a number of sites on the Anatolian Plateau, such as Kültepe and the Hittite capital of Hattusas (Boğazköy), reveal evidence of imported pottery from the eastern Mediterranean, implying contacts via the Cilician Delta.

The terrain of the south-eastern Turkish coast is dominated by the Tarsus Mountains, that form a barrier to communications to the interior Anatolian Plateau. Access is only possible through the Taurus Mountains via the Cilician Gates, north of the Cilician Delta. The Cilician Delta to the east of Mersin, is formed by the alluvial deposition of the rivers Ceyhan, Seyhan and Tarsus, running off the slopes of the Taurus Mountains. As a result of the unstable nature of the delta, settlement appears to have been largely restricted to higher ground around the Pleistocene terraces and the Karataş/ Misis Dağ promontory on the east of the Cilician Delta (Seton Williams 1954). A number of sites in these areas have been identified, both in an archaeological and textual context, as being occupied during the second millennium BC, some of which may have

functioned as harbours.

The major harbour site of the period appears to have been Tarsus (Gözlü Kule), Hittite Tarsa. Ceramic remains at the site reveal connections throughout the eastern Mediterranean (#69). Amongst the ceramic remains uncovered, levels II-V reveal material from the Hittite centre in Cappadocia. Syrian pottery also found at Tarsus, and in a Middle Bronze context at Kültepe Kanesh (Goldman 1950), also implies further links between Tarsus and the Anatolian Plateau.

Additional anchorage sites have been identified on the delta that both reveal ceramic comparisons with the Anatolian Plateau. The site of Mersin (Yümük Tepe) reveals contacts with a number of Bronze Age sites located en route to the Cilician Gates, and displays ceramics from throughout the eastern Mediterranean (#67). Mersin also had strong connections with the Hittite Empire, especially during the period of Hittite domination of Cilicia c. 1450-1200 BC. These connections are exemplified in similar architectural designs uncovered in Late Bronze Age Mersin and at the Hittite capital of Hattusas (Boğazköy). Another site on the western reaches of the delta, that has yielded large amounts of second millennium BC pottery, is the partly excavated site of Kazanli (#68). It is situated near the seaward end of the Tarsus River and would have afforded an ideal river mouth anchorage in antiquity.

Besides this handful of known anchorage sites, it is possible to infer the existence of a number of others based upon the survey work of Seton Williams (1954), amongst which the sites of Domuz Tepe (#72) and Soyali Hüyük (#74) on the eastern reaches of the Cilician Delta can be included. These sites are particularly noticeable because of their location in the vicinity of the Karataş promontory and the Ceyhan River, both physical features providing a means of access across the lower reaches of the delta. Seton Williams' (1954: 132-4,fig.3-4) survey also serves to illuminate a number of sites, both from the Middle Bronze and later Hittite period, that form a link across the delta and up beyond Ceyhan towards the Cilician Gates in the north. Seton Williams (1954: 127-8) outlines a number of these suggested routes based upon her survey observations.

There is considerable textual evidence to support the existence of the port towns of Cilicia (discussed later this chapter) and connections both with the northern Levantine coast and the Hittite interior. One site that is mentioned often in this context is the, as yet unidentified, site of Ura. Hittite text KBo XII 12 relates the shipment of grain to Ura on the Cilician coast and from a series of Akkadian texts we know that Ura was one of the Hittite dependencies (Heltzer 1977: 209; see Chapter III.1.ii).

Further proof of the importance of the Cilician sites

involvement with trade between the Hittite Empire and north-eastern Mediterranean, is seen in Hittite text KBo XII,12, where the tamkaru of Zallara are discussed in the context of the shipment of commercial goods. Zallara is another, as yet unidentified site of Cilicia.

Additional evidence underlining the importance of this overland route from the Cilician Delta north through the Taurus Mountains, linking with secondary centres of power that developed towards the end of the third millennium on the Anatolian Plateau, has been found in connection with the exploitation of tin and, possibly later, lead. Yener and Özbal (1987, 1993) present evidence for the extraction of tin in the Bolkardağ mining district of the southern Taurus Mountains (100km north of Mersin, near the Cilician Gates), during the third millennium BC. It is possible that tin from this region was not only transported inland to Anatolia and Mesopotamia but also south across the Taurus Mountains to be exported via the Cilician Delta to the Mediterranean. Although, by the eighteenth century BC it appears that tin was being sent from Assur to Kültepe Kanis, therefore implying that the Bolkardağ tin was either exhausted or not sufficient to meet their needs. However, tin processing is also evident at the Early Bronze Age site of Göltepe, 80km north of Tarsus, linked to the nearby mines of Kestel where ceramic assemblages have been discovered from the Chalcolithic through to the Byzantine period (Yener & Vandiver 1993).

In relation to the extraction of lead, Bass (1991: 74) has suggested that recent lead isotope analyses of lead fishnet sinkers discovered on the Uluburun, link them to ores in the Bolkardağ region, implying that lead was also being extracted from these regions during the second millennium BC. Further research needs to be undertaken in order to identify traces of Bolkardağ tin and lead, or smelting at sites on the Cilician Delta.

VI.1.d Route 'd' - Nile Delta to Lower and Upper Egypt

(Fig. VI.1.d)

The palaeogeography of the Nile Delta during the second millennium BC is known to be somewhat different from that of the modern delta (see Chapter IV.2.b). However, three main branches of the River Nile have been identified that link the coastal littoral to Lower and Upper Egypt during and since this period; the Rosetta Branch to the west, the Damietta (Mendesian) Branch to the north-northeast, and the Pelusiac Branch to the east. Traces of a fourth major branch, the Canopic Branch (which has been dry since the 8th century AD) are identified to the west of, and merging up-river with, the Rosetta Branch of the Nile River. Traces of a fifth, the Sebennitic branch of the Nile, believed to have been a major distributary from 5000 BC to 1000 BC (Stanley et al. 1992b), has been identified between the Rosetta and the Damietta branches and drains into Lake Burullus.

For the period extending over the Middle through to the New Kingdom, the Pelusiac Branch of the Nile appears to have been the branch most utilised for contacts between the coast and sites located upstream. There is limited evidence for the use of the Rosetta Branch of the Nile, most active during the latter part of this period. However, the predominant use of the Pelusiac Branch, to the east would seem the logical outlet for vessels en route to the coast of the Levant, the primary focus of Egyptian contacts

during the second millennium BC.

Entrance to the Pelusiac Branch of the Nile Delta appears to have been to the east of the modern Suez Canal, in the region of Tell el-Fara'in (#177), or along the south-eastern shores of the present Lake Manzala. The New Kingdom site of Tanis (#180), San el-Hagar, was possibly connected to a riverine route via Lake Manzala. Although this river course and the present Pelusiac Branch do not merge until a point to the south in the region of the Middle Kingdom site of Tell Basta (#184), it is possible that these two courses were linked at a more northerly point during the second millennium BC.

A string of sites, all of which were occupied during the New Kingdom, and some in the earlier Middle Kingdom, have been identified situated along the ancient course of the Pelusiac Branch of the Nile River. They are located progressively upstream of the Pelusiac Branch to the point where all three main branches of the Nile River merge at modern-day Cairo, north of ancient Memphis (#187), situated at the head of the Nile Delta. Tell Nabasha (#181) has been identified as the most northerly of these riverine sites, situated slightly to the northeast of the important Middle and Late Kingdom site of Tell el-Dab'a (#183), and the New Kingdom site of Qantir (#182). The importance of Tell el-Dab'a and Qantir as riverine anchorages throughout the second millennium BC is attributed to their favourable

geographic position. Thus, they are considered to have functioned as 'gateway' anchorages, acting as the initial point of contact between the eastern Mediterranean and the Nile Valley Kingdoms. It is understandable therefore, why the Hyksos, with their links with the Levant, established their capital here during the 15th Dynasty (see Chapter I).

To the south, the sites of Tell Basta (#184) and Tell el-Yahudiya (#185) form the southerly link along the Pelusiac Branch with the head of the Nile Delta. Memphis (#187) stands at the head of the delta, providing a link between Upper and Lower Egypt. Archaeological and documentary evidence relates to the importance of this site as a major harbour and emporium, throughout the second millennium BC, linking the Nile Valley sites of Amarna (#188), Abydos and Thebes with the rest of the eastern Mediterranean.

There is negligible evidence for the use of the Damietta Branch of the Nile during the period. However, the recent discovery of site S-44, 5km to the west of the Sebennitic Branch of the Nile (Stanley et al. 1992b; #190), implies the use of this branch prior to a change in environmental conditions at its mouth ie a shift in the lagoon margin, in the New Kingdom.

A number of sites located along the Rosetta Branch, and possibly the dried out Canopic Branch of the Nile

River, do imply the use of this riverine route predominantly by vessels approaching from the west, particularly during the New Kingdom period. The site of Pharos (#193) is thought to be situated to the southwest of the previous mouth of the Canopic Branch of the Nile River, linking with the upstream sites of Naucratis (#189) and Kom el-Hisn (#192). The, as yet, unidentified site of A-Ur, is known to have been situated on the ancient course of the Canopic Branch of the Nile River. To the east, the sites of Tell el-Fara'in, ancient Buto (#191), and San el-Hagar, reveal limited activity along the Canopic Branch during the New Kingdom period.

VI.1.e Harbours serving a single inland settlement/ centre

Not all inland routes of the second millennium BC, whether overland or riverine, constituted major arteries of trade; many simply provided an outlet for inland settlements, or were riverine outlets that served large centres upstream.

A number (over eighteen) of river mouth anchorages that served inland sites upstream have been identified by Raban (1985) along the coast of southern Levant. The exposed coastline of the Levant, as described in Chapter IV.1, provides little shelter to vessels. Consequently, from 2000 BC, a number of coastal, estuarine settlements were established as harbour towns, serving larger inland settlements located upstream on or near the coastal plain. Thus, the larger settlements were more favourably situated in sheltered up-river locations, protected from prevailing coastal maritime conditions. For example, the coastal settlement of Nahariya (#133) is linked to the large Bronze Age settlement of Tel Kabri, some 5km inland, by the Ga'aton River (Fig. VI.1.e.i). Tel Kabri was a large fortified city in the Middle Bronze Age, covering 32ha and formed the centre of a Canaanite city state, possibly Rehov, which is mentioned in the Egyptian Execration Texts (Niemeier 1991: 196-67). The palace at Tel Kabri has also revealed a plaster floor decorated with what has been seen as Aegean-looking fresco designs (Niemeier 1991), implying evidence of foreign contacts.

The Late Bronze Age tell site of Abu Hawam (#137), situated at the south-eastern end of Haifa Bay, where in the second millennium BC the River Qishon entered the eastern Mediterranean, also provided an outlet for sites up the River Qishon (Fig. VI.1.e.i). Tell Abu Hawam was an important centre of Late Bronze Age trade, serving the sites of Tel Regev (#136) and Tell Far on the flanks of the hills which border the coastal plain, and the site of Tell Amre upstream on the River Qishon at the point the river enters the plain. From the harbour site of Tell Abu Hawam, the shortest possible route from the coast to Beisan, Megiddo and Esdraelon was accessible. In addition access to the River Jordan was also possible. The harbour site of Tell Abu Hawam has revealed a wealth of imported material, particularly during the Late Bronze II period, and is perceived as being equivalent to the modern port town of Haifa during this period.

The final example of an estuarine harbour town of the Bronze Age Levant, is Tel Mor (#164), situated on a small hill near the outlet of the River Lachish (Fig. VI.1.e.ii). Occupied from the 16th century BC Tel Mor was the harbour town of Ashdod, 8km upstream. Tel Mor was a large trading centre, fulfilling the needs of sea transport and commerce for Ashdod. The natural harbour of Tel Mor was eventually abandoned in 10th century BC and replaced by the artificial harbour of Ashdod Yam to the south.

Further examples of harbours being established to serve the needs of one settlement can be seen in Eastern Crete. The harbour of Kommos (#308) on the central south coast of Crete, is said to have been the harbour town of the Palace of Phaistos, some 5km inland at the head of the Messara Plain (see Main Map). However, in this case the harbour is known to have outlived the political centre, serving as an outlet for southern Crete well after the fall of the Minoan palaces.

Similarly, in northern Crete, a route from the coast inland would have existed to serve the Minoan palace of Knossos. Knossos is situated some 6km inland and a number of sites have been suggested as the palaces harbour. Evans (1928 :229) locates the main harbour of Knossos at Katsambas (#264), situated towards the mouth of the River Kairatos that runs north from Knossos to the coast, and immediately to the east of Heráklion (#263). Katsambas is situated in direct line with Mount Juktas which is an easily identifiable landfall from out at sea. Riverine communication along the Kairatos River, could have served to link Katsambas with Knossos, or alternatively, Evans (1928: 230,fig.131A) identified a road that ran along the western slopes of Kephala and Isopata and connected the Palace of Knossos with the port of Katsambas (see Main Map). Katsambas was a flourishing centre of manufacture and arts, possessing imports from the east (Evans 1928 :238).

The ancient literary texts relating to the port of Minoan and early Archaic Knossos bring another site into focus; Amnisos (Homer Odyssey 19.190; Strabo X 4,7-8; #265). Situated at the mouth of the River Karteros some 10km northeast of Knossos, Amnisos was a significant site from Middle Minoan IIIB to Late Minoan IIB and is mentioned thirty seven times in Linear B clay tablets from Knossos as a settlement closely linked with the administration of the Late Minoan III palace at Knossos, although not once in relation to maritime affairs. The route between Knossos and Amnisos is hindered by a steeply rising limestone spur of the Profitis Ilias, but Amnisos would have provided safe anchorage along a concave sandy beach between two rocky headlands at the mouth of the River Karteros and is sheltered by an offshore islet (#265; see Main Map).

A fourth candidate for the harbour of Knossos is Nirou Khani (Ayia Theodoroi; #266) located on the north coast some 14km east of Heráklion. Here Late Minoan building remains have been uncovered on the shore, together with substantial rock cuttings partially submerged, identified by Frost (1963 :109), Hadjidaki (1977) and Shaw (1990: 425) as harbour installations. This was possibly the third harbour of Knossos (Schäfer 1991; see Main Map), however, Nirou Khani is in fact quite a long way from Knossos, and the route there from Knossos must always have been difficult.

Additional anchorages important in serving inland routes of trade would be those harbours of Cyprus that served as outlets for Cypriot copper. The primary sources of copper ore were around the foothills of the Troodos Mountains (Fig. VI.1.e.iii). Three important copper production centres to the north of the Troodos Mountains, north-western Cyprus, are Apliki, Mavrouvouni and Skouriotissa, the latter of which was possibly linked to the coast by way of the River Serakhis, which in turn joined Morphou Bay via the Bronze Age site of Toumba tou Skourou (#202; Vermeule & Wolsky 1990). Vermeule (1973) produced evidence at Toumba tou Skourou for Late Cypriot IA copper working. She believes that the copper ore was brought from Skouriotissa by boat, to the east side of the site, where there is evidence for the working of copper on a high platform. This was an ideal location to work the copper as the prevailing westerly winds would drive the smoke away from the village. Although the modern day mouth of the river is silted up and the site of Toumba tou Skourou lies some distance inland, it is believed that Toumba tou Skourou (#202) was once located on the edge of the bay of Morphou and would have acted as a perfect harbour site from which to export copper.

Similarly, a number of anchorage sites along the south coast of Cyprus have been identified as outlets for the distribution of copper. Copper mines have been found in the Vasilikos valley at Laroumena, 8km north of the Late Bronze

Age site of Kalavasos Ayios Dhimitrios (#235; Fig. VI.1.e.iii). Copper was smelted at the site of Kalavasos Ayios Dhimitrios (#235) and exported down river to the anchorage at Zygi, from hence it was exported. To the east, Maroni Vournes (#233), in the Maroni valley, was a site of copper production, exporting copper down the valley and through the coastal anchorage of Maroni Tsaroukkas (#234; see Main Map).

Swiny (1981: 51-87) first outlined the possibility of a land-based access or trade route, also relating to copper distribution nodes, that could well have been established in this period, passing down the Kouris river valley to the west of the Akrotiri Peninsula, linking Morphou Bay 70km away in the northwest of the island, with sites along the south coast. Excavations in the Episkopi area have revealed a wealth of second millennium material including the Late Bronze Age sites of Episkopi Phaneromeni and Bamboula (#241), Erimi Kafkalla and Kandou Balies (Swiny 1981: 54,fig.3; see Fig. #242). A line of copper production sites have also been identified up the Episkopi Valley, as far inland (some 15km) as Khalassa Pano Mantilaris, where evidence for metal activity is widespread. A recent survey by Flourentzos (1991: 66) has revealed pottery parallels from sites on the north coast, such as the Linou Katydhata area, with the Middle Bronze Age tombs of Alassa in the Episkopi-Kouris Valley (Knapp 1988: 148,fig.1).

Likewise, in the southeast of the island, the site of Athienou, on the southern side of the Messaria Plain (Fig. VI.1.e.iii), is believed to have been a centre of copper ore production in the Late Bronze Age (Knapp 1990: 150), and is within easy access of the coastal export centres; especially Enkomi (#224), Kition (#229) and Hala Sultan Tekke (#230).

Numerous other small routes of inland trade and contact existed around the shores of the eastern Mediterranean in the second millennium BC. To mention briefly, the route to Qatna and Homs on the Upper Orontes, from the coast of the northern Levant across the Plain of Akkar and through the Bargylus Mountains (Hankey 1967: 116); and the routes across the Amanus Range in northern Syria via the Beylan Pass (south of İskenderun) to the Amuq Plain and the Arsanli Pass (northeast of the Cilician Delta) (Alkim 1969: 281). However, it is not practical or indeed necessary to mention them all in the context of this discussion. It is of more importance to simply stress the existence of such inland trade routes, and illuminate their function within the overall pattern of contacts and trade of the eastern Mediterranean. Sites which occurred at the junctions of maritime and overland routes provided nodal points in the network of trade, and often grew to much more than local importance.

## VI.2 The relationship between harbour sites and maritime routes of trade

Maritime contacts, which were established during the third millennium BC, flourished during the second millennium BC, and resulted in the sea becoming the main artery of trade. A number of open-sea and coastal trade routes are described below. Some were important in the development of second millennium BC trade in the eastern Mediterranean, while others were minor routes of exchange or contact which operated during different periods of the Bronze Age. At the terminals of the major routes, harbours were established. Conversely, major routes of trade evolved around previously established harbours. Some of these harbours, such as Ugarit on the northern Levantine coast (#89), initiated, encouraged and, to a large extent, controlled trade between the different regions of the eastern Mediterranean, and evolved into major trading emporia of the Bronze Age. Other anchorage sites along the coastal routes played a more passive role in the pattern of trade and exchange: they supported the system, offering shelter to vessels en route to distant destinations.

However, it was not only the nature of trade that determined second millennium maritime routes of the eastern Mediterranean (see Chapter I & Ch.V.2). Mariners were often restricted from making headway in a desired direction, by the prevailing maritime conditions, the ships' performance,

and the mariners' seamanship and knowledge of the waters in which they sailed[3]. The routes discussed below are constructed on the assumption that by the end of the Bronze Age mariners were capable of sailing a maximum of 7 points into the wind including leeway (see Chapter II). The combination of all these factors determined the nature of trade and the types of voyages undertaken.

Hopkins (1983: 84-109) outlines three levels of maritime trade: long distance, medium range or inter-regional, and short-haul exchange between local markets. Within these various types of routes of exchange numerous harbours and anchorages can be identified (see Part II) performing differing functions (see Chapter V).

The maritime routes discussed below highlight not only the major passages of contact and the harbours and anchorages established en route, but also the roles they played and the periods in which particular harbours were important. It is interesting to note that two-thirds of the routes described involve passage across the open sea, discrediting the idea that Bronze Age mariners preferred voyages that hugged the coast (see Ch.II.2.ii). All of the

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[3] Predominant maritime conditions are discussed in Ch.IV.3 and were a crucial component to the routes undertaken. Another factor that influenced these routes, is that of visibility and to what extent voyages could be undertaken whilst still in sight of land. Discussion of this issue in the text is based upon Fig. VI.2b that outlines the limits of inter-visibility within the Mediterranean basin.

voyages that hugged the coast (see Ch.II.2.ii). All of the routes described below formed part of the overall anticlockwise circular route which is accepted as having provided the main framework of exchange within the eastern Mediterranean basin (Bass 1987: 697-98; Fig. VI.2).

MARITIME ROUTES IN THE EASTERN MEDITERRANEAN:

2.1 Route 'A' - Crete to Egypt

2.2 Route 'B' - Crete to Cyprus

2.3 Route 'C' - Cyprus to Northern Levant

2.4 Route 'D' - Cyprus to Southern Levant

2.5 Route 'E' - Cyprus to Cilicia

2.6 Route 'F' - Northern Levant to Cilicia

2.7 Route 'G' - Egypt to Southern Levant[4]

2.8 Route 'H' - Cyprus to Egypt

2.9 Route 'I' - Cilicia along Turkish coast to Rhodes

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[4] Runs parallel to the fourth and early third millennia BC Via Maris land caravan route.

VI.2.1 Route 'A' - Crete to Egypt (Fig. VI.2.1)

A direct route is believed to have been taken from Crete to Egypt and is described by Vercoutter (1954: 419,fig.162; Fig. VI.2) as the 'Western' or 'Direct' route, forming part of the overall anticlockwise circular route that provided the main framework of exchange within the eastern Mediterranean. Vessels voyaging from Egypt to Crete, however, are unlikely to have returned by the same route, since they would have been sailing directly into the prevailing wind ie more than the accepted 7 points off the wind (including leeway[5]; see Ch.II). Instead Bronze Age mariners are believed to have taken Vercoutter's (1954: 419,fig.162; Fig. VI.2) 'Eastern' or 'Indirect' route via the coast of the Levant and then west along the south Turkish coast to Eastern Crete.

The establishment of contacts with Egypt is evident from the third millennium BC (Chapter I), and Cline (1944: 32) believes that direct commercial trade began at least as early as the emergence of the Minoan palatial centers, and certainly by the Late Minoan III period, when Egyptian

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[5] It was not until the invention of the lateen sail and its descendant, the fore-and-aft rig, that vessels could sail any closer to the wind (Casson 1950: 45, 1971: 243-5); even Roman vessels with square rigs were forced off course when attempting to sail into the wind (Casson 1950: 45-6). The only reliable westerly passage from Egypt to Crete would have been to sail some considerable distance along the coast of north Africa and then in a north-easterly direction to Crete (see below).

objects far out number Orientalia in Crete (Phillips 1991). However, it is difficult to evaluate whether these contacts were in fact direct or involved the participation of intermediary ports of call and independent parties, along an indirect route. It is not until the Late Bronze Age that Cretans, currently assumed to be Keftiu, are first depicted in Egyptian tomb paintings or referred to in Egyptian texts as arriving from the west (see Ch.I; Vercoutter 1956: 51-53; Wachsmann 1987), thus implying that by this stage, if not earlier, mariners were using the direct, open-sea route between Crete and Egypt.

The most conveniently located anchorage for the export of goods from the southern shores of Eastern Crete to Egypt, is Kommos (#308). Quantities of imported second millennium goods have also been discovered at Kommos, together with evidence for maritime installations. In addition, a number of harbour sites situated on the north and east coasts of Crete functioned as 'gateway' harbours for vessels approaching the island from the east. Such anchorages include the harbour town of Palaikastro (#288); the island of Pseira (#277) and the peninsula town of Mochlos (#278); the harbours of Knossos ie Amnisos (#265) and Katsambas (#264); the palace and harbour of Malia (#268); and Zakros (#290), perhaps the most ideally situated to control trade on the extreme east coast of the island of Crete. All of these anchorages would have been ideal transit points at which to off-load goods.

Bronze Age vessels en route from Crete to Egypt would no doubt have attempted to make a landfall well to the west of the Nile Delta (see below). However, evidence for vessels anchoring along this coast is limited, and is so far restricted to the Late Bronze Age anchorage at Mersa Matruh (#198), situated on the coast at the modern boundary between Egypt and Libya. Excavations at Mersa Matruh suggest that the site served as a 'summer revictualling station for Mediterranean traders' (Knapp 1990: 123; White 1986) en route from Crete to the Egyptian Delta. Another likely destination point for mariners en route to the Egyptian Delta was the harbour town of Pharos (#193), situated on the western edge of the Nile Delta.

Maritime conditions:

The overriding factors affecting contacts between Crete and Egypt were the maritime conditions. The combination of the prevailing NW meltemi winds and the currents that flow in a south-easterly direction across the Mediterranean to the north coast of Africa (see Chapter IV.3), were ideal conditions to aid a direct open-sea voyage between Crete and Egypt, with a prudent aim off to the west. However, the return journey direct from Egypt to Crete would have been far more difficult as mariners would be sailing directly into prevailing maritime conditions.

Prevailing winds along the south coast of Crete are westerlies and the current flows in a westerly direction.

North to NW winds prevail along the north coast of Crete and are enhanced by onshore diurnal sea breezes that blow in the latter part of the day. Within the coastal waters of Egypt prevailing winds are north-westerly and currents flow to the east across the mouth of the Nile. In the spring, offshore, southerly hamsin winds blow off the Nile Delta.

Maritime routes: Route 'A'

2.1.i From Crete to Egypt

The departure point for vessels leaving harbours on the southern or eastern coasts of Crete (discussed above), lies due northwest of the Egyptian Delta. Passage to the south is assisted by south-easterly-flowing currents and with the winds astern. To avoid sailing too far to the east of the Nile Delta, it would be prudent for Bronze Age sailors to aim off to the west of their desired destination, as predominant maritime conditions would tend to cause their vessels to drift down wind to the east. Thus, the voyage would have been undertaken with the prevailing wind over the starboard quarter of the vessel.

The route between Crete and Egypt is undertaken out of the sight of land and there are no obvious landfall points along the coast of north Africa. The only indication Bronze Age mariners had that they were approaching the shores of the Egyptian Delta was the cloudy appearance of the coastal water, discoloured by the large amount of sediment

discharged at the mouths of the River Nile, although this was obviously of no help if mariners reached the coast at night. Bronze Age mariners may well have used sounding leads or poles to monitor the reduced depth of water as they approached the shores of north Africa, as described by Herodotus (2.5.2; see Chapter II.3). Another indication of relative latitude on an open-sea voyage between Crete and Egypt, would be the relative height of the Great Bear constellation which is closer to the horizon in the southern seas along the Nile Delta, than it is in northern latitudes around Crete (see Chapter II.3; McGrail 1991).

An account of the route between Crete and Egypt is found in Homer (Odyssey XIV.252-257). The voyage, aided by 'fresh and favourable winds from the north, which made our going as easy as though we were sailing downstream', was apparently completed in five days: 'On the fifth day we reached the great River Nile'. Strabo (10.4.5) also describes a voyage to Egypt from Cape Samonium, modern Sidhero, in north-eastern Crete, taking a similar amount of time. Based on velocities of between 120km/ 24 hour period, over an approximate distance between Crete and the Nile Delta of 560km, and assuming a constant wind, Lambrou-Phillipson (1991: 12) calculates four days to complete the outward journey; although Kahanov (1995, personal communication) believes that the journey could have been accomplished in less time, assuming a speed of 5 knots.

Shelter may have been sought at Mersa Matruh (#198), in lee of the lagoonal bar. Mersa Matruh offers no immediate landmark other than its location slightly to the west of the promontory of Râs 'Alam el Rûm. Although this is the only site from which we have evidence for limited use as an anchorage in the Late Bronze Age, it is quite possible that other potential sites afforded shelter to vessels along this stretch of the coast. Passage c. 250km east to the Nile Delta, was made with prevailing winds over the port quarter and the coast of north Africa to starboard, and was assisted by easterly-flowing currents. Bronze Age mariners could also have anchored at Pharos on the western edge of the Nile Delta, in lee of the offshore reef, or at Abu Sir (#196) to the southwest. From here goods were transported up the Rosetta or the former Canopic branches of the River Nile to Pharaonic centres inland (see Chapter VI.1.d).

Kemp and Merrillees (1980) have suggested an alternative route from Crete to Cyrene, much further west on the north African coast. This route would have involved passage over some 300km of open sea, and then along the coast to the Nile Delta, an additional 800km. Although this route covered a far greater distance than Vercoutter's (1954: 419) 'Western' route, it involved less voyaging over open seas, and guaranteed that mariners did not drift to the east of their destination point. However, as Pryor (1988: 22) points out, this route is thwart with dangers.

The low-lying, exposed nature of the coast, with shallows that extend far out to sea, meant that Bronze Age sailors were in risk of being stranded on a sandy lee shore.

### 2.1.ii From Egypt to Crete

Considering the limited capabilities of Bronze Age sailors, their vessels and rigging (see Chapter II), it is most improbable that a direct voyage would have been attempted between Egypt and Crete, as Bronze Age mariners would essentially be sailing directly into prevailing winds (see above), and if attempted then the tacks would be extremely long and the voyage likewise!. Lambrou-Phillipson (1991: 13) discusses the impracticalities of a direct journey from Egypt to Crete. An alternative indirect route via the Levantine coast of the eastern Mediterranean would be a more feasible return route (see these legs in Routes 'B', 'C', 'D', 'F', G' and 'I').

A number of scholars (Watrous 1992: 177-8,fig.10-11; Cline 1994: 91,map 4), however, believe that it was in fact possible to sail directly from Egypt to Crete by taking advantage of the southerly hamsin wind that occasionally blows off the Libyan desert in the summer season. I would dispute the feasibility of such a route being undertaken by Bronze Age mariners - the hamsin wind is unpredictable and unreliable, blowing for only a few days and its effects are rarely noticed as far north as Crete. It may, however, have been possible that Bronze Age mariners took advantage of

diurnal breezes and pursued a voyage along the north coast of Africa to a far westerly point such as Derna, whose harbour of Azarium was certainly used in the 5th century AD (Boardman 1966: 150-152), and then make passage to Crete in a north-easterly direction with the prevailing wind on the port beam. However, there is no archaeological evidence to support the existence of such a route, which would have involved Bronze Age mariners sailing for many days along the hostile, harbourless coast of north Africa.

Despite the greater distance of the indirect, northerly route, some 1600km, between Egypt and Crete, there is extensive evidence for Egyptian contacts with places en route and no evidence for trade along the north African coast until the utilisation of the harbour at Mersa Matruh in the 14th century BC (#198). In support of this argument, Lambrou-Phillipson (1991: 14) discusses an Egyptian text 'The Admonitions of an Egyptian Sage' that describes the route from Egypt to the 'land of Keftiu', Crete. The route followed an 'eastern course towards Byblos, north towards the other Near Eastern ports, and finally turning west', along the coast of southern Turkey, eventually reaching harbours along the northern and eastern coasts of Eastern Crete. Thus, it is most likely that this indirect route was used by Bronze Age mariners voyaging from Egypt to Crete and possibly by mariners voyaging from Crete to Egypt, particularly during the earlier part of the second millennium BC.

VI.2.2 Route 'B' - Crete to Cyprus (Fig. VI.2.2)

Contact between Crete and Cyprus appears to have existed throughout the Bronze Age. Current evidence suggests that the focus of contacts between Cyprus and Crete changed during the course of the second millennium, with the most intense period of contact and exchange undoubtedly being the latter half of the second millennium BC.

During the Early and Middle Bronze Age, Minoan goods were essentially restricted to the north coast of Cyprus, relating to the passage of vessels 'stopping over' en route between Crete and the coast of the Levant. By the beginning of the Late Bronze Age, northern Cyprus, particularly sites in the northwest, displayed a concentration of Minoan goods, implying that the stop-over points had become trade terminals. At the same time, the gradual introduction of Cretan imports is seen at sites in the east of the island, as Cyprus intensified its role in eastern Mediterranean trade. By the 13th century BC such sites as Enkomi, Kition and Hala Sultan Tekke had become established urban centres of commerce. By the latter part of the Late Bronze Age, c. 1200 BC, an increasing Mycenaean cultural and ceramic influence had begun to spread from the northwest of Cyprus, evidenced by Late Helladic I material recovered from sites such as Toumba tou Skourou, throughout the island, concentrated in the commercial centres along the southern

and eastern coasts of Cyprus.

In Crete, Cypriot goods are predominantly evident in the central and eastern parts of the island. Very small numbers of imported artifacts are known from the Early and Middle Bronze Age, but from the Protopalatial period onwards numbers of imported Cypriot finds in Crete increased. A concentration of finds is evident both around Kommos on the southern shore, and in harbour sites along the north coast of the island[6].

As a result of this evidence, a number of maritime routes can be identified between Crete and Cyprus. Some are more a consequence of maritime conditions, others are due to changing social, political and economic factors.

Maritime conditions:

The predominant maritime conditions affecting movement between Crete and Cyprus during the summer sailing season are the W and NW meltemi winds. Currents flow from the northwest to the southeast between the two islands. These prevailing maritime conditions were surely taken advantage of when sailing between Crete and Cyprus. However, returning to Crete along exactly the same route would have been practically impossible as Bronze Age sailors would have been heading directly into the predominant wind for

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[6] Also found at Chania in the Late Minoan III period, implying an extension of the long-distance trade route to the west.

the entire stretch of about 480km to Crete.

The return passage would more likely have involved an alternative route taking advantage of land and sea breezes and possibly the counter-clockwise longshore current that flows along the south coast of Turkey (Mantzourani & Theodorou 1991: 49). After following the south Turkish coast westward to Rhodes, Bronze Age mariners would then sail in a southerly direction to Crete, via Karpathos, thereby rarely out of the sight of land. Having reached Crete advantage would have been taken of the longshore current that encircles Eastern Crete in a clockwise direction (Lacombe & Tchernia 1972: Fig.3; Fig. IV.29).

Maritime routes: Route 'B'

2.2.i From Crete to Cyprus (The Southern Route)

A large number of anchorage sites have been identified along the north coast of Crete that provide varying degrees of protection against prevailing meltemi winds. A number of these anchorages are thought to be associated with the Palace of Knossos. These include the harbours of Katsambas/ Poros (#264), Amnisos (#265) and Nirou Khani (#266), as well as the anchorage associated with the palace site of Malia (#268). All of these anchorages are subject to similar maritime conditions. When leaving any one of them it is advisable to leave at night or early in the morning when meltemi winds are light and offshore winds prevail

(see Chapter IV.3).

The island of Dia (#260) could also have afforded a number of offshore anchorages in the sheltered bays on its southern coast, separate from the main sites on the mainland. Movement in a southerly direction between the island of Dia and the mainland is aided by onshore meltemi winds, returning on the dying offshore night breezes early in the morning.

Once outside Candia Bay, boats heading eastward can be sailed on a broad reach with the wind slightly aft of their port beam. Passage would advisably keep well clear of the coast, as the growing meltemi wind would be likely to blow vessels ashore. Beyond the Gulf of Mirabélo passage to the east would have been facilitated with the meltemi winds astern.

Passage to the east along the southern shores of Crete was a little more difficult since, although the prevailing winds are westerly, the current flows in a westerly direction and winds are changeable with squalls blowing off the mountains, and southerly winds occasionally blowing up from the Sahara. The only major harbour along this stretch of coast is Kommos (#308), with a number of minor stop-over points further east, including Kalí Liménes (#305), Lendas (#304), Trypeti (#303) and Árvi (#298). Kommos is subject to prevailing onshore winds during much of the day. Sailors

would leave the harbour during the night or early in the morning on the light offshore winds, a product of the night breeze. Passage south was assisted by prevailing NW winds on the starboard quarter. Once round Cape Líthinon passage along the south coast was undertaken with the prevailing winds astern. Advantage could also be taken of diurnal breezes for manoeuvring in and out of anchorages.

At the far eastern end of the island, movement out of the sheltered harbours of Zakros (#290) and Palaikastro (#288) was assisted by the prevailing westerly winds. From here the passage across to the west coast of Cyprus was made with the wind generally astern, although Bronze Age sailors would have had to aim off to the north to allow for the leeway effects of the meltemi winds, otherwise they would end up due south of Cyprus. In good weather it is possible to sail between Crete and Cyprus without losing sight of the south coast of Turkey.

The route from Crete to Cyprus (Mantzourani and Theodorou 1991: 49-50,fig.9/ Route 'A'), referred to here as the Southern Route, appears to be the most direct passage between the two islands. However, a route to the north, along the coast of southern Turkey, was also feasible (Mantzourani and Theodorou 1991: 49-50,fig.9/ Route 'B') and is referred to here as the Northern Route (discussed below; Fig. VI.2).

Passage around Cyprus from the west to the east was no doubt undertaken along both the north and south coasts. During the Middle Bronze Age it would appear that the major route was along the north coast (to be discussed below). However, in the Late Bronze Age there is more evidence for links between Crete and the southern and eastern anchorages of Cyprus. In fact, McCaslin (1980: 113,nt.66) does not believe that mariners used the Northern Route for the purposes of long distance trade during the Late Bronze Age, as sheltered anchorages both along the north coast of Cyprus and the hostile south coast of Turkey were limited and the main harbours in Cyprus during this period were located on the southern and eastern coasts of Cyprus (Fig. VI.2).

Sailors voyaging from Crete would identify the island landfall of Cyprus by the high peaks of the Troodos Mountains, visible from some distance out to sea. The western reaches of the Akamas peninsula, particularly the promontory of Lara Point (MP IV 1951; #252), would serve as a landmark for the south-western shores of the island, while Cape Kormakiti and the western reaches of the Kyrenia Mountains would guide sailors to the north-western shores of the island and Morphou Bay.

2.2.i.a Passage along the south coast of Cyprus

A number of sites on the west coast of Cyprus provide a degree of shelter from prevailing W winds, although this

western 'tail' of the island seems to have been sparsely populated throughout the Bronze Age, with only Maa Palaeokastro (#248) having been occupied for a short period in the 12th century BC. Other anchorages along this stretch of coast that could have been used in the Bronze Age include Lara (#252), particularly its northern anchorage (McCaslin (1980: 3,fig.1, 104) has identified a stone anchor at this site), Drepanum (in lee of the island of Ayios Yerghios; #251), Maniki Bay (in lee of the offshore island; #250), Kerati Bay (#249) and Yeranisos (#253), in the north.

The predominant winds and currents are fair for passage to the east along the south coast of Cyprus, with the wind astern or on the starboard quarter, although sailors have to beware of winds and swell that pick up from the southwest, which could blow their vessels ashore. Shelter along this route is available in lee of Paphos Point.

Having rounded Zephyros Point, ships could anchor at Palaepaphos (#245) in the entrance to the River Dhiarrizos. Movement into the river mouth is assisted by the south-westerly summer breeze or onshore sea breezes, as well as the prevailing W winds. Vessels could then anchor or beach in the river mouth and transfer goods to and from river craft, or possibly navigate upstream along the wide river to the Bronze Age site of Kouklia, where copper could be

loaded. The time to leave the river mouth anchorage is at night or in the early morning on the dying offshore night breeze, thus taking vessels well clear of the land.

Passage east is again assisted by prevailing W winds astern and the easterly-flowing current. Stops may have been made in the bays of Pissouri (#244), Evdhimou (#243) and Paramali (#242) (the latter two have a fresh water supply), before eventually reaching Episkopi Bay.

The River Kouris flows past the riverine sites of Episkopi Phaneromeni and Episkopi Bamboula (#241) and enters the north-eastern corner of Episkopi Bay. The prevailing winds are fair for entering this bay and passage upstream is possible for a short distance, though quite possibly smaller riverine craft would have been used for this purpose. The river was the obvious outlet node for a number of copper mines, metal-production and smelting sites that have been identified up the valley (see Ch.VI.1.e). Winds are onshore in Episkopi Bay and shelter is provided in the river mouth or in a possible silted harbour at the back of the bay (see #241). The time to leave the River Kouris is at night or early in the morning on the dying night offshore breeze, which aids passage out to sea and round Cape Zevgari.

Some shelter is provided in Dreamers Bay (#238) on the southern side of Akrotiri Peninsula, and McCaslin (1980:

3,fig.1) has identified a stone anchor of the Bronze Age type in the waters off Cape Gata, which was possibly used as an anchorage point where vessels waited for favourable conditions to take them around the south-eastern cape of the peninsula up into Akrotiri Bay.

The west side of Akrotiri Bay is reasonably sheltered from prevailing W winds, which would have facilitated entrance to and exit from an anchorage in the present Akrotiri Salt Lake area (#237). Such an anchorage would have provided a large sheltered area for vessels to stop-over and possibly to trade with surrounding Bronze Age settlements. The current flows towards the northeast across Akrotiri Bay and the winds follow the contour of the land around the bay and then veer to the west along the north-eastern shore of the bay.

Two small anchorages, Zygi and Maroni Tsaroukkas (#234), have been identified as harbours associated with the Late Bronze Age sites of Kalavasos Agios Dhimitrios (#235) in the Kalavasos valley and Maroni Vournes (#233) in the Maroni valley, respectively. These anchorages provided limited shelter and acted as temporary stopping points for the exchange and trade of copper. The winds run parallel to the shore at this point and entering these harbours is best attempted in the late afternoon when the winds have died down somewhat. After an overnight stop craft can leave the anchorages early next morning on the dying offshore land

breeze.

Cape Kiti (#231) appears to have been a point where vessels anchored in order to wait for favourable conditions for entering Larnaca Bay. McCaslin (1978, 1980: 21) has identified a number of primarily 'composite' type stone anchors just to the north of Cape Kiti, on the southeast shores of Larnaca Bay. He interprets the anchorage as a point where vessels stopped to take on water after having successfully rounded the dangerous cape. It could also have been a stopping place for vessels waiting to round Cape Kiti en route from east to west, in the same way that an anchorage to the west of the cape may have been used by vessels travelling from west to east.

Once in Larnaca Bay, advantage can be taken of the longshore current that flows to the north along the western side of the bay (a product of the SSW sea breezes). However, wind conditions within Larnaca Bay can be variable, and make movement in and out of Bronze Age harbours, such as Kition (#229) and Hala Sultan Tekke (#230), that are located along the western shores of the bay, problematic, particularly when NE winds pick up, making entrance into the bay hazardous (see Chapter IV.3). Passage along the north shore of Larnaca Bay in an easterly direction to the anchorage of Pyla Kokkinokremos (#228), is assisted by NW winds that prevail in the early morning. Entering and leaving the anchorage of Pyla Kokkinokremos is

aided by land and sea breezes.

Continuing to the east, shelter is provided in the river mouth anchorage of Ayios Yeorgios (#227), in the lee of Cape Pyla, particularly when N winds blow offshore to the east. McCaslin (1980: 26, 3,fig.1) has found two Bronze Age type stone anchors here. Cape Greco (#225) is another point where vessels would stop and wait for favourable conditions to assist their passage into Famagusta Bay. McCaslin (1980: 26, 3,fig.1) has also observed three stone anchors in the waters off the east side of Cape Greco. This could also indicate that vessels approaching from the north would wait for favourable conditions to round the cape and continue passage to the southwest.

Famagusta Bay, like Larnaca Bay, is subject to changeable wind conditions. Mariners would enter the mouth of the River Pedhieos, which led to the inland anchorage of Enkomi (#224), during the calmer conditions of the evening. To the northeast of Famagusta Bay movement up the south side of the Karpas peninsula is aided by S winds that prevail in the afternoon. There are few anchorages along this stretch of the coast except perhaps in lee of Khelones Point (#221).

Cape Andreas is a nautically hazardous headland and offers an ideal example of an anchorage where ships had to wait for fair winds to avoid being in a 'lee shore'

situation, or possibly even row around the point. The large number of stone anchors found in the waters off this point are testimony to this fact (#219). Once round Cape Andreas, movement to the west along the north coast of Cyprus is hampered by winds from the west and north, as well as by the easterly-flowing current. Sailors would have to be careful not to allow their vessels to be blown onshore. Passage is possible, however, with the aid of land and sea breezes which are experienced along this stretch of coast. Movement is undertaken in stages, zigzagging along the coast.

2.2.i.b Passage along the north coast of Cyprus

For the Middle Bronze Age period in particular, the largest number of sites in Cyprus that reveal contacts with Crete are those in the northwest of the island. Bronze Age sailors approaching from Eastern Crete would have taken advantage of the meltemi winds to reach the northwest coast.

A number of sites around the shores of Morphou Bay, including Toumba tou Skourou (#202) and Ayia Irini (#203), appear to have been important sites, especially in the Middle Bronze Age. They would have acted as outlets for the distribution of copper from mines in the Troodos Mountains, such at Apliki and Katydata. Sailors from Crete could approach the bay with the prevailing wind astern and anchor in the mouth of the River Ovgos or beach along the shore at

Ayia Irini. They would have left these anchorages in the early morning when W winds were light. Passage north and around Cape Kormakiti is aided by the prevailing W winds.

Movement in a easterly direction along the north coast of Cyprus is aided by the prevailing W winds astern. Anchorage is attested at a number of second millennium sites that are sheltered from W winds, such as Orga (#205) and Vavilas (#206). Entering and leaving these sites is assisted by land and sea breezes which are also experienced along this stretch of coast, particularly in the region of the Kyrenia Mountains. Lapithos was another important Middle and Late Bronze Age site in the northwest of Cyprus, although limited shelter was provided. The anchorage at Kyrenia was no doubt also utilised, providing an outlet for the inland site of Vounos. The harbour would have been recognised from out at sea by the peaks of the Kyrenia Mountains. McCaslin (1980: 3,fig.1) has identified a stone anchor of Bronze Age type at Kyrenia (#209).

Along the north-eastern shores of northern Cyprus, a number of sheltered anchorages have been identified with varying degrees of evidence for their use in the second millennium. Use of shelter in the north and east-facing bays of Aphendrika (#217), Ayios Thyrsos (#215) and Akanthou (#212) and Ayios Philon (#216), is attested for this period. Other bays that were potential Bronze Age anchorages include Ayios Photios (#214) and Stazousa Point

(#211).

2.2.ii From Cyprus to Crete (The Northern Route)

An attempt to return to Crete via the Southern Route would have been impossible as this direct route is into the prevailing winds. Therefore, an alternative route along the south coast of Turkey is suggested, ie the Northern Route (Portugali & Knapp 1985: 53,fig.4-3; Mantzourani & Theodorou 1991: 50,fig.9/ Route 'B'; McCaslin 1980: 105,fig.36/ Route II; Fig. VI.2).

Passage in a northerly direction from the north coast of Cyprus some 70km to the south coast of Turkey, can be made, often in sight of land, with the prevailing W wind over the port side of the vessel, on a reach. Once close to the coast of southern Turkey, passage along the coast to the west is very difficult, particularly during the day when the meltemi winds are strongest. However, it may have been possible to undertake this passage in the night and early morning when Bronze Age mariners would have made use of diurnal winds, anchoring when maritime conditions were not favourable (see this leg in Route 'I').

From Rhodes, currents in the area of the Dodecanese are diverse. The prevailing meltemi winds are north-westerly and any route to Crete would essentially entail passage with the wind on a starboard reach. The voyage is most easily achieved during the changeable conditions of

the spring or the calmer conditions of the autumn (Geo. Handbook 1941). Advantage may be taken of the diurnal winds that blow off the south Turkish coast, and passage may be attempted down either the east or the west coast of Rhodes.

A southerly current flows from Rhodes to Karpathos and on to Crete, which aids passage to the south. When travelling against adverse winds, advantage can also be taken of the high, steep land masses that form both Rhodes and Karpathos, and which lie directly across the path of the prevailing wind, providing shelter in their lee. However, rounding the southern point of Rhodes can be problematic, and sailors would have to wait in lee of the anvil-shaped headland of Cape Praso for favourable conditions[7].

Rhodes suffers from a dearth of natural harbours. There are no safe anchorages on the east side of the island should vessels get caught in a storm. Conversely, the west coast of Rhodes is more exposed to prevailing winds and vessels risk being blown ashore if the meltemi winds are strong. However, the west coast of the island does offer a number of secure havens in lee of the islands of Alinia and Khálki, with the heaviest concentration of Bronze Age settlement in the northwest of the island eg Trianda and

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[7] Rounding any point is difficult because of the great change in the ships' heading relative to the wind. Bronze Age mariners would often have had to wait for favourable conditions in order to avoid being swept off course (see Fig. II.15).

Ialysos, where the prevailing winds are modified somewhat by the proximity of the Anatolian Plateau. Passage to the northwest coast of Karpathos, is more direct from the west side of the island.

Karpathos Island is a natural bridge between the islands of Rhodes and Crete and is described as such in an 18th Dynasty Egyptian text (Susini 1965: 225). Tristomo Bay forms the southern shores of a channel between the northern shores of Karpathos Island and Saro Island to the north, and affords some shelter when meltemi winds are light. Bronze Age remains have been discovered on the eastern shores of Saro Island (Susini 1965: 244) which provides some shelter to vessels anchored in its lee.

Like Rhodes, the east side of Karpathos is more sheltered than the west, but offers no protected anchorages, except the small anchorage of Pegadia in the southeast. Problems can be encountered rounding its southern cape in order to cross to the island of Kasos, which is the next step on the journey to Crete. The west side of Karpathos is more exposed to prevailing winds but offers sheltered anchorage in the bay of Phoeniki, on the southwest coast. Additionally, passage west to Kasos is more direct from the west coast of Karpathos.

Kasos offers shelter to vessels on its southern shores and in the bay of Vlichada on its northern shore. Vlichada

is protected from prevailing meltemi winds as it lies in lee of the offshore islets to the north of the island (Denham 1964: 80).

From Kasos, Bronze Age sailors would attempt the passage due west-southwest to Crete, using the mountains of the Siteía plateau as a landfall. The crossing is very difficult as strong NW meltemi winds prevail for long periods of time over the summer months, which can cause vessels to drift off course down wind to the south. Sailors are advised to wait for favourable maritime conditions and make passage with the winds well forward of the starboard bow.

Having reached Crete shelter is provided in lee of Cape Sidhero. With the predominant NW winds broad on the starboard beam, passage can be undertaken from Cape Sidhero southwards to the harbours of Palaikastro (#288) or Zakros (#290). Alternatively, ships bound for harbours on the north coast of Crete, would have to make use of the less persistent diurnal breezes to make broken passage to the west, with the meltemi winds broad on the starboard bow. The few harbours on the south coast would have been equally difficult to reach due to the fact that the westerlies which prevail along this coast oppose travel to the west. However, this route can be utilised when conditions along the north coast are not favourable, as St. Paul's journey illustrates (Acts 27: 1-8).

VI.2.3 Route 'C' : Cyprus to Northern Levant

(Fig. VI.2.3)

The evidence for contacts between Cyprus and the coast of the northern Levant is outlined in Chapter I, with links being particularly extensive in the Late Bronze Age. Middle Bronze Age contacts with the northern Levant appear to have been concentrated along the north coast of Cyprus. A number of anchorages have been identified as stop-over points along the north coast utilised by sailors en route to the northern Levant (see Route 'B'). However, by the Late Bronze Age we have evidence for the increased use of anchorages along the southern and eastern coasts of Cyprus, especially at centres of trade such as Enkomi and Kition, with a wealth of evidence implying links between the two areas (see Chapter I).

Thus it is possible to identify a number of main axis routes between Cyprus and the northern Levant, from departures points in Cyprus, such as Cape Andreas[8], and primary centres, such as Enkomi and Kition in south-eastern Cyprus, to various points along the coast of the northern Levant. Ugarit has been identified as a major emporium in the northern Levant throughout the second millennium BC, particularly during the Late Bronze Age (see Chapter I &

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[8] Although Cape Andreas may well have acted as a departure point of sailors from the north coast route, it offers negligible harbour facilities and is not believed to have been a major anchorage point.

Part II) and was the closest major harbour along the coast of the northern Levant from Enkomi. A number of other points along this coast have been identified as good landmarks, such as Ràs el Basit in the north, and Beirut, in the region of the Lebanon Mountains, to the south. Other stretches of this coastline are seen as destination points, as they served to provide entry points inland, such as the Akkar Plain. No doubt numerous alternative crossings were made between Cyprus and the northern Levant, however, the routes discussed below are focused around coastal sites that reveal the most evidence for use as anchorages in the second millennium BC.

Maritime conditions:

The predominant maritime conditions affecting the route between Cyprus and the northern Levant are the prevailing W to NW winds and the anticlockwise Mediterranean current which flows in a northerly direction between the eastern shores of Cyprus and the coast of the northern Levant. Prevailing W winds are enhanced in the latter part of the day along the coast of the northern Levant by onshore sea breezes. Offshore sea breezes prevail along this coast in the night. Winds around the coast of south-eastern Cyprus are variable but tend to follow the contours of the coast and blow predominantly from the southwest (see Chapter IV.3). At Cape Andreas winds prevail from the west with negligible effects of occasional northerlies that blow off the Turkish coast. Diurnal winds

also affect this stretch of the coast of Cyprus.

Maritime Routes: Route 'C'

2.3.i From Cyprus to Northern Levant

As outlined above a number of regions have been identified along the coast of Cyprus as points of departure for vessels undertaking voyages to the northern Levant, however, it was quite feasible for Bronze Age vessels, with prevailing winds astern, to access all landfall sites and harbours along the coast of northern Levant from anywhere along the eastern shores of Cyprus.

From Cape Andreas, the promontory and anchorage site of Ràs el Basit (#85) lies roughly east-northeast. Passage to this prominent landmark of Ràs el Basit along the northern reaches of the coast of the Levant, is made with prevailing W to NW winds aft of the port beam, thus allowing for leeway. If Bronze Age mariners were undertaking this voyage towards the end of the day when the meltemi winds had died down, then they should make passage with the setting sun over the port quarter of the boat and the rising Celestial Pole star just forward of the port beam. The emporium of Ugarit (#89) lies c. 120km due east of Cape Andreas, and passage is made with prevailing winds astern to the landmark of Ràs Ibn Hani and hence reaching with the wind abeam the port side in a northerly direction to Ugarit (see this leg in Route 'F'). Bronze Age mariners

will invariably be in sight of land undertaking a voyage from Cape Andreas to either of these destinations during the day.

From Cape Andreas, the Plain of Akkar lies slightly north of southeast. Allowing for leeway, sailors would set a course with the wind broad on the starboard quarter in order to make passage from Cape Andreas to the Akkar Plain. Beirut lies roughly south-southeast of Cape Andreas, and passage to this anchorage and the offshore island anchorage of Tyre (#125) to the south, should be made with the wind over the starboard beam. By setting a course due south, with the wind over the starboard quarter, vessels would be blown slightly to the east by the effects of drift down wind, and, when in sight of their destination, could change course to the east, making use of the prevailing winds astern to reach the harbours (see this leg in Route 'F').

The Late Bronze Age anchorage of Enkomi (#224) situated along the shores of Famagusta Bay in eastern Cyprus, was no doubt a frequent departure point for vessels leaving Cyprus for the northern Levant. Bronze Age vessels departing from the outer limits of Famagusta Bay should be able to make any landfall point or harbour along the coast of the northern Levant. Ràs el Basit lies slightly north of east-northeast from Famagusta Bay and vessels wishing to make passage to the headland of Ràs el Basit should set a course with the prevailing winds aft of the port beam and,

allowing for leeway, they should reach the landmark point. Alternatively, they could sail in a north-easterly direction with S winds blowing broad on the port quarter, in lee of the southern shores of the Karpas Peninsula and then depart from Cape Andreas (hence, undertaking the route outlined above). Ugarit lies just to the south of Ràs el Basit and similar route instructions apply.

Passage from Enkomi to the Akkar Plain is made on a east-southeast track with the winds over the starboard quarter of the vessel, which, allowing for leeway, should bring the vessel to the Bay of Akkar. To the south, the anchorages of Beirut (#120) and Tyre (#125) lie roughly southeast and southeast x south, respectively, of Famagusta Bay. If Bronze Age mariners set an initial course slightly aft of the starboard beam, then they can change tack to the east once in sight of their destination, running with prevailing winds astern to guide them to anchor. Reaching their required anchorage, boats would stop by heading into the wind or lowering the sail.

The Late Bronze Age harbour of Kition Kathari (#229) is situated on the western shores of Larnaca Bay, south-eastern Cyprus. On a clear day it is possible to see the Syrian coast from the low foothills behind Kition (McCaslin 1980: 106), thus, it is possible to make passage to the east in sight of land. The Akkar Plain lies roughly to the east of Kition, whereas Ugarit and Ràs el Basit lie east-

northeast and northeast-east, respectively. Therefore, passage to Akkar Bay is made with prevailing winds or the setting sun, astern, whereas passage to Ugarit is made with the winds aft of the port beam, following a course roughly northeast-east. Allowing for leeway, a course set to the northeast, with the prevailing W winds well forward of the port quarter, should assist passage to the headland of Ràs el Basit.

Beirut lies roughly east-southeast of Larnaca Bay and leeway tends to blow vessels slightly off this course to the northeast, therefore it is advisable to set a course with the winds in the starboard quarter in order to reach the harbour of Beirut. A similar course should be set in order to make passage between Kition and Tyre. Bronze Age sailors would have to beware not to be blown on to a lee shore along this coast.

2.3.ii From Northern Levant to Cyprus

Mariners wishing to undertake passage from the northern Levant to Cyprus are essentially attempting to sail into the prevailing W winds, particularly on a route such as between Ugarit and Cape Andreas. Based on discussions in Chapter II, it is assumed that Bronze Age mariners, or more precisely Late Bronze Age mariners, were capable of sailing a maximum of 2 points to windward, which is equivalent to 7 points off the prevailing wind if leeway is included. Thus, when W winds prevail the only feasible

direct voyages between the northern Levant and Cyprus are between Tyre and Cape Andreas, as undertaken by Wen-Amun in 11th century BC (ANET: 16-24/ 25-29). In order to undertake passage from departure points along the northern reaches of the northern Levantine coast to Cyprus, a number of alternative approaches were available, although whatever course was chosen this route is hazardous and susceptible to opposing maritime conditions.

One option open to Bronze Age sailors was to tack the c. 120km between the northern Levant and Cyprus. However, as suggested, it was not until the end of the second millennium that mariners had developed the technical capabilities to sail into the wind (see Chapter II), and tacking over such a distance would have involved very long, wide reaches and mariners would have to work hard all day to make relatively little headway. It is interesting to note that for a number of reasons direct links between the two areas increased in the Late Bronze Age, no doubt one being, that it was not until the latter part of the second millennium BC that mariners were able to make progress, although limited, into the prevailing winds.

A more efficient course of action would be to take advantage of diurnal winds, leaving anchorages on the coast of the northern Levant before daybreak on the nocturnal offshore land breeze, thus sailing as far west to northwest (the effects of the offshore land breeze only extend some

5km offshore) as possible before the westerly winds picked up around midday. Sailors would then have had to change course and follow a northerly passage, reaching with the wind over the port beam and assisted by the northerly-flowing current. By keeping a distance offshore vessels are less likely to be blown to the east on to a lee shore. After two to three days Bronze Age mariners would hopefully reach the coastal waters of Cyprus, in sight of their destination, and hence advantage could be taken of the onshore sea breezes, in order to manoeuvre vessels into anchorages. As a general rule it is advisable to undertake this passage at the very beginning or towards the end of the sailing season ie the spring and autumn, when W winds do not blow with such force and E winds are experienced for a certain number of days. Pryor (1988: 1-6) describes such a route taken by the traveller Ibn Jubayr in the twelfth century.

A final option open to Bronze Age sailors attempting to cross from the northern reaches of the northern Levant to Cyprus, was to wait until N winds blew off the coast of southern Turkey and undertake a passage to the west, reaching with the wind over the starboard beam of their vessel.

VI.2.4 Route 'D' - Cyprus to Southern Levant (Fig. VI.2.4)

Direct contact between Cyprus and the southern Levant is most evident during the Late Bronze Age, with only limited contact during the earlier part of the second millennium BC. By the Late Bronze Age, harbours along the south and east coasts of Cyprus, such as Enkomi (#224), Kition (#229), Hala Sultan Tekke (#230) and Kouklia (#245), played a dominant role in international exchange, not only as a link between east and west but also as major producers and exporters of copper.

Numerous routes were no doubt plied between these two areas, represented at sites along the coast of the southern Levant by increasing imports of Cypriot and Mycenaean style pottery. Destination and departure points along the coast of the southern Levant are recognised at Akko (#134), Tell Abu Hawam (#137), Dor (#145), Tell Qasile (#159), Tel Mor (#164) and Ashkelon (#166). However, quantities of Middle Cypriot wares have also been recovered from the coastal sites of Tel Nami (#144), Tel Mevorakh (#148), Tel Michal (#157) and Tell Jerishe (#160).

Maritime conditions:

Northwest winds prevail between the coasts of Cyprus and the southern Levant, often backing to the southwest along the southern reaches of the coast of the southern Levant (see Route 'G'). Winds can vary considerably inshore

along both the coast of the southern Levant and Cyprus. Along the southern and eastern coasts of Cyprus winds tend to blow from west to east following the contour of the land and are variable within the bays of Larnaca and Famagusta (see Chapter IV.3). Diurnal winds are also experienced along both coasts and are particularly strong during the height of the summer sailing season. The effects of diurnal winds are enhanced along the coast of the southern Levant by winds associated with the Persian Trough. Easterly offshore breezes are experienced during the night and early morning, veering to the southwest in the morning and then to the northwest by the latter part of the day. The predominant current is northerly-flowing.

Maritime Routes: Route 'D'

2.4.i From Cyprus to Southern Levant

Departing from any number of points along the coast of southern and eastern Cyprus, passage to the coast of the southern Levant was feasible with the prevailing W winds aft of the starboard beam. Alternatively, direct passage to the coast of the northern Levant with the winds astern and hence reaching with the wind abeam down the coast of the Levant to the south, was also an option (see Route 'C' and Route 'G'). A number of routes are discussed to highlight contacts between important centres of trade and exchange along the coasts of Cyprus and the southern Levant.

Sailors departing from Larnaca Bay on the south-eastern coast of Cyprus, do so early in the morning with NW land breezes astern. During the day SSW winds blow up the western shores of the bay and make exist in a southerly direction problematic. Once out of Larnaca Bay mariners would set a course to the southeast, with prevailing winds over the starboard quarter, which, allowing for leeway, should take them directly to Haifa Bay. The Bay of Haifa accommodated the harbours of Akko (#134) and Tell Abu Hawam (#137), particularly important during the Late Bronze Age II period, and offered a good landmark to vessels, as it is the largest bay along this coast and is situated immediately north of the Carmel Range[9]. Tel Nami (#144) is located on the southern reaches of the coastal plain that borders the Carmel Range and is recognised from seaward by a gap in the Carmel Range; the emporium of Dor (#145) lies immediately to the south. Mariners wishing to reach the southern reaches of the coast of the southern Levant, in the vicinity of the harbour of Tell el-'Ajjul (#169), should set a course due south, with the wind over the starboard quarter.

Bronze Age mariners en route between the north coast of Cyprus and destination points in the southern Levant would set a course from Cape Andreas due south, with

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[9] Mount Carmel was recognised as a prominent landfall by Egyptian sailors who compared the range with the 'nose of the Gazelle's head' from the 6th Dynasty (Lichtheim 1973: 20).

prevailing NW winds on the starboard quarter. This voyage may have been assisted, certainly in the north, by N winds that occasionally blow off the south Turkish coast. In the south, problems would have been encountered when winds backed to the southwest as mariners were unable to sail their vessels on such a close-haul into prevailing winds. Mariners would then have had to continue their passage south closer to the shores of the southern Levant, taking advantage of diurnal winds to zigzag a route down the coast, but avoiding a lee shore when onshore winds prevail. A similar route would have been made between Famagusta Bay and the coast of the southern Levant, vessels departed Famagusta Bay in the morning with light NNE winds astern.

A direct passage from the south-western shores of Cyprus, departing from anchorages such as Maa-Palaeokastro (#248) and Kouklia (#245), was made with prevailing WNW winds astern. The coast of the southern Levant lies due southeast of these waters and setting a course to the south-southeast, with the winds over the starboard quarter of the vessel, should bring Bronze Age mariners to the coastal waters of the southern Levant. However, this route is, to a large extent, across open seas out of the sight of land and mariners may have preferred to have undertaken a coastal passage along the south coast of Cyprus (see this leg in Route 'B'), before setting out to sea. Thus, they could undertake a route in sight of land and perhaps have taken on additional cargo en route.

A convenient departure point along the south coast of Cyprus to the coast of the southern Levant, would have been the embayment or lagoonal anchorage of Akrotiri, the area of the modern day Akrotiri Salt Lake (#237). Goods may have been collected here from nearby coastal settlements and copper producing centres associated with the Episkopi, Vasilikos and Maroni valleys, prior to being exported. From the E-facing anchorage of Akrotiri, vessels would depart with prevailing westerlies astern and once out of coastal waters, set a course to the east-southeast, with the wind astern, in order to make track to the Bay of Haifa on the northern shores of the southern Levantine coast. If a destination further south were preferred, perhaps to the coastal area around Jaffa, which is recognised from seaward because it is located in the centre of the Sharon Plain, then a course due southeast would be set, with the prevailing winds well aft of the starboard beam. However, if SW winds prevail along the southern reaches of this coast then Bronze Age mariners would have to steer their vessels with great difficulty closer to the wind, with the wind over the starboard beam, in order to reach their desired destination.

### 2.4.ii From Southern Levant to Cyprus

When NW and W winds prevail along the coast of the southern Levant, a direct route to Cyprus was almost impossible, as Bronze Age mariners would be attempting to sail their vessels more than two points into the prevailing

wind. A direct route, on a close haul, between Tell el-'Ajjul in the south and the east coast of Cyprus was feasible when winds were westerly, but passage between the northern reaches of the southern Levant and Cyprus could only have been possible by following a track north on a port beam, to the northern Levant. Mariners would have taken advantage of offshore night winds in order to keep as far offshore the Levantine coast as possible (thereby avoiding being blown on to a lee shore) and make passage to the north with E winds on the starboard beam and over the port quarter when winds veer to the southwest in the morning. A route between the coast of the northern Levant and Cyprus is then undertaken (see this leg in Route 'C').

However, when SW winds prevail along the southern Levantine coast, a direct route to Cyprus is more feasible, as Bronze Age mariners are essentially sailing with the prevailing winds over their port beam. Thus, sailors heading from Haifa Bay to Larnaca Bay would set a course to the north-northwest, with winds aft of the port beam, and sail on this tack until winds veer to the northwest. This process would be repeated, seeking shelter along the coast of the Levant when north-westerlies prevail, until Bronze Age mariners came in sight of the landmark of Cape Kiti. Hence they would manoeuvre their vessels into Larnaca Bay with onshore diurnal winds astern. Similarly, those mariners en route between Dor (#145) or the Sharon Plain and Larnaca Bay, would set a close haul course, slightly

into the prevailing wind and, allowing for leeway, should reach the offshore waters of Cape Kiti (#231). A similar course would have been set by mariners voyaging between Haifa Bay or the Sharon Plain and the landmark of Akrotiri Island/ Peninsula, on the south coast of Cyprus.

The coast of western Cyprus lies roughly northwest of the coast of the southern Levant. Bronze Age mariners wishing to make passage to western Cyprus would have to undertake a route utilising diurnal winds and those associated with the Persian Trough, up the coast of the southern Levant and hence to the coast of south-eastern Cyprus. A direct open-sea passage to western Cyprus would have been impossible as mariners would have essentially been heading directly into prevailing NW winds.

When E winds blow off the coast of the southern Levant during the spring and short periods during the autumn, passage to the northwest is assisted with prevailing winds aft of the starboard beam for much of the voyage to Cyprus. Passage to the north was also assisted by the northerly-flowing currents that flow up the coast of the southern Levant.

## VI.2.5 Route 'E' : Cyprus to Cilicia (Fig. VI.2.5)

Although links between Cyprus and Cilicia were established from the third millennium BC, evidence for contacts during the second millennium BC is not extensive (see Ch.I). Late Cypriot material has been recovered from a number of sites on the Cilician Delta, including the ports of Tarsus (#69) and Mersin (#67), but there is limited evidence for Hittite contacts with Cyprus.

Maritime conditions:

The predominant maritime conditions affecting the route between Cyprus and Cilicia are the prevailing W winds and the anticlockwise Mediterranean current which flows to the north between the eastern shores of Cyprus and the coast of the Levant, and then flows due west along the south coast of Turkey. South-westerly winds blow inshore along the coast of Cilicia and up into the İskenderun Gulf. Occasionally, NE winds blow off the Cilician Delta.

Maritime routes: Route 'E'

### 2.5.i From Cyprus to Cilicia

From the southern coast of Cyprus to Cape Andreas the route is as described in Route 'B'. Similarly, the route along the north coast of Cyprus in a easterly direction to Cape Andreas is also described in Route 'B'. Vessels would also have attempted passage to the southern shores of Rough

Cilicia from any number of anchorages along the north coast of Cyprus. Sheltered anchorages with evidence of Bronze Age settlement along the north coast of Cyprus include Aphendrika (#217), Ayios Thyrsos (#215) and Akanthou (#212). From the anchorage at Ayios Philon (#216) a number of Bronze Age type anchors have been recovered, implying its use, possibly as a fishing anchorage, in this period. Other sheltered anchorages include Ayios Photios (#214) and in lee of Stazousa Point (#211).

Prevailing W winds along the north coast of Cyprus would have assisted passage due northeast, with the winds well aft of the port beam. Alternatively, a course due north with the wind on the port beam, would have facilitated passage due northeast, allowing for leeway. The advantages of taking this route from the north coast of Cyprus to the south coast of Turkey, are that, assuming fair visibility, Bronze Age mariners would always be in sight of land. The nature of the Rough Cilician coast of southern Turkey is such that it also provides numerous good landmark sites, such as Anamur Burun (#49). Once within the coastal waters of the south Turkish coast, prevailing winds are due south-westerly and assist passage to the east (see this leg in Route 'I'). Mariners would have stayed well offshore as the predominant westerly-flowing currents are more pronounced inshore, and thereby reduce the speed of the vessel. Likewise, prevailing south-westerly winds, particularly in the late afternoon when enhanced by onshore

sea breezes, can drive vessels ashore.

From the large numbers of Bronze Age type anchors recovered from the waters around Cape Andreas (Green 1973; #219), it would seem that this was a well-used anchoring point. No doubt a number of the vessels that dropped anchor here were waiting to set sail for Cilicia. Some 120km to the east of Cape Andreas lies the coast of the northern Levant which is often visible from Cyprus (Downey 1961). To the northeast lies the İskenderun Gulf, which theoretically is in sight of Cyprus, but due to the low-lying nature of the Cilician Delta and assuming visibility is not always good, vessels heading directly for the gulf no doubt often left Cape Andreas out of sight of their destination. Therefore, a number of routes could have been taken to Cilicia depending on the desired destination, prevailing maritime conditions and visibility.

The western reaches of the Cilician Delta and the harbours of Mersin (#67) and Tarsus (#69) lie almost directly north of Cape Andreas. Setting a course due north, Bronze Age mariners would be sailing across the prevailing W winds (over the port beam) and would no doubt drift down wind thus making good to the northeast. If a passage directly north was desired then Bronze Age sailors would have had to set a course due north-northwest and the actual track of the vessel would have been due north with the wind just forward of the port beam.

Those mariners heading from Cape Andreas to the Iskenderun Gulf would set a course due north-northeast, with the Celestial Pole star fine on the port beam. With the prevailing winds just aft of the port beam and allowing for leeway, the actual track of the boat will be due northeast, which should take the vessel directly up into the gulf. Vessels would undertake this passage with Mount Casius just forward of their starboard beam, and once close to the shores of the Cilician Delta, SW winds prevail and passage into the gulf is made running with the wind astern. The İskenderun Gulf offers no obvious landmarks, other than the southern reaches of the Misis Dağ/ Karataş promontory, although mariners are aware that they are approaching the Cilician Delta when they observe the sandy waters discharged from the delta rivers. Sounding poles or leads may have been used to determine the depth of the waters and therefore the vessels distance offshore (Chapter II.3).

An alternative route could be taken via the Gulf of Antakya, heading c. 135km for the landmark of Mount Casius which is often visible from Cape Andreas. The Gulf of Antakya lies due east-northeast of Cape Andreas and with the wind on the port quarter of the vessel, a course due northeast will assist passage to the gulf, allowing for drift down wind. Assuming fair visibility, mariners taking this passage to Cilicia would rarely be out of the sight of land. Prevailing westerly winds assist passage to the east into the rising sun, but mariners have to take care not to

be blown on to a lee shore especially when sea breezes blow in the afternoon.

The Gulf of Antakya affords a number of sheltered anchorages both in the mouth of the Orontes River and in the possible lagoonal anchorage of Seleucia Pieria (#80). However, sailors must beware of E winds that occasionally funnel down the Orontes River valley, that would oppose the intended passage of the vessel. From the Orontes River, passage to the north is assisted by northerly-flowing currents. Land and sea breezes are also experienced along this coast and mariners would have to leave the gulf at night or in the early morning on the dying night breeze, before the W winds pick up.

A number of potential SSW-facing river mouth anchorages to the north of the Orontes River up to Resülhinzer Point, such as Karakilise, could have afforded shelter to vessels in the Bronze Age. Passage to the north is made with the winds just forward of the port beam, taking care not to be blown on to a lee shore when the westerlies prevail. Mariners would have to keep well offshore rounding Resülhinzer Point and once in the Gulf of Iskenderun the winds back to the southwest and passage is made with the prevailing winds astern. Shelter is afforded in lee of the promontories of Arsus (#79) and İskenderun (#78) on the east side of the Gulf of İskenderun. Onshore sea breezes that are experienced along this coast in the

latter part of the day would assist passage into these anchorages but mariners would have to head their vessels into the wind once in the anchorage to avoid being blown on to a lee shore.

Prevailing winds are south-westerly in the Gulf of Iskenderun and blow up into the back of the gulf. Passage to the northeast is assisted with the winds astern. Land and sea breezes are experienced along the eastern shores of the gulf and assist beaching or anchoring in the harbours of Kinet Höyük (#76), Kara Hüyük (#75) and Payas (#77).

The exact morphology of the coast and aspect of anchorages on the west side of the gulf is difficult to determine due to the effects of geomorphological change since the Bronze Age (see Ch.IV.2). However, it is probable that vessels sought shelter in the river mouths, such as that associated with the site of Soyali Hüyük (#74), and behind sand spits that are characteristic of deltaic areas, or beached their craft along the low-lying sandy shores. It is thought that the outlets of the Ceyhan, Seyhan and Tarsus rivers were on the south-western side of the delta in the Bronze Age. The Ceyhan river mouth is believed to have been located on the western end of the Misis Dağ promontory, in the vicinity of Karataş (#71), during this period and would have afforded a well sheltered anchorage in the lee of the dağ. Shelter may also have been afforded in lee of the offshore reefs associated with Ayas (#73),

however, it is doubtful that any trace of anchors or an anchorage will be revealed in this area since they will have been obscured by the immense volume of sediment that has since been deposited at the present outlet of the River Ceyhan.

The river mouths of the Ceyhan, Seyhan and Tarsus are all exposed to prevailing SW winds, and although shelter is afforded once at anchor in the river mouths, sailors would have to leave these anchorages at night or in the morning and make passage to the west before these winds pick up. Access inland was no doubt possible up the rivers or along the slightly higher ground of the Misis Dağ and therefore this south-westerly region of the Cilician Delta was probably the most likely destination for most merchant vessels, particularly during the Late Bronze Age. On the western reaches of the delta the harbours of Mersin (#67), Kazanli (#68) and Tarsus (#69) provide shelter to vessels. Mariners have to beware of sand banks all along this coast. The prevailing currents are westerly but prevailing SW winds overcome these currents and assist passage to the east.

A direct route from Cyprus to Cilicia is almost impossible when northerly winds blow off the coast of southern Turkey. Vessels could attempt this passage by sailing at close haul to the northerly winds on a port tack as possible (ie up to two points), but were likely to be

blown off course to the east or make very little headway. Bronze Age mariners would have waited for favourable conditions before attempting passage to the northeast.

2.5.ii From Cilicia to Cyprus

A route between the Cilician Delta and Cyprus is directly into prevailing W to SW winds, as Cyprus lies roughly southwest of the Gulf of İskenderun and the Cilician Delta and was therefore impossible to reach directly. Unless N or NE winds were blowing off the delta, in which case passage to the southwest would have been assisted with winds astern, Bronze Age sailors would have had to utilise diurnal winds in order to set a course to the west, into the setting sun, along the southern reaches of the Cilician Delta. Passage to the west would be assisted by the predominant westerly-flowing current, with land on the starboard side of the vessel. Utilising diurnal winds, Bronze Age mariners would then continue southwest along the coast of Rough Cilicia (see this leg in Route 'I'). Eventually, they would set a course to the south, with W winds over the starboard beam, to a point along the north coast of Cyprus. This crossing would have been assisted by offshore land breezes early in the morning, but would have been impossible if prevailing winds were south-westerly. The Karpas and Kyrenia Mountain ranges are occasionally visible from the south coast of Turkey and provide good landfall.

Alternatively, Bronze Age mariners may have wished to follow a route to the south, via the Gulf of Antakya to the northern reaches of the coast of northern Levant. This passage would be undertaken with the prevailing westerlies over the starboard beam. The difficult crossing from the coast of the northern Levant is discussed in Route 'C'.

VI.2.6 Route 'F' : Northern Levant to Cilicia (Fig. VI.2.6)

There is a wealth of evidence for the utilisation of a maritime route along the coast of the northern Levant throughout the Late Bronze Age (see Chapter I). This coastal route also experienced a substantial volume of traffic in the Middle Bronze Age and a number of coastal sites reveal occupation during this period, particularly north of Byblos (#116). However, we have evidence from textual sources for maritime trade between Egypt and Byblos - and further north to Ugarit (#89) - from the late third millennium BC (see Chapter III.1.ii), and therefore anchorages all along this trade route must have been utilised throughout the second millennium BC.

The maritime route along the coast of the northern Levant was utilised as part of the return route from Egypt to Eastern Crete, and is described by Vercoutter (1954: 419,fig.162; Fig. VI.2) as the 'Eastern' or 'Indirect Route'; and 'Route II' by McCaslin (1980: 105,fig.36; Fig. VI.2). It forms one leg in the anticlockwise, long distance trade route around the eastern Mediterranean basin (Bass 1987). Bronze Age mariners undertaking this journey are known to have anchored in a number of sheltered harbours en route, such as Ugarit (#89), Sukas (#97), Beirut (#120), and Tyre (#125). However, Route 'F' was undoubtedly also used by short-haul traders and fishermen, plying up and down the coast of the northern Levant in the Bronze Age,

who invariably made frequent stops to exchange goods and to fish in sheltered bays.

Maritime conditions:

Prevailing winds along the coast of the northern Levant are westerlies, which are particularly pronounced in the afternoon when enhanced by onshore sea breezes and occasionally back south-westerly in the morning and veer north-westerly in the afternoon. These winds die at the end of the day and conditions remain calm until offshore land breezes pick up through the night, dying off again in the early morning. Diurnal breezes assist the passage of vessels in and out of harbours along this coast. In the north, in the area of the İskenderun Gulf, winds back south-westerly. North-easterly winds occasionally blow off the Cilician Delta and easterlies funnel down the valleys along the coast of the northern Levant, both opposing prevailing maritime conditions. The predominant current flows to the north along the coast of the northern Levant and backs to the west along the coast of southern Turkey.

Maritime routes: Route 'F'

2.6.i From Northern Levant to Cilicia

Anchorage along the southern reaches of Route 'F' was invariably sought behind offshore reefs such as Tyre (#125) and Sidon (#122). These intermittent kurkar ridges that run parallel to the coast afford shelter from prevailing

westerlies in their lee. Vessels travelling in a northerly direction along the coast are assisted by the prevailing currents and run with the wind over their port beam. Manoeuvring in and out of anchorages in lee of offshore reefs is assisted with the prevailing wind astern, although mariners have to beware that a number of these reefs are partially submerged and can present a hazard, as well as shelter, to sailors. Mariners would depart anchorages in the night or early in the morning on the dying offshore breeze.

The route up the coast of the northern Levant is bordered by a rocky, cliff-lined coast, particularly in the region of the Lebanon Mountains (see Chapter IV.1). Mariners would therefore have taken advantage of the offshore night breeze and followed a course well offshore, thereby avoiding being swept ashore by prevailing westerlies.

Besides the offshore reefs, anchorage is also afforded in a number of river mouths to the south of Tyre, such as Tell Habeish (#126) and Alexandrion (#127), as well as the extremely well protected deep, N-facing bay to the southwest of Ras esh-Shiq, at Sarafand (#124). Both here, and to the north, in the N-facing anchorages of St. Andrew's and St. George's bays of Beirut (#120), the prevailing winds run parallel to the harbour entrances, facilitating entrance into the harbours with the wind

astern and then on a starboard beam. Sailors would have departed these sheltered anchorages at night or early in the morning on the dying offshore breezes, and kept well offshore, particularly in the region of the Lebanon Mountains, in order to avoid being blown on to a lee shore. The imposing slopes of the Lebanon Mountains present a threat to vessels when W winds prevail, and when gusting offshore winds blow, caused when the wind funnels down the mountain valleys.

To the north, anchorage is afforded in the river mouth of the Nahr el Kelb (#118) and in the southern part of Juneh Bay (#117). One of the most important anchorages along this stretch of coast throughout the second millennium BC, is the harbour of Byblos (#116; Chapter I). The small W-facing bay is protected by crab-like peninsulas which almost enclose the entrance. Again, entrance and exit to the bay of Byblos, was assisted by diurnal breezes. The site is dominated to the east by the towering peaks of the Lebanon Mountains, which provide fresh water to anchorages all along this stretch of the coast.

To the north, Frost's (1973: 79) 'proto-harbour' of Batrun (#115), and the southern shores of Il Huri Bay (Šigata; #114), provide shelter in the lee of projecting headlands. The northern reaches of Il Huri Bay also provides shelter, in the lee of a short promontory, in the anchorage of Enfeh (#113).

At Tripoli, the coast turns to the east, to form the southern reaches of a bay that fronts the low-lying Plain of Akkar. Unless access to the plain or shelter in lee of the headland of El Mina at Tripoli (#111) was sought, mariners would have kept well offshore at this point, as a broken line of reefs and rocky islets, known as Tripoli Roads, extends off the north-western point of El Mina promontory in a northerly direction for 6-7km and presents a hazard to mariners, especially on a lee shore. However, both the anchorage of El Mina and the smaller anchorage of Tell Haned (#110), provide shelter to vessels at anchor, in lee of promontories.

The Plain of Akkar marks the widest tract of level lowland along the coast of the northern Levant and provides a gateway to the interior between the Lebanon Range to the south and the Jebel Ansariyeh to the north. A number of river outlets on the western reaches of Akkar Plain offer shelter to vessels in their mouths. Amongst these, a site at the mouth of the River 'Aqra (#109), in the south, reveals evidence of having been occupied in the Late Bronze Age. On the northern reaches of the plain, the Middle and Late Bronze Age site of Tell Simiriyan (#106) is located upstream of the Abrash estuary. Again, access in and out of these riverine anchorages is assisted by diurnal breezes.

To the north of Akkar Plain, a number of offshore anchorage sites reveal evidence for their use during the

Late Bronze Age. They are Machroud (#104) in the south and Arwad (#102) to the north, and they both appear to have been connected with coastal settlements on the mainland opposite. Of the two, Arwad provides the most sheltered anchorage in two E-facing bays, on the lee side of the island. Frost (1970: 64) states that

> 'Geographically, Arwad is the most important site on the Syro-Lebanese littoral (as) it commands the Homs Gap'.

Now partly submerged, this extremely sheltered anchorage reveals evidence for its rock-cut adaptation in the Bronze Age (#102). Mariners manoeuvring in and out of these anchorages, taking advantage of the diurnal breezes, would have watched out for rock outcrops that lie just below the water level.

To the north of Tartus, the coast of the northern Levant presents a straight, featureless coastline with no sheltered anchorages until sailors reach the broad, open, W-facing bay of Baniyas. A small headland provides shelter in its lee on the south side of the bay and beaching is possible along the sandy shores to the north. The low-lying nature of the coastline may have seemed appealing to Bronze Age mariners but Baniyas Bay is quite exposed to prevailing westerlies and there is no direct evidence to imply the use of this anchorage in the Bronze Age.

The river of Nahr es-Sene (#98), lies to the north of Baniyas Bay, and no doubt provided shelter to Bronze Age

craft in lee of the swampy river mouth. The river outlet is WSW-facing and diurnal breezes were utilised when approaching and leaving the river mouth anchorage.

North of the Nahr es-Sene, Bronze Age mariners would have been approaching a stretch of coastline that traditionally lay within the Ugaritic sphere of influence (Riis 1973: 204; Astour 1970). A number of anchorages along this coast are believed to have been strongly associated with Ugarit in the Late Bronze Age (Astour 1970). The most southerly of these anchorages is the W-facing, anvil-shaped promontory of Tell Sukas (#97). Two sheltered bays provide anchorage to the north and south of the promontory and were used throughout the second millennium BC. Prevailing winds are onshore but shelter on the north side of the south bay and south side of the north bay, is afforded. Mariners would have left this anchorage on the dying night breeze.

The anchorage of Jebeleh (#96) also provided limited shelter to vessels in the Late Bronze Age. The anchorage is approached via a NW-facing, narrow entrance through the coastal sandstone ridge, with prevailing winds astern. North of Jebeleh the river outlets of Nahr er-Rūs (#95) and Nahr el-Kebir (the latter being the largest river outlet along the coast of the northern Levant), were both used as anchorages in the Late Bronze Age. Nahr el-Kebir (#94) allows access inland through the mountains up the Eleutheros valley to Orontes. The coastal littoral here is

quite marshy and it is possible that it has prograded westward somewhat since the Bronze Age. Off-lying rocks present a hazard to sailors approaching these river mouth anchorages. Diurnal winds were utilised in order to enter and depart the river mouths.

The anvil-shaped promontory of Rās Ziaret accommodates the harbour of Latakia (#93). Anchorage is afforded either side of the promontory that provides shelter in its lee. The promontory of Rās Ziaret and the two hills that bound the Late Bronze Age settlement to the east, served as a good landmark for sailors. However, the most protruding and identifiable landmark along this coast lies to the north of Latakia. The headland and distinguished landmark of Rās Ibn Hni accommodates the second millennium BC, particularly the Late Bronze Age, harbour of Rās Ibn Hni (#91). The main harbour lies to the north of the promontory and is approached from the northwest with the wind aft of the starboard beam into the N-facing bay. The broad southern bay, is S-facing and often exposed to prevailing westerlies.

To the north the harbour of Ugarit, Minet el Beida (#89), and its associated smaller anchorage to the west, Minet el Keban (#90), are possibly the most sheltered harbours along the coast of the northern Levant and were certainly used extensively throughout the Bronze Age. At an intersection between land and sea routes, Ugarit is

described by Heltzer (1978) as the 'trade-gate' to Syria, and was a major destination/ departure port of the eastern Mediterranean. The anchorages were approached from the northwest with the wind over the starboard quarter and sailors would have left at night or early in the morning on the dying night breeze.

The flat headland of Rās Fasori (#88) provides a good landmark to the north of Ugarit and was also used as an anchorage in the Late Bronze Age. Shelter is provided in lee of the headland and a small offshore islet, in a N-facing bay. Limited shelter is also provided in the anchorages of Slaiyeb Turkman (#87) and Īsā Begli (#86), which are situated to the north of Rās Fasori. Both anchorages are believed (Astour 1970) to have been utilised in the Late Bronze Age.

The anvil-shaped promontory of Rs el Basit lies to the north and affords shelter on the north side, in its lee. The harbour of Rs el Basit was used throughout the Late Bronze Age and displays a wealth of imported artifacts (#85). The final two anchorages along this stretch of coast which are believed to have been associated with Ugarit (Astour 1970), are the offshore island of Pigeon (#84) and the bay of Kara Duran (#83). Ile Pigeon provides shelter in its lee and is distinguished from seaward because it lies to the west of Mount Anti-Casius. Kara Duran is a NNW-facing bay and is dominated to the east by Mount Casius,

which enabled Bronze Age mariners to recognise this anchorage from seaward. Diurnal winds assisted manoeuvring in and out of these anchorages but Bronze Age sailors would have taken care not to be blown on to the rocky lee shore by prevailing westerlies.

To the north of Kara Duran Bay, passage was made in a northerly direction to the Gulf of Antakya, with prevailing winds over the port beam. The route then continues as described in Route 'E'.

2.6.ii From Cilicia to Northern Levant

The passage from Cilicia southwards along the coast of the northern Levant is undertaken directly into the prevailing northerly-flowing current, which no doubt reduce the vessels' speed. Prevailing winds are from the west, and Bronze Age mariners would make passage to the south with the wind over the starboard beam. Diurnal breezes were utilised to manoeuvre in and out of anchorages. Thus the maritime conditions, route and anchorages utilised are effectively the same as the passage between the northern Levant and Cilicia, except the voyage is made in reverse ie reaching on a starboard beam. (See Route 'E' for a description of the passage between the Orontes River and Cilicia).

## VI.2.7 Route 'G' - Egypt to Southern Levant (Fig. VI.2.7)

Maritime contacts between Egypt and the Levant are known to have been well established from the third millennium BC, following the traditional overland route of the Via Maris, (see Chapter I). From around 2000 BC large scale urbanisation took place along the coast of the southern Levant, particularly in the north, continuing for almost two hundred years (Raban 1987: 174-176, 1989 personal communication). Anchorages along the southern reaches of the southern Levant, such as Tell el-'Ajjul and Ashkelon, appear to have played a more important role in maritime contacts and exchange with Egypt in the Middle Bronze Age. By the second half of the second millennium BC, numerous sites all along the coast of the southern Levant reveal a degree of contact with Egypt, particularly at maritime centres such as Akko, Tell Abu Hawam and Dor. Due to the exposed nature of this coastline and lack of natural anchorages, a number of second millennium BC harbours were located in river mouths and served larger centres located upstream (Raban 1985).

The route between Egypt and the coast of the Levant, forms the first stage in Vercoutter's (1954) 'Eastern' or 'Indirect' Route from Egypt to Crete, is described by McCaslin (1980) as 'Route II', and most importantly, formed part of the overall anticlockwise, circular framework of exchange within the eastern Mediterranean (Fig. VI.2).

Thus, Route 'G' was an important link within the pattern of contacts and exchange of the second millennium BC.

Maritime conditions:

Along the coast of the Nile Delta prevailing winds are north-westerly, a product of the lasting effects of the meltemi and the seasonal Persian Low. In the early morning easterly winds, also associated with the Persian Trough, enhance land breezes, particularly along the coast of the southern Levant. These winds veer to the southwest during the morning. Southerly (hamsin) winds blow off the delta in the spring. The predominant current flows to the east across the mouth of the delta and backs to the north up the coast of the southern Levant. The coast of the southern Levant is exposed to prevailing W winds during the height of the sailing season; however, diurnal winds also blow, particularly during the hot summer months and assist passage in and out of harbours and river mouths. The affects of the hamsin winds blowing off the delta can often produce a SW breeze along the southern reaches of this coastline, enhanced in the early morning by the Persian Low. Thus, maritime conditions combine to assist passage from the southern Nile Delta up the coast of the southern Levant, but movement in the opposite direction is slowed down by the northerly-flowing current and when SW winds prevail (particularly in the morning), opposing headway. However, on continuing a voyage to the north, Bronze Age mariners would be slowed down by the prevailing north-

westerlies and thus, passage from Egypt north to Byblos is believed to have taken twice as long as the return journey from Byblos to Egypt (Ahituv 1970: 320).

It is interesting to note that during the spring and again for a short period in autumn, E winds blow off the coast of the southern Levant. A twelfth-century Muslim traveller wrote concerning the prevailing maritime conditions along this stretch of the coast:

> 'The blowing of the winds in these parts has a singular secret. It is that the east wind does not blow except in spring and autumn, and, save those seasons, no voyages can be made and merchants will not bring their goods to Acre' (Ibn Jubayr, The travels of Ibn Jubayr, trans. R.J.C. Broadhurst (London, 1952), Pp. 326-7, in Pryor 1988: 1).

Although a little extreme to deny the existence of maritime activity along this coast outside of the spring season and a few days in autumn (particularly when considering short-haul passage) it is however, important to note that during the height of the summer sailing season, maritime conditions would have presented Bronze Age mariners with a lee shore. It is therefore advisable for sailors when possible to take advantage of the easterlies in order to assist their passage along this coast and utilise diurnal winds and south-westerlies and north-westerlies (products of the Persian Low) to manoeuvre in and out of harbours.

Passage to the north along the coast of the southern Levant, is undertaken with prevailing westerlies reaching over the port bow. Bronze Age sailors would have kept well

offshore in order to avoid being blown on to a lee shore. Depending on the nature of their voyage, Bronze Age mariners would probably have anchored at maritime centres outlined below, when they needed to take on supplies or to trade.

Maritime Routes: Route 'G'

2.7.i From Egypt to Southern Levant

Sailors leaving the Nile Delta for the southern Levant are mostly likely to have departed via the Pelusiac Branch of the River Nile (see Chapter VI.1.d). Once out at sea sailors were assisted in their passage to the east by the predominant easterly-flowing current. Prevailing winds blow aft of the port beam and sailors have to beware not to be blown on to the sandy shores of the Sinai coast. When the hamsin winds blow off the delta in the spring, passage to the north was assisted with the wind astern. This stretch of the coast is basically harbourless although beaching or shelter behind coastal bars, at sites such as El'Arish (#174), El'Fousiyeh (#175), or Khatib el Kels (#176), may have been possible when necessary. However, fresh water is non-existent and sheltered anchorage scarce and sailors would have to beware not to run aground in the shallows.

Movement up the coast of the southern Levant was assisted by the northerly-flowing current and, when they blow, with the hamsin winds astern. However, prevailing

winds along this coast are westerly, backing south-westerly, so passage up this coast is made with the wind on or slightly aft of the port beam, with movement in and out of harbours assisted by diurnal breezes and winds associated with the Persian Trough.

Only one offshore reef, that of the anchorage of Tel Ridan (#171), offers shelter to vessels along the southern reaches of the coast of the southern Levant, some 150m offshore. A number of Bronze Age type anchors have been recovered from the waters in the lee of the reef at Tel Ridan, suggesting its use in the Bronze Age. Sailors would have taken care not to be blown on to the reef, leaving the anchorage at night or early in the morning on the dying night breeze.

An important harbour along this stretch of the coast is located in the mouth of the River Besor. The harbour, which served the settlement of Tell el-'Ajjul, was a particularly active junction of trade in the Middle Bronze Age when the river mouth is believed to have enclosed a broad estuary that provided shelter to vessels at anchor (#169). To the north, the straight coastline in the vicinity of Gaza and Ashkelon, presents a lee shore to vessels. Despite its exposed location, the site of Ashkelon was an important maritime centre in the Middle, and to a lesser extent, Late Bronze Age, and a silted hollow area has been identified as the Bronze Age harbour, offering a

degree of protection to vessels at anchor (#166).

Mariners would leave their anchorage at Ashkelon on the dying night breeze or with the easterly night wind astern and then head north some distance offshore, with the prevailing winds slightly aft of and then over the port beam. To the north a number of river mouths provide shelter to vessels at anchor. The mouth of the River Evtah is now covered by recent sand dunes obscuring the Bronze Age topography. However, 5km upstream, the fortified settlement of Tell Poran (#165) was an important centre in the Middle Bronze Age, no doubt served by an anchorage at the river mouth. Similarly, Tel Mor, situated at the mouth of the River Lachish, has been identified as serving the predominantly Late Bronze Age site of Ashdod, which is located some 8km upstream (#164). Mariners would have approached the river mouths with W winds astern or slightly over their port bow and left early in the morning on the dying night breeze.

The anchorage of Yavne Yam to the north, is located just to the south of the mouth of the River Soreq. The site, located on the north side of a peninsula, was occupied throughout the second millennium BC and utilised a sheltered anchorage in lee of an offshore reef (#163). A number of Bronze Age stone anchors have been found in the bay. Vessels are thought to have anchored here in order to trans-ship goods to smaller riverine craft so that they

could be transported a few kilometres upriver to the Bronze Age settlement of Tell Mahoz. Sailors are warned to beware of the offshore reef, as onshore winds can blow vessels on to a lee shore (as evidenced by a modern wreck stranded on the reef at this point). Hence, Bronze Age mariners would enter the harbour from the north, with prevailing winds over the starboard bow and leave the harbour of Yavne Yam at night or in the early morning when offshore land breezes blow.

The site of Jaffa (#161) was an important maritime centre throughout the second millennium BC and beyond. Entrance into the coastal, N-facing harbour of Jaffa is facilitated by prevailing westerly or onshore day breezes astern. However, the anchorage of Jaffa is sheltered by a rocky promontory and sailors have to be careful not to be driven on to the rocks. Ibn Jubayr (see above; Pryor 1988: 1) suggests that in fact mariners do not approach this part of the coast except when easterlies prevail during the spring and for a few days in the autumn. An alternative riverine anchorage is also believed to have been utilised during the second millennium BC (#161), which offered a more secure anchorage in a lagoonal basin upstream of the ancient course of the River Ayalon. Mariners would have taken advantage of the offshore land breezes or easterlies, when they blow, to leave the anchorage at Jaffa.

The Yarkon River to the north, is the main drainage

channel of the Sharon Plain, and accommodated a number of second millennium BC anchorages. The sites of Tell Gerisa (#160) and Tell Qasile (#159) are both believed to have been accessible from the sea during the Bronze Age and functioned as trading posts, serving the Late Bronze Age inland settlement of Tell Aphek. The mouth of the River Yarkon, in the vicinity of Tel Aviv (#158), a site which has been occupied since the second millennium BC, is exposed to prevailing westerlies, but is believed to have utilised a riverine embayment in the Bronze Age. The river mouth anchorage provided shelter to vessels and access to the up-river harbours of Tell Gerisa (#160) and Tell Qasile (#159).

Access across the Sharon Plain is also possible to the north of the River Yarkon, in the region of the Middle and Late Bronze Age trading post of Tel Michal. Coring in this area has revealed a natural anchorage for the Middle Bronze Age IIA site of Tel Michal in the previous mouth of the River Gelilot (Herzog et al. 1989: 206; #157). Shelter was also provided in lee of an offshore kurkar ridge. Mariners approaching this river mouth anchorage from the south should avoid being blown on to the reef and would have taken advantage of offshore land breezes when departing. Shelter is also provided in the lee of the offshore reef at Apollonia to the north, where fifteen stone anchors have been recovered supporting the use of this anchorage in the Late Bronze Age (#156).

Marine conditions are believed to have extended as far inland as the now riverine site of Tel Poleg (#155) in the second millennium BC, providing anchorage at the base of the site which is situated on a kurkar ridge. A second ridge system fronts the coastal littoral and is cut by the River Poleg. The river mouth anchorage associated with the settlement of Tell 'Ashir (#154) is believed to have been utilised here in the Bronze Age. The entrance to the river is narrow, and although vessels are safe once at anchor in lee of the reef, Bronze Age mariners must have taken care not to be blown on to a lee shore. It was advisable to approach this anchorage in the spring or late autumn when easterlies prevail, or in the morning when south-westerlies prevail or when the westerlies die down towards the end of the day.

The Late Bronze Age settlement of Tel Mikhmoret to the north, is situated on the northern banks of the outlet of the River Alexander. Anchorage is sought in lee of the coastal kurkar ridge and approached via a narrow rock-cut channel (#153). Bronze Age mariners would have approached this anchorage with caution and not attempted to enter the harbour when westerlies prevailed, if they wanted to avoid being blown on to a lee shore. Passage to the north is made on a port tack and some shelter is provided in the small bay associated with the site of Tell Girth (#152) and in lee of the offshore ridge at Sedot Yam (#150). The Herodian port of Caesarea (#149) lies to the north of Sedot Yam and

is believed to have provided anchorage to vessels in the now silted river mouth or to the south of a short promontory, during the Bronze Age. Only limited shelter is provided by all the above anchorages and vessels would have needed to have taken care when westerlies prevailed.

The river mouth anchorage of Tell Malatt (#147) is thought to have served the upstream site of Tel Mevorakh (#148) throughout the second millennium BC and provided a coastal link at the junction between the Sharon Plain and the coastal Carmel Plain. However, one of the most important harbour sites, particularly during the Late Bronze Age, along this stretch of the coast of the southern Levant is that of Tel Dor (#145). A number of harbours have been identified associated with the site of Dor, thereby providing anchorage to vessels in all weather conditions. The main anchorage lies to the south of the site, in lee of Tantura ridge. A large number of stone anchors have been recovered from the harbour, together with a series of ashlar built quays (#145). Dor is believed to have played an important role in Late Bronze Age trade of the eastern Mediterranean, functioning as an emporium for goods traded along this coast.

A site that increasingly appears to have played an important role in Middle Bronze IIA and Late Bronze Age trade is that of Tel Nami (#144) to the north of Tel Dor. The site reveals evidence for extensive contacts throughout

the eastern Mediterranean and provided a well sheltered estuarine anchorage, possibly in the lee channel of the Me'arot River between an offshore islet (now a promontory) and the shore (#144). Sailors approaching the site from out at sea could identify the location of Tel Nami by a discernable gap in the Carmel Ridge, just inland of the site. The anchorage is somewhat exposed when winds back to the southwest. Mariners would have left the anchorage when the night shore to sea east breeze started and then made passage to the north with prevailing winds over the port quarter and then beam.

The rocky, anvil-shaped promontory of Atlit (#142) still accommodates one of the most secure harbours along the southern Levantine littoral. Vessels approaching from the south with the wind over the port beam can anchor on either side of the headland - the northern one being slightly more protected by a series of offshore rocks which extend to the north off the seaward end of the promontory. A large number of stone anchors have been recovered from the harbour of Atlit confirming the use of this anchorage in the Bronze Age. Mariners would have had to approach both the northern and southern anchorages with caution as rocks lie offshore. Additionally, Late Bronze Age remains have been recovered from the sites of Tel Megadim (#141) and North Atlit (#140) which are situated along the shores of North Atlit Bay. However, the northern reaches of the bay are exposed to prevailing W winds and only temporary

anchorage is recommended.

Haifa Bay, the largest bay along the coast of the southern Levant, lies to the north, and is visible from some distance offshore. Bronze Age vessels could have anchored or beached along the shores of Haifa Bay, and accessed a number of sites situated along the Bronze Age shore of the bay (see Part II). However, the most sheltered anchorages are found on the southern reaches of the bay, in lee of the Carmel Range, at Tell Abu Hawam (#137), and to the north, in the harbour of Akko (#134). Bronze Age mariners could have taken advantage of the shelter afforded in either anchorage, depending on prevailing maritime conditions, utilizing diurnal winds to enter and leave the bay. The harbour of Tell Abu Hawam is believed to have been the main port of entry during the Late Bronze II period, and it was located at a junction between maritime and land routes to the interior. Situated at the mouth of the River Qishon, Tell Abu Hawam also acted as a trans-shipment point between the coast, the up-river anchorage of Tel Regev, and further inland to the Jordan Valley and beyond (#137).

Tell Akko (#134) accommodated a sheltered harbour nestled within the southern extent of the crescent-shaped mound, at the outlet of the Na'aman River, and protected by what was then an offshore island, that is now connected to the mainland and marks the site of the later Medieval city of Acre. Akko played an important role in Late Bronze Age

trade of the eastern Mediterranean, but was exposed to adverse maritime conditions when SW winds prevailed.

To the north of Akko a number of river mouths provided shelter to vessels at anchor, such as the River Sha'al at Achzib (#131). Achzib was occupied throughout the second millennium BC and accommodated substantial shelter in the river mouth anchorage in lee of the tell, with additional protection from offshore reefs. Access in and out of these riverine anchorages was assisted by diurnal winds. The shore from here north to Rosh Haniqra becomes quite steep and mariners would have to beware not to be blown on to a lee shore. The offshore islands of Rosh Haniqra provide shelter to vessels in their lee (#129).

### 2.7.ii From Southern Levant to Egypt

Passage from the southern Levant to Egypt is made with the prevailing winds over the starboard beam and land over the port beam, but against the predominant current that flows to the north along this coast. The voyage is slowed down by opposing currents and considerably hindered when winds back to the southwest. Otherwise, passage from north to south along this coast was undertaken much in the same way as described from south to north, taking advantage of the effects of diurnal winds and winds associated with the Persian Low, to manoeuvre in and out of anchorages, and utilising easterlies when they prevailed in the spring and occasionally during the autumn. However, once Bronze Age

sailors reached the eastern limits of the coast of Egypt, they may have experienced the effects of the hamsin winds that occasionally blow off this southern coast, which would have restricted movement to headway. Passage in a south-westerly direction in this south-eastern corner of the Mediterranean can be severely hindered by opposing maritime conditions, with little shelter available for vessels to secure safe anchorage en route to the Nile Delta. A route well offshore with the southerly winds over the port beam, may have secured a safer passage to the Delta.

VI.2.8 Route 'H' - Cyprus to Egypt (Fig. VI.2.8)

Contacts between Cyprus and Egypt were established by the Middle Bronze Age, c. Middle Cypriot II period (Catling 1975: 44), evidenced by large quantities of Cypriot pottery recovered from the end of this period, at sites such as Tell el-Dab'a (#183) and Memphis (#187). However, it was not until the Late Bronze Age period that trade between the two areas appears to have been conducted on a larger scale, particularly between the Nile Delta and sites along the south coast of Cyprus. Quantities of Egyptian material have been recovered from sites, such as Kition Kathari (#229), Hala Sultan Tekke (#230), Maroni Vournes (#233), Kalavasos Ayios Dhimitrios (#235) and Episkopi Bamboula (#241), in southern Cyprus.

Archaeological evidence for Cypriot goods in Egypt is somewhat less abundant. Despite the fact that almost all the imported pottery at the Late Bronze Age site of Mersa Matruh (#298), located on the coastal littoral of the Libyan desert to the west of the Nile Delta, is of Cypriot origin (Late Cypriot IIA-C), the amount of Cypriot pottery recovered from sites in the Egyptian Delta is rather limited, being restricted to finds of Base Ring juglets, possibly containing opium, that are found in abundance higher up the river. However, the importation of copper ingots, assumed to be Cypriot, is evidenced in a number of Egyptian tomb paintings (see Chapter I) and the dearth of

Cypriot material recovered from sites in Egypt could be explained by the fact that Egypt imported predominantly convertible goods from Cyprus, such as copper ingots, which are not necessarily traceable in the archaeological record. However, textual evidence, particularly references in the 14th century BC Amarna letters (EA 33-40), describe numerous accounts of contacts between Egypt and Cyprus (Georgiou 1979: 96-98).

The 11th century BC account of the journey of Wen-Amon, the Egyptian official of the temple of Amon at Karnak (ANET: 19/25-29), offers substantial evidence for an actual voyage from Egypt, up the coast of the Levant, and eventually, although not necessarily intentionally, to the shores of Cyprus. However, Wen-Amon's query on arrival in Cyprus ("Does any one here speak Egyptian") perhaps suggests that this was not a regular destination point. Although, it does seem that princess Heteb was able to communicate with Wen-Amon, and he eventually returned to Egypt to recount his story, thereby providing an example of the return voyage between Cyprus and Egypt.

Maritime conditions:

Prevailing winds between Cyprus and Egypt are west-northwesterly, backing to the west along the coast of the Nile Delta and along the south coast of Cyprus. Predominant currents also flow to the south-southeast in the west and then back to the east along the coast of Egypt. Southerly

hamsin winds blow off the delta in the spring.

Maritime routes:

2.8.i From Cyprus to Egypt

Bronze Age mariners would have left their anchorages along the south coast of Cyprus at night or early in the morning assisted by offshore land breezes. The Nile Delta lies 400km to the south to southwest of Cyprus and sailors would set a course well to the southwest with NW prevailing winds slightly forward of the starboard beam, in order to make track to Egypt. By heading as close to the prevailing winds as possible Bronze Age mariners would thereby compensate for the effects of drift down wind which would cause their vessels to be blown towards the east.

The route between Cyprus and Egypt was undertaken out of the sight of land and there is no obvious landfall point along the coastal reaches of the Nile Delta, therefore, sailors would have to have previous experience of these waters in order to approach the desired branch of the Nile River. Sailors were, however, able to recognise the approaches of the delta by the large sediment discharge which discolours the coastal waters of the Egyptian coast for some distance offshore, or by using sounding poles or leads to determine the depth of water (see Chapter II.3).

Predominant winds and currents therefore favour

movement from Cyprus to the south. However, passage west to the harbour of Mersa Matruh is also possible as mariners would be sailing with the wind on their starboard beam. Thus, it is possible that Cypriot material recovered from this site was transported directly from Cyprus, or alternatively arrived via Crete.

2.8.ii From Egypt to Cyprus

A direct route from the Egyptian Delta to Cyprus is not quite as straightforward as that in the other direction. Depending on the point of departure from the Egyptian Delta, sailors were faced with a passage that required movement of sometimes more than two points into the prevailing wind.

Departure from the western reaches of the Nile Delta (ie the Rosetta branch) to Cyprus was more feasible, as a passage is made on a port beam across the prevailing NW winds. A more westerly departure point, such as Mersa Matruh (#198), would also have been feasible, again with the wind on the beam. However, if mariners were departing from the eastern reaches of the Nile Delta (ie the Pelusaic branch) they would undertake a track along the Sinai coast and up the coast of the Levant (see this leg in Route 'G'), as taken by Wen-Amon in the 11th century BC. It was impossible for Bronze Age mariners to sail from the eastern reaches of the delta directly to Cyprus, as it involved sailing more than two points into the prevailing winds.

The route via the Levantine coast was assisted by southerly hamsin winds when they blow and winds associated with the Persian Low, and passage from the Levant to Cyprus was aided by easterlies that blow off the coast of the southern Levant in the spring and autumn, and by SW winds associated with the Persian Low that blow in the morning. This route had additional advantages in that mariners were always in sight of land and were able to stop en route for shelter, supplies or to trade, if they desired.

## VI.2.9 Route 'I' : Cilicia - south Turkish coast - Rhodes (Fig. VI.2.9)

There is no doubt that passage along the southern coast of Turkey was frequently undertaken by vessels in the Bronze Age. It formed part of the overall anticlockwise circular route which provided the main framework of exchange within the eastern Mediterranean. Vercoutter described a similar 'Eastern Route' (1954: 419,fig.162; also called the 'Indirect' route) which he envisaged sailors taking on the return voyage from Egypt to Crete. Route 'I' was also a route undertaken between Crete and Cyprus; described as a return route ('Route B') by Mantzourani & Theodorou (1991: 49-50,fig.9) and (Route II) by McCaslin (1980: 105,fig.36; Fig. VI.2). Route 'I' not only served to provide a return route from east to west but was also used by traffic voyaging from the west, and over short-haul distances along the coast of southern Turkey.

Although no major Bronze Age harbour sites have as yet been identified along the southern coast of Turkey other than in the region of the Cilician Delta, it does afford a number of sheltered anchorages and stop-over points for vessels to rest and take on water when necessary. Evidence exists at a number of coastal sites for contacts with the eastern Mediterranean. This is particularly true of the area of the Cilician Delta and for the period of the Late Bronze Age. The only two Bronze Age shipwrecks to have been

investigated in the eastern Mediterranean are found off the coast of southern Anatolia, at notorious danger points where the vessels would have rounded headlands.

Maritime conditions:

The prevailing winds along the south coast of Turkey during the summer sailing season, particularly in the western part of the region, are the W meltemi winds, which would have assisted passage from west to east. Diurnal breezes also persist along this coast, predominantly in the east. North winds occasionally blow off the Anatolian Plateau and the coast of southern Turkey. When used in combination with the Mediterranean current that flows in a westerly direction from Syria to Rhodes, these winds can assist passage to the west. As Admiral Sir Francis Beaufort (1818 :39) remarked, the westerly-flowing current is particularly noticeable inshore, following the contours of the coast, but not noticed so much further out to sea. All of these maritime conditions no doubt assisted passage in both directions along the south coast of Turkey.

Maritime routes: Route 'I'

2.9.i From east to west along the south Turkish coast

Bronze Age mariners voyaging from east to west along the coast of south Turkey, would have done so with land on their starboard side and sailing into the setting sun. The Cilician Delta acted as a junction point for Bronze Age

traffic of the eastern Mediterranean. A number of anchorages have been identified along this stretch of the coast, notably Tarsus (#69) and Mersin (#67), which served as outlet nodes for the Hittite lands to the north. Departure from both of these harbours is facilitated by offshore land breezes that prevail during the night and in the early morning, which, when combined with the westerly-flowing surface current, also assisted passage to the west with the N wind over the starboard beam.

During the height of the summer sailing season, diurnal winds are most pronounced. Sea breezes blow in the afternoon and when combined with prevailing westerlies, SSW winds blow directly into the track of vessels that voyaged to the west. Sailors made headway to the southwest by taking advantage of the offshore land breezes and the predominant westerly-flowing surface currents, sheltering or beaching their craft at anchorages such as Soli (#66), Ayas (#73), Kizkalesi (#63) or Narli Ky (#62), en route, when opposing winds were too strong. These anchorages were best approached later in the day when the prevailing winds ran parallel to or slightly onshore. Ayas, Susanoğlu (prior to silting), and Narli Ky in particular, offer shelter to vessels at anchor during the day. Sailors would have left these anchorages at night or in the early morning while offshore land breezes prevailed.

The best time to make passage along the coast of south

Turkey was in the autumn when temperatures were not as extreme and the effects of the meltemi winds reduced. Otherwise passage to the west was made in a series of short stages.

The Silifke delta appears to have been a local trade station along this route. Approached via the Gksu River across the marshy delta, it is probable that during the Bronze Age the coast was much closer to present-day Silifke (see Ch.IV.2) and its Bronze Age predecessor (#59), which were possibly served by the then coastal site of Hdde (#60), or by a riverine anchorage on the south-western side of the delta. Hence goods may have been transferred to riverine craft and transported up-river. Advantage could be taken of diurnal breezes when entering and leaving the delta estuary. Ağalimani (#57), on the eastern shores of Taşucu Gulf, provides ample shelter either side of a peninsula which could have been used for vessels to anchor in while waiting for favourable conditions to approach the delta or transfer goods.

Bronze Age mariners would have left the anchorage of Ağalimani early in the morning on the dying night breeze, in order to continue their passage to the southeast. Shelter was provided in lee of the anvil-shaped promontory of Aphrodisias (#56; whether it was then an island, an isthmus or in a lagoon), especially if sailors were forced to stop and wait for favourable conditions.

Passage to the west from Aphrodisias was preferably undertaken during the night or early in the morning with the wind on the starboard beam and the current flowing to the west. A number of headlands and anchorages provide shelter along this stretch of the coast and fresh water streams flow down to the shores. Aydinick (#53), Soğuksu Liman (#52) and Bozyazi (#50) offer extremely sheltered anchorage. However, Bronze Age sailors would have to watch out for oncoming westerlies in the summer which can drive vessels ashore, and strong breezes that blow off the mountains in the autumn. This is a treacherous stretch of coast to a mariner who is not familiar with the conditions!

Anamur Burun (#49) is the most southerly point along the south Turkish coast and of prominent importance as the landfall from Cyprus. It has played a significant role as a road station and harbour throughout antiquity and offers relatively easy access through the Taurus Mountain Range. It is in the region of Anamur Burun that sailors from Cyprus no doubt made landfall. The anchorage offers shelter from prevailing SW winds and onshore sea breezes. Sailors would have departed at night or early in the morning on the dying night breeze.

Passage to the northwest was assisted by offshore land breezes in the early part of the day. When afternoon sea breezes prevailed a course was made with the wind on the port beam, heading into the setting sun. Diurnal breezes

assist entering and departing anchorages such as Kalidiran (#47) and Antiochia (#46) along this stretch of the coast. Many of these anchorages may have acted as stop-over points to take on water when necessary. However, sailors must beware of the afternoon swell that is often experienced in the anchorages of Karataş (#48) and Gazipaşa (#45).

Alanya (#43) is another prominent landfall along the coast, providing shelter to vessels in its lee. It marks the point between Rough Cilicia and the low-lying coastline of the Pamphylian Plain to the west. Between Alanya and Antalya the prevailing winds are onshore and limited shelter is provided for vessels, with exception of the anvil-shaped promontory of Fığla Burun (#42) and possibly Side (#39). The effects of offshore breezes and westerly-flowing currents assisted passage to the west along this stretch of coast.

Despite the fact that prevailing winds are onshore during much of the day and gusts blow down off the plain from the north at night, Antalya (#37) seems to have been an important anchorage, with access inland and shelter from W winds. The anchorage was approached from the south with prevailing winds astern. Sailors would leave early in the morning on the dying night breeze.

Passage to the south down the west side of the Gulf of Antalya was assisted by the dying night breeze astern and

the prevailing southerly current, keeping sight of land over the starboard beam. A number of anchorages along this stretch of coast provided shelter to vessels, particularly if the boats got caught on a lee shore when the sea breeze picked up. These include Kemer (#36), ineviz Liman (#33) and, most importantly, the extremely sheltered anvil-shaped promontory of Phaselis (#35), where fresh water is also available. avus Liman (#32) may have acted as an anchorage where shelter was sought while awaiting favourable conditions to round Cape Gelidonya, as the prevailing south-westerly currents and winds can be especially forceful around this headland. No doubt the Late Bronze Age wreck at Cape Gelidonya foundered while trying to round the cape. Fresh water is available at this point.

Once having rounded Cape Gelidonya, passage to the west was hampered, particularly in late summer during the latter part of the day, by the prevailing meltemi winds. Sailors would have to set sail at night or early in the morning when prevailing winds were light. The Bay of Finike offers shelter to vessels in lee of Gvercin Adasi (#29), in the riverine anchorage of Limyra (#30) and in the Bay of Karaz (#31). Access into these anchorages was assisted by onshore sea breezes astern which blow in the latter part of the day. Sailors would have departed on the dying night breeze.

As Bronze Age sailors proceeded on their course to the

west, the effects of the prevailing westerly meltemi winds became more pronounced. However, a number of sheltered anchorages exist along this stretch of the coast. These include the river mouth harbour of Myra (#27), in lee of the island of Ashil (Gkkaya Liman) (#26) and the anchorages in the vicinity of Kekova Roads. Kekova Roads can be approached from the east and the west depending on the prevailing conditions, although small islands at the western end can make navigation into the straights hazardous. Once vessels were in lee of the island of Kekova, sheltered anchorage was assured (see Part II).

Ulu Burun presents the next obstacle en route to the west, as the fated Late Bronze Age shipwreck at this point reminds us. Unless a course towards Kaş harbour was desired then sailors would have kept offshore at this point. Entering Kaş (#16) was preferable in the late afternoon when onshore sea breezes blow, with winds slightly aft of the port beam, taking care not to be blown ashore by the prevailing meltemi winds. Departure would have been undertaken early in the morning on the dying offshore land breeze.

To the west, some shelter is provided in the anchorage of Kalkan (#14) and presumably Patara (#13), prior to silting. Continued passage to the northwest, towards to the Bay of Fethiye, was undertaken in the early morning when prevailing W winds were not as pronounced. Again sailors

have to beware not to be blown ashore by the afternoon sea breezes. Limited shelter is provided along this stretch of coast and those sailors attempting a direct passage to the west would have to keep well offshore, as conditions are particularly hazardous.

Entrance into the Bay of Fethiye was assisted by prevailing winds which blow up into the gulf, watching out for gusting winds which funnel down from the mountains to the north. The anchorage of Fethiye (#10), on the south-eastern side of the gulf, provides a perfectly sheltered, almost enclosed, anchorage. Anchorage on the west side of the gulf is also possible in lee of the islands of Tersane (#06) and Domuz and the promontory of Kapu Dağ (#05). Sailors would have departed from the gulf during the night or early in the morning on the dying night breeze.

Beyond Fethiye Bay sailors would have kept well away from the shore, as between Dişblimez Burun and the low-lying embayment anchorage of Caunos, swell reflects off the steep coast when the meltemi winds blow. In the Bronze Age, prior to silting in the river mouth, entrance into the anchorage of Caunos (#03) was undertaken late in the afternoon when the meltemi had died down, leaving again in the early morning. Passage to Rhodes was assisted by the prevailing current, avoiding periods when the meltemi wind was especially strong.

2.9.ii From west to east

Passage from west to east along the south Turkish coast was assisted by prevailing meltemi winds astern, and Bronze Age mariners would be sailing into the rising sun, taking advantage of diurnal winds when wishing to enter and leave harbours. Beyond Cape Gelidonya, passage was made with the predominant south-westerly summer wind on the starboard quarter. However, caution was no doubt practised in order not to be blown ashore, particularly in the latter part of the afternoon when the effects of the meltemi are heightened by the onshore sea breeze. Diurnal breezes were utilised when entering and leaving harbours.

Chapter VII

## Conclusions: What did a Bronze Age harbour look like?

> 'Anyone who attempts to classify the trade routes on a rational basis should dwell, not on the details of the track, nor on considerations of place or situation, but on the importance and nature of the traffic which feeds the route... To consider only the itinerary of these routes, as if that itinerary showed the reason for their existence, would be (to take an obvious comparison) as absurd as to classify ports according to their geographical position. To distinguish the coastal ports from the river ports, and to divide the former into ports situated on estuaries and terminal ports situated at the navigable limits of a river, is in our opinion much the same as making a psychological study of the members of a family from their descriptions on a passport' (Febvre 1932: 325).

Despite Lucien Febvre's prejudice against classification, the comparative study of anchorages is an essential step in understanding maritime trade - especially in its earliest phases before the construction of elaborate artificial harbours. Sailors have always found the need for a periplus, such as that of *Pseudo Scylax*, c. 500 BC (see Ch.III.1.ii), or the more recent 16th century AD *Book Bahriye*, a guide to the Aegean and the Mediterranean by the Turkish Admiral Pirî Reis (Afetinan 1975), that portrays detailed plans of numerous anchorages and their aspects in relation to the wind-rose. Indeed, the *Portolan* maps of the Renaissance were named after the *portolano* - the navigator who guided sailors into an unfamiliar port. This thesis is an attempt to reconstruct what a Bronze Age 'navigation' or 'sailor's guide' would have described, and has outlined the

importance of a systematic survey of the available material relating to second millennium BC anchorage and harbour sites of the eastern Mediterranean. Through an interdisciplinary analysis of their location, function and relation to trade and through an appreciation of the coastal topography and palaeogeography of the region, a greater understanding of the subject has been sought.

Although Bronze Age harbours of the eastern Mediterranean did not take on the monumental proportions of later Classical ports, their existence is unquestionable, and they can be inferred as much from direct evidence in the archaeological record as from their logical necessity in light of the extensive evidence for maritime trade and exchange which developed throughout the second millennium BC. Bronze Age harbours took many forms and performed many different functions; the maritime-orientated patterns of settlement in coastal areas of the eastern Mediterranean confirms the essential role that harbours and anchorages played within the developing economy and network of trade, contact and exchange of the second millennium BC. Maritime activity, on whatever scale, demanded havens, anchorages and harbours; and sheltered bodies of water everywhere were used in this way around the shores of the eastern Mediterranean during the second millennium BC. The pictorial representations of boats from Bronze Age contexts demonstrate the kinds of vessels which would have required harbours (Ch.II.1). Contemporary texts refer to contact and

exchange which involved the trans-shipment of quantities of materials between harbours (Ch.III.1.ii). The amounts of imported material recovered from coastal contexts also give direct evidence for maritime traffic, and thus imply the need for anchorages. The gazetteer (Part II/ Appendix I) describes a whole range of anchorage-points and facilities, from emporia such as Ugarit (#89), Kition *Kathari* (#229) and Dor (#145), where warehouses, quays and waterfront structures provide direct evidence for the existence of harbours, to lagoons, river mouths, naturally sheltered bays and anchorages in the lee of promontories, which must have been used in order to sustain traffic on known routes of maritime trade.

PHYSICAL DETERMINANTS OF HARBOUR LOCATION

Prior to the construction of large-scale harbour installations, Bronze Age mariners exploited the natural topography, mooring vessels in calm bodies of water sheltered from adverse maritime conditions, wherever necessary and possible. The majority of Bronze Age harbours, like their modern-day equivalents, were selected as havens or harbours because of their natural features. A contrast is drawn between the nature of anchorages located on low-lying coastlines and those situated on cliff-lined coasts (see Ch.IV.1.b). Accordingly, a topographical typology of second millennium anchorages of the eastern Mediterranean is set out in Chapter IV.1.b and indicated on distribution maps (Fig. VII.1.i-xi) which relate to Table

2 below.

Not surprisingly over one quarter of the sites analysed were situated in naturally sheltered bays, predominantly located along cliff-lined coasts (Fig. VII.1.ii). A smaller number of anchorages were associated with other topographical features normally connected with cliff-lined coasts, such as anchorages in the lee of promontories (Fig. VII.1.iii), anvil-shaped headlands (Fig. VII.1.iv) or anchorages in sheltered valleys or inlets (Fig. VII.1.v). Southern Turkey represents a coastline whose predominant topographically defined types of anchorage are those associated with cliff-lined coasts, as described above; while Cyprus has a large number of anchorages in the lee of promontories, since here the prevailing winds run parallel to the shore and anchorages were sheltered by protective spits of land. By comparison, along the coasts of Eastern Crete and Lycian Turkey, there are a greater number of anchorages in sheltered valleys, or inlets created by rivers along rocky coastlines. Other features often associated with cliff-lined coasts are offshore islands. The distribution of island anchorages outlined in Fig. VIII.1.vi largely relates to cliff-lined coasts, with the greatest number being along the coasts of Lycian Turkey and Eastern Crete. Two exceptions are noted, the island anchorages of Arwad (#102) and Machroud (#104), that are associated with the northern reaches of the Levantine offshore kurkar ridge system (see Ch.IV). The

southern reaches of this offshore reef system, the southern Levant, housed the greatest number of second millennium mainland anchorages protected by offshore ridges (Fig. VII.1.vii).

Mainland anchorages protected by offshore islands and reefs are commonly located along low-lying stretches of the coast of the eastern Mediterranean. Anchorages associated with the offshore reef system of the southern Levant demonstrate how Bronze Age mariners were able to take advantage of the limited natural protection afforded along a stretch of straight-line, low-lying coast that was invariably exposed to adverse maritime conditions. Similarly, the distribution of anchorage sites associated with river mouths is concentrated along the coast of the southern Levant, indicating an alternative means by which Bronze Age mariners were able to secure safe haven along an otherwise exposed stretch of coast. River mouths and river embayments were commonly used all around the shores of the eastern Mediterranean during the Bronze Age, as havens, and made up almost one fifth of all the topographically defined anchorage types (Fig. VII.1.viii).

The last three categories of anchorage types analysed in the topographical typology are all associated with low-lying coastlines, particularly areas which, since the second millennium, have silted up due to alluvial accumulation. Thus, riverine (Fig. VII.1.ix), deltaic (Fig.

VII.1.x) and lagoonal (Fig. VII.1.xi) anchorages appear in greatest numbers on the Egyptian, Cilician and Silifke deltas, with a number of specifically riverine and lagoonal anchorages located along the shores of the southern Levant and on the edges of low-lying alluvial plains in Cyprus.

However, there are stretches of the coast, such as the southern Levant, where Bronze Age mariners were not only limited by the available topography in their selection of sheltered anchorages but were also restricted by adverse maritime conditions. Chapter IV.3 outlines three basic coastal aspects in relation to the direction of the prevailing wind (McKee Types (1), (2)/(3) and (4) shorelines (see Fig. IV.33), and describes the shores around the eastern Mediterranean in relation to the McKee Type aspects of their associated anchorage sites. Each second millennium anchorage has been awarded a McKee Type description based upon the aspect of the anchorage in relation to the prevailing wind (Part II; Fig. VII.2.i-iii; Table 3).

McKee Type (1) anchorage sites are located on lee shores and essentially relate to coastlines directly exposed to prevailing winds. In the context of the eastern Mediterranean, McKee Type (1) anchorages generally correspond to W-facing coasts exposed to westerly winds (see Ch.III.3) and the majority are located along the Levantine coast, western Cyprus and along the eastern

reaches of the south coast of Turkey which is exposed to south-westerly winds (Fig. VII.2.i). An analysis of the distribution of McKee Type (2)/(3) anchorages, which correspond to those shorelines exposed to parallel winds, reveals that they are essentially located on north- and south-facing coasts of the eastern Mediterranean, such as southern Crete, the north and south coasts of Cyprus and a number of sites scattered along the coast of southern Turkey (Fig. VII.2.ii). Thus the distribution of McKee Type (1) and (2)/(3) anchorages conform to the expected distribution of sites located on the predominantly north-, south- and west-facing coasts of the eastern Mediterranean, that are essentially affected by prevailing westerly winds.

Since McKee Type (4) anchorages are, by definition, located with their backs to the prevailing wind, one might not expect a great number of McKee Type (4) anchorages to exist in the eastern Mediterranean where prevailing winds are essentially westerly and east-facing coastlines are negligible. However, almost half of the anchorages analysed were located on McKee Type (4) shorelines (Fig. VII.2.iii). McKee Type (4) shores afford the most sheltered anchorage of the shorelines described by McKee (see Ch.IV.3), and thus Bronze Age mariners would seek out such anchorages in order to secure maximum shelter for their vessels along the essentially exposed shores of the eastern Mediterranean. They also adapted offshore reefs, and made use of natural

bays and river mouths, promontories and islands as havens, always attempting to moor in an anchorage that lay, as it were, with its back to the prevailing wind. On comparing the number of McKee Type (4) anchorages utilised in the Middle Bronze Age (Fig. VI.3.i) to those used in the Late Bronze Age (Fig. VI.3.ii), it appears that the ability of Bronze Age mariners to secure McKee Type (4) anchorages along essentially exposed shores improved during the second millennium BC in response to increased demand.

## THE INCREASING ABILITY OF BRONZE AGE MARINERS TO ADAPT THE COASTAL INTERFACE: THE USE OF ASHLAR MASONRY QUAYS

Prevailing maritime conditions are thus an important factor when assessing the location of Bronze Age anchorages around the shores of the eastern Mediterranean. However, by the same token, the distribution of McKee Type (4) anchorages, often located along exposed lee shores with little natural protection, also reflects the ability of Bronze Age mariners to overcome adverse maritime conditions and make the most of available natural resources. Over time, Bronze Age mariners learnt to enhance anchorages, particularly those located along exposed coastlines, such as the southern Levant, to secure protected moorings for their vessels, by a number of different means (as demonstrated in Part II and Chapter III).

From as early as the Middle Bronze Age (Raban 1985,1987) mariners constructed retaining walls (dams) and

de-silting channels, particularly at river mouth anchorages that were prone to silting, such as Achzib (#131), Tel Mevorakh (#148), Misrefot-Yam (#130) and Tel Poleg (#155) along the coast of the southern Levant, in order to obtain safe anchorage (Ch.III.2.ii). By the Late Bronze Age, mariners had developed the skills to adapt offshore reefs, at sites such as Arwad (#102) and Sidon (#122), by creating rock-cut installations, that provided additional shelter in their lee (Ch.III.2.ii).

These adaptations, although not necessarily the most efficient means of securing havens, allowed mariners to utilise coasts which otherwise afforded little natural shelter and which would previously have been used at considerable risk. Thus, Bronze Age mariners were able to enhance the potential of McKee Type (4) anchorages located along lee shorelines, as well as adapt exposed low-lying coastlines, to secure sheltered anchorage. Conversely, during the Bronze Age, artificial techniques are notably absent along more naturally sheltered stretches of the coast, such as southern Turkey, where there was no need to adapt the coastline. Natural harbours and those less-sheltered harbours adapted by rock-cut means (see Fig. III.9) are referred to by Frost (1980: 1) as 'proto-harbours'. Proto-harbours antedate the discovery of how to build directly on the sea floor (see Ch.III.2.ii) and can be of vast size, as their extent was dictated by natural features (Frost 1980: 1).

The dating of rock-cut installations is discussed in Chapter III.3 and it would appear that some means of adapting and securing anchorages through artificial means was possible throughout the second millennium BC, especially along the coast of the Levant. The rock-cut channels identified along the coast of the southern Levant from the Middle Bronze Age (see above & Part II), provide early evidence that the technology to cut rock, specifically in marine locations, already existed. During the second millennium, mariners improved these skills, no doubt adopting similar techniques from craftsmen working in a non-marine context, in order to adapt and develop the coastal interface to suit their requirements. The increased volume of maritime activity also heightened the demand for secure anchorages. The combination of these factors gave rise to the development of free-standing, ashlar-built, stone structures in a maritime context by the end of the Bronze Age.

The use of ashlar masonry for non-maritime purposes is attested in Egyptian sanctuaries and tombs by the beginning of the third millennium BC, and in the northern Levant since at least the middle of the third millennium (Hult 1983: 61). It is possible that Egyptian influences contributed to the development and use of ashlar masonry in the northern Levant as maritime communications between Egypt and this region, particularly with Byblos, were well established during this early period (Ch.I). Ashlar masonry

was widely used in Crete by the second millennium, as represented in the context of the Minoan palaces (Hult 1983: 44-52; Cadogan 1976). However, it was not until the 14th century BC that the first known ashlar quays were constructed in an Egyptian riverine context at Birket Habu, Thebes (see Ch.III), although prior to this period many Bronze Age quay systems were depicted in Egyptian tomb paintings of Nilotic scenes (Kemp & O'Connor 1974; Goyon 1971; Raban 1991; Marcus 1990; see Chapter III). However, ashlar masonry has not yet been found in use in a maritime context anywhere in the eastern Mediterranean prior to the end of the Late Bronze Age.

Dating from the beginning of the Late Bronze Age, the first pictorial representation of what has been described as ashlar masonry in use in a maritime context, has been identified in the Miniature Fresco from Room 5 in the West House at Akrotiri (Morgan 1988: 121-143). A built quay is depicted at the waterfront in the 'Arrival' town (Shaw's third town (1990: 432) on the south wall of Room 5 (see Chapter III.1.ii.b; Fig. III.2.ii/.3). In support of this interpretation potential harbour installations, from the same period, have been indentified at a number of sites in Crete; an artificial basin for the mooring of sea-going vessels has been recognised by Raban (1991: 140) at Malia (#268); and what have been described as stone-built ship-sheds have been discovered at Kommos (#308) and Nirou Khani (#266; Shaw 1990). Although there is an important

technological difference between the use of ashlar masonry in a non-maritime context, and the utilisation of ashlar masonry in a free-standing context on the sea floor (the construction of quays[1]) these innovations suggest that it was in Crete that ashlar masonry was first used in a maritime context.

Although Crete does appear to have a claim for the earliest known use of ashlar structures in a maritime context, there is also an argument for their first use in the Levant. One of the most important sites that displays the use of ashlar masonry, firstly on the land, and later in a maritime context, is Ugarit (#89). From the end of the Middle Bronze Age ashlar masonry was used in the construction of the North Palace and in the Late Bronze Age in the construction of the Royal and South Palaces (Hult 1983: 22-23). It was not until the 13th century BC that ashlar masonry is seen in use at *Minet el-Beidha*, the harbour of Ugarit, where there are at least two long walls of ashlar 'headers' (see Ch.III.2.ii; #89) exposed on land not far from the present water-line and in the same context as the 13th century harbour magazines (Raban 1991: 142). This implies a progression from the use of ashlar masonry in a non-marine to marine context.

There is a possibility that rock-cut quays were

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[1] See Ch.III.2.ii for a discussion of the problems associated with free-standing structures in a maritime context.

constructed in the Late Bronze Age at sites along the Levantine coast, such as Sidon (#122) and Tyre (#125), and later re-used, thus obscuring the earlier installations (Frost 1973). While at Kition *Kathari* two 13th century BC ashlar-built structures, identified by Karageorghis (1976: 53-4,60-1) as defensive 'bastion' walls, have been interpreted by Raban (1983: 238-41, 1988b: 281, 1991: 143; Fig. #229.3) as free-standing ashlar quays associated with the first harbour at Kition (#229). Finally, the use of ashlar blocks in a maritime context is noted at Dor (#145). A series of at least three successive quays that have been studied, dating from the 13th through to the 11th centuries BC (Raban 1983; Fig. #145.7-.9; Chapter III).

## SOCIO-GEOGRAPHICAL DETERMINANTS OF ANCHORAGE SITE LOCATION

Thus, over the period of the second millennium BC, mariners enhanced the means to secure safe havens by overcoming, to a certain extent, the problems of geomorphological and sea-level change and adverse maritime conditions along exposed coastal zones. However, the selective criteria for the location of harbours were not merely restricted to physical considerations (the configuration of the coastline, currents, winds (see Ch.IV), but were also a result of socio-geographic factors (the location of the harbour in relation to routes of trade and political centres and the commercial success of the harbour). As Raban (1991: 145) puts it:

> 'the soaring demand for maritime facilities [...], instigated by the rapid urbanism of the

> Levantine coast and the palatial economy of Crete, ... brought about the new type of estuarine harbours, the extensive artificial remodification of coastal topography and the introduction of stone blocks quays in Crete and in the Levant'.

Thus, mariners responded to changes in both the physical and political (socio-geographic) environment. Advancing technological achievements in shipbuilding design resulted in the introduction of larger vessels (see Ch.II.2.iii), while the demands of swelling volumes of traffic required additional shelter and brought about changes in the nature of Bronze Age maritime activity. The scale of the economy expanded along with the number of players and the types and specialisations of trade and exchange (see Chapter V.2). Maritime mercantile activities formed the focus of the Late Bronze Age economy in the eastern Mediterranean, and harbours, as coastal interfaces, provided the venues for these activities. Thus, harbours and anchorages increased in number over the period of the second millennium, and it is likely that by the latter part of this period, socio-geographic factors out-weighed physical factors as the major determinant of harbour location (Karmon 1985: 1), particularly along important routes of contact within the pattern of eastern Mediterranean trade.

## THE EXPANDING NATURE OF BRONZE AGE TRADE NETWORKS

We may thus begin to comprehend why it was necessary to enhance the protection afforded by Bronze Age harbours, and hence to address the reasons for their growth in number, particularly in certain coastal regions of the

eastern Mediterranean, during the second millennium BC. Over this period the nature of Bronze Age voyaging evolved from the relatively small-scale, short-distance contacts undertaken at the end of the third millennium BC, until the Late Bronze Age when maritime transport became the primary means of contact and exchange around the eastern Mediterranean (Ch.II.2.ii). Open-sea voyages were conducted freely and coastal pilotage expanded not only to supply short-distance redistributive systems, with mariners stopping at numerous harbours en route, but also to support inter-regional and long-distance networks of exchange. Shipbuilding techniques and rigging also developed over the period and the capabilities of Bronze Age mariners improved. By the end of the period sailors were able to sail their vessels up to 6 points (c. 68 degrees) off the wind: ie they could make 2 points (c. 22 degrees) to windward (not including leeway; see Chapter II.2.i), thereby undertaking voyages that had been difficult at the beginning of the period when they did not yet have this windward ability.

This capacity, which developed to meet the growing volume of trade, made possible the use of more direct routes. Chapter VI illustrates how throughout the second millennium BC trade was primarily conducted in the north-eastern region of the Mediterranean, with movement between Egypt, the Levant and inland centres to the east. Ugarit (#89) was particularly important within this network of

maritime exchange, as it was centrally situated and acted as a link between the eastern Mediterranean via routes inland, such as the Nahr el Kelb and the Orontes rivers, and the east (Ch.VI.1.b). Over the course of the Late Bronze Age Ugarit became the most important harbour site in the north-eastern Mediterranean, replacing Byblos (#116) as the major anchorage along the Levantine maritime trade route. A number of subsidiary anchorages, such as the natural anchorage at Ràs el Basit (#85), the landfall site of Rās Ibn Hàni (#91) and the harbours of Latakia (#93) and Tell Sukas (#97), have been identified as being under the Ugaritic sphere of influence (Astour 1970), and expanded over the course of the Late Bronze Age in response to the increased demands of trade.

With the rise of the Hittite Empire at the beginning of the Late Bronze Age, the role played by the Cilician Delta became increasingly prominent within the network of trade. During this period the area of the Cilician Delta, the Orontes and Ugarit came under the Hittite sphere of influence (see Chapter I). At the beginning of the 12th century BC the Hittite ruler Muwatallis moved his capital from Hattuša, south, to the region of the Cilician Delta (Redford 1992: 183). There is increasing documentary (CH.III.1.ii) and archaeological evidence for the expansion of sites on the Cilician Delta which potentially served as anchorages supporting inland routes of trade between the eastern Mediterranean and the Anatolian Plateau to the

north (Seton Williams 1954: 127-28). Sites such as Tarsus (#69) and Mersin (#67) which had been established in the Middle Bronze Age, grew in response to increased demands by the Hittite Empire for inlets of imported goods. In addition to the previously established harbour-towns a number of sites such as Kazanli (#68), Domuz Tepe (#72), Soyali (#74), and in particular the as yet still unidentified Hittite site of Ura referred to in Late Bronze Age texts from Ugarit (see Ch.III.1.i), were settled. These could have been utilised as anchorages serving the riverine movement of goods across the Cilician Delta in the Late Bronze Age. During this period, with the reduction in the rate of sea-level rise and the onset of deltaic progradation, conditions on the delta were relatively stable and the river courses were more navigable for movement inland.

Over this period patterns of trade and exchange expanded, encompassing links along the south coast of Turkey, via Rhodes to Crete, and particularly with Cyprus. During the Middle Bronze Age anchorages along the north coast of Cyprus acted as 'stop-over' points along the route between the Levant and Crete. However, over the period of the second millennium BC Cyprus underwent social and economic expansion, with increased international contacts, particularly related to the extraction and export of copper. A number of primary coastal centres developed, performing multiple functions as centrally placed harbours

that acted as entrepôts along the maritime routes between east and west (particularly evidenced by the trade in Mycenaean pottery at the end of the Late Bronze Age); they also functioned as outlets for copper production, with regional development in their own right. Sites along the east coast of the island, such as Enkomi (#224), Kition *Kathari* (#229) and Hala Sultan Tekke (#230), were particularly important due to their geographical location along the western reaches of the Levantine maritime trade route. Like other sites along the south coast, such as the Maroni (#233/ #234), Kalavasos (#235) and Kouris (#241) valley sites that expanded as outlets for the export of copper, the eastern settlements also participated in the production of copper.

With the growth of Minoan Crete, Cretan links with the east expanded via the junction island of Rhodes (see Ch.I). A number of harbours located along the eastern shores of Crete, such as Zakros (#290) and Palaikastro (#288), expanded as 'gateway' harbours for the transfer of goods between the island and the east. However, it would appear that it was not until the Late Bronze Age that direct contacts were established between Crete and Egypt[2]. The

[2] Chapter VI.2.1 discusses the evidence for early contacts between Crete and Egypt, and despite the fact that relatively large numbers of Egyptian objects have been recovered from both Early and Middle Minoan contexts in Crete, far outnumbering objects from the Near East, the practicalities involved in undertaking a direct route from Egypt to Crete, would render this maritime route impossible. Thus, Bronze Age

importance of this route is demonstrated by the expansion of the emporium of Kommos (#308), which served as an outlet of trade on the south side of the island, and by the establishment of the anchorage of Mersa Matruh (#198) on the north coast of Africa, where large amounts of 14th and 13th centuries BC Cypriot pottery have been recovered, confirming the role of the anchorage as a nodal point or trading post and revictualising station for vessels en route to the Nile Delta. This completes the overall anticlockwise circular route widely accepted as having provided the main framework of Late Bronze Age exchange within the eastern Mediterranean (Bass 1987: 697-98).

## PATTERNS OF DIFFERENTIAL GROWTH OF HARBOURS AND ROUTES OF TRADE, AND THE OVERALL EFFECT ON REGIONAL DEVELOPMENT IN THE EASTERN MEDITERRANEAN

With a growth in the exchange network and the need for more direct routes of trade and improved access to the hinterland, the pattern of connections evolved and particular stretches of the coastline emerged as major arteries of trade and exchange, requiring the establishment of bigger, better and more numerous harbours, often adapted from earlier anchorage sites. Patterns of differential

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mariners trading between Egypt and Crete would invariably have taken Vercoutter's (1954: 419,fig.162; Fig. VI.2) 'Eastern' or 'Indirect' Route. With regards contacts between Crete and Egypt, I beleive that the evidence suggests that direct contacts on a substantial scale were not established until later in the second millennium (see Ch.VI.2.1).

growth, which are reflected in and relate to both harbour quality and quantity, are observed along particular stretches of the coast and relate to the expansion of the trade routes.

An analysis of the numbers of known second millennium harbour sites of the eastern Mediterranean, including major ports, is outlined in Table 4, and reveals a growth in the number of sites occupied in the Late Bronze Age as compared with the Middle Bronze Age (see Fig. VII.4). Only in the southern Levant, where large numbers of harbours were established already in the Middle Bronze Age, was there no overall growth during the Late Bronze Age. All major anchorage sites occupied in the Middle Bronze Age continued to be occupied in the Late Bronze Age, and the predominant regions of expansion in the number of major sites, appear to be the northern Levant, Cyprus and Cilicia.

A number of anchorages in the northern Levant correspond to the development of naturally sheltered harbours located in convenient places along an expanding route of trade. The anvil-shaped headland of Ràs el Basit (#85) provided adequate shelter in a McKee Type (4) anchorage and reveals contacts with the Levant coast (particularly Ugarit), Egypt, the Mycenaean Aegean and Cyprus, starting in the 14th century BC. Not only was the site located along an expanding route of trade, but it developed in preference to surrounding Late Bronze Age

anchorages, such as Kara Duran (#83), Ile Pigeon (#84), Īsā Begli (#86) and Rās Fasori (#88), because of its superior shelter as a natural anchorage.

Likewise to the south, other anchorage sites under Ugaritic influence have been identified, that also expanded in the Late Bronze Age. Of particular importance was the prominent landfall site of Ràs Ibn Hàni (#91). The site was established in the 14th century BC and afforded adequate natural shelter in a bay protected by an anvil-shaped headland. Ràs Ibn Hàni developed, along with Latakia (#93), whence links inland were established via the Nahr el Kebir (#94) and Tell Sukas (#97), as they afforded sheltered anchorage along a rapidly expanding route of maritime trade, providing additional harbour facilities to supplement the main harbour of Ugarit, *Minet el Beida* (#89).

The ability to secure safe anchorage along the coast of the southern Levant is already evident from the Middle Bronze Age, and harbours were established here throughout the second millennium BC. However, along this stretch of coast particular sites expanded in preference to others in response to demands for facilities to handle the increased levels of maritime activity. The naturally sheltered river mouth anchorage of Tell Abu Hawam (#137), which afforded shelter to vessels in lee of the Carmel Ridge promontory, became especially important in the Late Bronze II period,

during the peak of maritime activity. It was located on the southern shores of Haifa Bay, at a junction between land and sea (Artzy 1994: 130), and facilitated the shortest route inland via the Esdraelon valley to Meggido and Beisān. On the northern shores of Haifa Bay lay the sheltered anchorage site of Akko (#134). The combined use of these two sites afforded superior anchorage to others in the area, such as Achzib (#131) to the north, and Tel Shiqmona (#139) and 'Atlit (#142) to the south (although Tel Nami (#144) may have taken over this role for a brief period in the Late Bronze IIB (Artzy 1994: 123); thus they developed as major harbour sites along a prominent route of Late Bronze Age trade.

Additional sites along the coast of the Levant developed in the Late Bronze Age due to increased demands for sheltered anchorage, despite the fact that they afforded inadequate natural shelter. As discussed above, by the latter part of the second millennium BC mariners had acquired the means to enhance offshore island anchorages in order to secure havens. Thus, towards the end of this period, the offshore reefs of Arwad (#102), Sidon (#122) and Tyre (#125) were adapted and afforded convenient 'stop-over' points along an increasingly active maritime route of trade. Despite the hostile nature of this coastline (see Ch.III.1) the development of these anchorages was essential to support trade along this route of exchange and to afford easier access to inland trade routes, such as from Arwad

inland along the Homs Gap. Separation of the offshore reef anchorages from the mainland foreland location also ensured a degree of protection to the mainland from centres of exchange offshore (see Ch.V.1.viii).

Hence, regional development, initiated by the expansion of trade, was concentrated in areas of superior harbours. For example, between the 14th and 12th centuries BC, Cyprus is considered to have been an integral player in the development of links between the east and west, as demonstrated by the growth in the number of major anchorage sites along the south-eastern coast of the island. McCaslin (1980: 119) believes that the major maritime trade route between the east and west was along the south coast of Cyprus, with sites in the east being particularly active due to their close proximity to the Levantine maritime exchange route. Unlike northern Europe where a large proportion of trade was conducted via intergrated river systems, the coastal interface of the eastern Mediterranean was more strictly defined. Hence, networks of exchange relied predominantly upon maritime routes, resulting in the growth of regions that possessed superior harbours and were centrally located within this network of exchange, such as Ugarit, Cyprus and the Cilician Delta.

During the course of the second millennium the potential of the sea was realised to support a growing network of maritime exchange. Harbours were an essential component of this development. Their very existence recognised a need, while their growth over the second millennium BC, both in number and in the quality of facilities they afforded, confirms the essential role that they played within the growing economy of the eastern Mediterranean. The pattern of maritime trade routes that emerged and the harbours and anchorages that supported this network, were to form the basis of regional development within the eastern Mediterranean basin. Thus, as Frost (1970c: 55) states:

> 'the civilisation that originated in the eastern Mediterranean was not transmitted by hordes in search of new pasture lands or armies on the march, but by seafarers'.

This is the essence of Bronze Age harbours and how they developed during the second millennium: from a reliance on natural harbours, with minimal facilities, to the growth of complex harbours capable of servicing numerous vessels and cargoes. By the end of this period, harbours were located within the network of eastern Mediterranean trade, when and where they were required by the social and economic demands of Bronze Age societies in all their spatial and temporal variety.

Table 2: List of Bronze Age anchorages of the eastern Mediterranean, identified by site number, as defined by their topographical typology.

| Anchorages on straight-line coast | Anchorages in natural bays | Anchorages in lee of promontory | Anchorages on anvil-shaped headland |
|---|---|---|---|
| 65 | 1 | 4 | 5 |
| 75 | 8 | 15 | 33 |
| 87 | 9 | 24 | 35 |
| 92 | 10 | 29 | 39 |
| 99 | 12 | 36 | 42 |
| 101 | 14 | 43 | 56 |
| 104 | 16 | 48 | 85 |
| 105 | 17 | 49 | 91 |
| 127 | 21 | 53 | 93 |
| 128 | 25 | 63 | 97 |
| 139 | 31 | 73 | 111 |
| 140 | 32 | 91 | 116 |
| 141 | 37 | 113 | 142 |
| 143 | 38 | 137 | 210 |
| 147 | 44 | 138 | 212 |
| 149 | 47 | 200 | 213 |
| 152 | 52 | 204 | 225 |
| 158 | 55 | 206 | 248 |
| 166 | 57 | 211 | 252 |
| 167 | 62 | 214 | 266 |
| 168 | 78 | 219 | 267 |
| 170 | 79 | 221 | 278 |
| 172 | 83 | 225 | 304 |
| 173 | 89 | 231 | |
| 174 | 90 | 232 | |
| 177 | 91 | 246 | |
| 194 | 96 | 247 | |
| 203 | 100 | 253 | |
| 207 | 110 | 256 | |
| 209 | 114 | 259 | |
| 234 | 115 | 261 | |
| 236 | 116 | 265 | |
| 263 | 117 | 299 | |
| 296 | 119 | | |
| 298 | 120 | | |

| Anchorages on straight-line coast | Anchorages in natural bays | | |
|---|---|---|---|
| 300 | 124 | | |
| | 135 | | |
| | 145 | | |
| | 201 | | |
| | 205 | | |
| | 213 | | |
| | 215 | | |
| | 216 | | |
| | 217 | | |
| | 218 | | |
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| | 220 | | |
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| | 249 | | |
| | 250 | | |
| | 254 | | |
| | 257 | | |
| | 262 | | |
| | 268 | | |
| | 269 | | |
| | 271 | | |
| | 272 | | |
| | 273 | | |
| | 274 | | |
| | 275 | | |

| Anchorages on straight-line coast | Anchorages in natural bays | | |
|---|---|---|---|
| | 279 | | |
| | 280 | | |
| | 281 | | |
| | 282 | | |
| | 283 | | |
| | 284 | | |
| | 285 | | |
| | 287 | | |
| | 288 | | |
| | 289 | | |
| | 290 | | |
| | 291 | | |
| | 292 | | |
| | 294 | | |
| | 295 | | |
| | 296 | | |
| | 301 | | |
| | 302 | | |
| | 305 | | |
| | 307 | | |

| Anchorages in sheltered valley or inlet | Anchorages on islands | Anchorages sheltered by offshore island or reef | Anchorages in river mouths |
|---|---|---|---|
| 15 | 6 | 2 | 3 |
| 19 | 7 | 26 | 13 |
| 22 | 11 | 41 | 27 |
| 23 | 18 | 53 | 34 |
| 26 | 20 | 56 | 40 |
| 28 | 21 | 57 | 45 |
| 46 | 54 | 64 | 50 |
| 63 | 71 | 73 | 51 |
| 86 | 84 | 88 | 61 |
| 112 | 102 | 111 | 66 |
| 272 | 103 | 122 | 67 |
| 276 | 129 | 125 | 68 |
| 298 | 132 | 130 | 76 |
| 303 | 175 | 131 | 77 |
| 306 | 176 | 134 | 79 |
| | 193 | 143 | 81 |
| | 208 | 144 | 94 |
| | 239 | 145 | 95 |
| | 260 | 146 | 98 |
| | 270 | 149 | 107 |
| | 277 | 150 | 108 |
| | 286 | 153 | 109 |
| | 293 | 154 | 110 |
| | | 156 | 118 |
| | | 157 | 121 |
| | | 161 | 123 |
| | | 163 | 126 |
| | | 171 | 130 |
| | | 193 | 131 |
| | | 215 | 133 |
| | | 216 | 134 |
| | | 218 | 137 |
| | | 232 | 142 |
| | | 250 | 144 |
| | | 251 | 147 |

| | | Anchorages sheltered by offshore island or reef | Anchorages in river mouths |
|---|---|---|---|
| | | 265 | 154 |
| | | 266 | 157 |
| | | 268 | 158 |
| | | 269 | 159 |
| | | 271 | 164 |
| | | 272 | 169 |
| | | 292 | 177 |
| | | 305 | 190 |
| | | 308 | 200 |
| | | | 201 |
| | | | 202 |
| | | | 227 |
| | | | 229 |
| | | | 235 |
| | | | 241 |
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| | | | 273 |
| | | | 280 |
| | | | 297 |
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| | | | |

| Riverine anchorages | Deltaic anchorages | Lagoonal anchorages |
|---|---|---|
| 30 | 58 | 13 |
| 69 | 59 | 80 |
| 70 | 60 | 130 |
| 82 | 68 | 144 |
| 106 | 69 | 145 |
| 136 | 70 | 153 |
| 148 | 72 | 155 |
| 151 | 74 | 161 |
| 155 | 180 | 162 |
| 160 | 181 | 175 |
| 161 | 182 | 176 |
| 165 | 183 | 178 |
| 186 | 184 | 179 |
| 187 | 185 | 195 |
| 189 | 190 | 196 |
| 202 | 191 | 197 |
| 224 | 192 | 198 |
| 233 | 195 | 199 |
| 235 | 196 | 230 |
| 241 | 197 | 237 |
| 309 | | 240 |
| | | 268 |

Table 3: List of Bronze Age anchorages of the eastern Mediterranean, identified by site number, as defined by their McKee Type.

| McKee Type (1) Anchorages | McKee Type (2)/(3) anchorages | McKee Type (4) anchorages |
|---|---|---|
| 14 | 1 | 2 |
| 15 | 4 | 3 |
| 19 | 12 | 5 |
| 24 | 13 | 6 |
| 28 | 14 | 7 |
| 37 | 20 | 8 |
| 38 | 21 | 9 |
| 39 | 25 | 10 |
| 44 | 27 | 11 |
| 47 | 32 | 16 |
| 51 | 34 | 17 |
| 55 | 42 | 18 |
| 58 | 43 | 22 |
| 63 | 45 | 23 |
| 67 | 48 | 26 |
| 75 | 49 | 29 |
| 76 | 54 | 30 |
| 80 | 61 | 31 |
| 86 | 62 | 33 |
| 87 | 65 | 35 |
| 92 | 66 | 36 |
| 96 | 68 | 40 |
| 98 | 74 | 41 |
| 99 | 77 | 46 |
| 100 | 83 | 50 |
| 101 | 91 | 52 |
| 104 | 94 | 53 |
| 105 | 95 | 56 |
| 106 | 97 | 57 |
| 107 | 109 | 59 |
| 108 | 112 | 60 |
| 121 | 113 | 64 |
| 123 | 117 | 69 |
| 126 | 120 | 70 |
| 127 | 124 | 71 |
| 128 | 137 | 72 |
| 133 | 138 | 73 |
| 135 | 161 | 78 |
| 139 | 194 | 79 |
| 140 | 201 | 81 |
| 141 | 205 | 82 |
| 143 | 207 | 84 |
| 147 | 209 | 85 |
| 149 | 210 | 88 |
| 152 | 213 | 89 |
| 158 | 214 | 90 |
| 162 | 226 | 91 |
| 166 | 229 | 93 |
| 167 | 231 | 102 |
| 168 | 234 | 103 |
| 170 | 235 | 110 |
| 172 | 236 | 111 |
| 173 | 238 | 114 |
| 177 | 242 | 116 |
| 195 | 243 | 118 |
| 202 | 245 | 119 |
| 203 | 246 | 122 |
| 216 | 250 | 124 |

| McKee Type (1) Anchorages | McKee Type (2)/(3) anchorages | McKee Type (4) anchorages |
|---|---|---|
| 220 | 294 | 125 |
| 228 | 295 | 129 |
| 239 | 296 | 130 |
| 249 | 297 | 131 |
| 254 | 298 | 132 |
| 258 | 299 | 134 |
| 263 | 300 | 136 |
| 264 | 301 | 137 |
| 274 | 303 | 142 |
| 275 | 304 | 144 |
| 281 | 310 | 145 |
| 282 | | 146 |
| 307 | | 148 |
| | | 150 |
| | | 151 |
| | | 153 |
| | | 154 |
| | | 155 |
| | | 156 |
| | | 157 |
| | | 159 |
| | | 160 |
| | | 163 |
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| | | 204 |
| | | 206 |
| | | 208 |
| | | 211 |
| | | 212 |
| | | 215 |
| | | 217 |
| | | 218 |

| McKee Type (1) Anchorages | McKee Type (2)/(3) anchorages | McKee Type (4) anchorages |
|---|---|---|
| | | 219 |
| | | 221 |
| | | 222 |
| | | 223 |
| | | 224 |
| | | 225 |
| | | 227 |
| | | 229 |
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| | | 235 |
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| | | 247 |
| | | 248 |
| | | 251 |
| | | 252 |
| | | 253 |
| | | 256 |
| | | 257 |
| | | 259 |
| | | 260 |
| | | 261 |
| | | 262 |
| | | 265 |
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| | | 267 |
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| | | 269 |
| | | 270 |
| | | 271 |
| | | 272 |
| | | 273 |
| | | 276 |
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| | | 292 |
| | | 293 |
| | | 302 |
| | | 305 |
| | | 306 |
| | | 308 |
| | | 309 |

Table 4: List of anchorages sites of the eastern Mediterranean, their McKee Type and topographical definitions, period of occupation and classification as evidence for their use in the Bronze Age.
Key to classification relates to that outlined in Appendix I (Part II) (Vol. II: 1); and key to topogrphical definitions relates to Ch.IV.1.b. and Figs. IV.10.i-xi.

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 1 | (2)/(3) | ii | . | . |
| 2 | (4) | vii | . | . |
| 3 | (4) | viii | (LB) | @ |
| 4 | (2)/(3) | iii | . | . |
| 5 | (4) | iv | . | S |
| 6 | (4) | vi | . | S |
| 7 | (4) | vi | . | . |
| 8 | (4) | ii | . | . |
| 9 | (4) | ii | . | . |
| 10 | (4) | ii | . | S |
| 11 | (4) | vi | . | S |
| 12 | (2)/(3) | iii | . | . |
| 13 | (2)/(3) | viii xi | . | S |
| 14 | (1) (2)/(3) | ii | . | . |
| 15 | (1) | iii v | . | . |
| 16 | (4) | ii | (LB) | * |
| 17 | (4) | ii | . | S |
| 18 | (4) | vi | (LB) | * |
| 19 | (1) | v | . | S |
| 20 | (2)/(3) | vi | . | S |
| 21 | (2)/(3) | ii vi | . | . |
| 22 | (4) | iv | . | . |
| 23 | (4) | v | . | S |
| 24 | (1) | iii | . | S |
| 25 | (2)/(3) | ii | . | . |
| 26 | (4) | vii v | . | S |
| 27 | (2)/(3) | viii | (LB) | * |
| 28 | (1) | v | . | . |
| 29 | (4) | iii | . | S |
| 30 | (4) | ix | (LB) | * |
| 31 | (4) | ii | . | S |
| 32 | (2)/(3) | ii | . | . |
| 33 | (4) | iv | . | . |
| 34 | (2)/(3) | viii | . | S |
| 35 | (4) | iv | . | S |
| 36 | (4) | iii | . | . |
| 37 | (1) | ii | . | S |
| 38 | (1) | ii | . | S |
| 39 | (1) | iv | . | S |
| 40 | (4) | viii | . | . |
| 41 | (4) | vii | . | . |
| 42 | (2)/(3) | iv | (LB) | * |
| 43 | (2)/(3) | iii | . | S |
| 44 | (1) | ii | . | S |
| 45 | (2)/(3) | viii | . | S |
| 46 | (4) | v | (LB) | * |
| 47 | (1) | ii | . | S |
| 48 | (2)/(3) | iii | . | . |
| 49 | (2)/(3) | iii | . | S |
| 50 | (4) | viii | (LB) | * |
| 51 | (1) | viii | . | . |
| 52 | (4) | ii | (LB) | * |
| 53 | (4) | iii vii | . | S |
| 54 | (2)/(3) | vi | . | S |

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 55 | (1) | ii | . | . |
| 56 | (4) | vii iv | . | $ |
| 57 | (4) | vii ii | . | $ |
| 58 | (1) | x | . | . |
| 59 | (4) | x | (LB) | @ |
| 60 | (4) | x | (LB) | * |
| 61 | (2)/(3) | viii | . | $ |
| 62 | (2)/(3) | ii | . | . |
| 63 | (1) | iii v | . | $ |
| 64 | (4) | vii | . | $ |
| 65 | (2)/(3) | i | (LB) | * |
| 66 | (2)/(3) | viii | (LB) | * |
| 67 | (1) | viii | (MB) (LB) | [] |
| 68 | (2)/(3) | viii x | (LB) | @ |
| 69 | (4) | x ix | (MB) (LB) | [] |
| 70 | (4) | ix ix | . | . |
| 71 | (4) | vi | . | $ |
| 72 | (4) | x | (LB) | * |
| 73 | (4) | vii iii | . | $ |
| 74 | (2)/(3) | x | (MB) (LB) | * |
| 75 | (1) | i | (LB) | * |
| 76 | (1) | viii | (MB) (LB) | @ |
| 77 | (2)/(3) | viii | . | $ |
| 78 | (4) | ii | . | $ |
| 79 | (4) | ii viii | . | $ |
| 80 | (1) | xi | . | $ |
| 81 | (4) | viii | (LB) | * |
| 82 | (4) | ix | (MB) (LB) | [] |
| 83 | (2)/(3) | ii | (LB) | * |
| 84 | (4) | vi | (LB) | * |
| 85 | (4) | iv | (LB) | @ |
| 86 | (1) | v | (LB) | * |
| 87 | (1) | i | . | $ |
| 88 | (4) | vii | (LB) | * |
| 89 | (4) | ii | (MB) (LB) | [] |
| 90 | (4) | ii | . | . |
| 91 | (4) (2)/(3) | iii ii iv | (LB) | @ |
| 92 | (1) | i | . | . |
| 93 | (4) | iv | (LB) | @ |
| 94 | (2)/(3) | viii | . | . |
| 95 | (2)/(3) | viii | (MB) (LB) | * |
| 96 | (1) | ii | (LB) | * |
| 97 | (2)/(3) | iv | (MB) (LB) | @ |
| 98 | (1) | viii | (LB) | * |
| 99 | (1) | i | . | . |
| 100 | (1) | ii | . | . |
| 101 | (1) | i | . | $ |
| 102 | (4) | vi | (LB) | [] |
| 103 | (4) | vi | (LB) | $ |
| 104 | (1) | i | . | $ |
| 105 | (1) | i | (MB) (LB) | * |
| 106 | (1) | ix | (MB) (LB) | * |
| 107 | (1) | viii | . | . |
| 108 | (1) | viii | . | . |

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 109 | (2)/(3) | viii | (LB) | * |
| 110 | (4) | ii viii | (LB) | * |
| 111 | (4) | iv vii | . | $ |
| 112 | (2)/(3) | v | . | . |
| 113 | (2)/(3) | iii | . | $ |
| 114 | (4) | ii | . | $ |
| 115 | (2/(3) | ii | . | $ |
| 116 | (4) | iv ii | (MB) (LB) | [] |
| 117 | (2)/(3) | ii | . | $ |
| 118 | (4) | viii | (LB) | * |
| 119 | (4) | ii | . | . |
| 120 | (2)/(3) | ii | (LB) | @ |
| 121 | (1) | viii | (LB) | . |
| 122 | (4) | vii | (LB) | [] |
| 123 | (1) | viii | (LB) | * |
| 124 | (4) (2)/(3) | ii | (LB) | * |
| 125 | (4) | vii | (LB) | @ |
| 126 | (1) | viii | . | . |
| 127 | (1) | i | . | . |
| 128 | (1) | ii | (MB) (LB) | * |
| 129 | (4) | vi | . | $ |
| 130 | (4) | viii xi vii | (MB) (LB) | @ |
| 131 | (4) | vii viii | (MB) (LB) | @ |
| 132 | (4) | vi | . | $ |
| 133 | (1) | viii | (MB) (LB) | * |
| 134 | (4) | vii viii | (MB) (LB) | [] |
| 135 | (1) | ii | (LB) | * |
| 136 | (4) | ix | (MB) (LB) | * |
| 137 | (4) (2)/(3) | viii iii | (MB) (LB) | [] |
| 138 | (2)/(3) | iii | . | . |
| 139 | (1) | i | (LB) | * |
| 140 | (1) | i | (LB) | * |
| 141 | (1) | i | (MB) (LB) | * |
| 142 | (4) | viii iv | (MB) (LB) | @ |
| 143 | (1) | i vii | . | $ |
| 144 | (4) | vii viii xi | (MB) (LB) | @ |
| 145 | (4) | ii xi vii | (MB) (LB) | [] |
| 146 | (4) | vii | . | . |
| 147 | (1) | i viii | . | $ |
| 148 | (4) | ix | (MB) (LB) | * |
| 149 | (1) | vii i | . | $ |
| 150 | (4) | vii | (LB) | * |
| 151 | (4) | ix | (MB) (LB) | * |
| 152 | (1) | i | (LB) | * |
| 153 | (4) | vii xi | (LB) | * |
| 154 | (4) | viii vii | (MB) (LB) | * |
| 155 | (4) | ix xi | (MB) (LB) | @ |
| 156 | (4) | vii | . | $ |
| 157 | (4) | vii viii | (MB) (LB) | * |
| 158 | (1) | i viii | (MB) (LB) | * |
| 159 | (4) | viii | (LB) | * |
| 160 | (4) | ix | (MB) (LB) | @ |
| 161 | (2)/(3) | vii xi ix | (LB) | * |
| 162 | (1) | xi | . | $ |

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 163 | (4) | vii | (MB) (LB) | * |
| 164 | (4) | viii | (MB) (LB) | @ |
| 165 | (4) | ix | (LB) | * |
| 166 | (1) | ii | (MB) (LB) | @ |
| 167 | (1) | i | . | $ |
| 168 | (1) | i | (LB) | * |
| 169 | (4) | viii | (MB) (LB) | @ |
| 170 | (1) | ii | (LB) | * |
| 171 | (4) | vii | (MB) (LB) | * |
| 172 | (1) | i | . | $ |
| 173 | (1) | i | (MB) (LB) | * |
| 174 | (2/3) | ii | . | $ |
| 175 | (4) | xi vi | . | $ |
| 176 | (4) | xi vi | . | $ |
| 177 | (1) | i viii | . | $ |
| 178 | (4) | xi | (LB) | * |
| 179 | (4) | xi | (MB) | * |
| 180 | (4) | x | . | $ |
| 181 | (4) | x | (LB) | * |
| 182 | (4) | x | (LB) | @ |
| 183 | (4) | x | (MB) (LB) | [] |
| 184 | (4) | x | (MB) | * |
| 185 | (4) | x | (MB) (LB) | @ |
| 186 | (4) | ix | (MB) | * |
| 187 | (4) | ix | (MB) (LB) | [] |
| 188 | (4) | ix | (LB) | [] |
| 189 | (4) | ix | . | $ |
| 190 | (4) | x viii | (MB) (LB) | * |
| 191 | (4) | x | . | $ |
| 192 | (4) | x | (LB) | * |
| 193 | (4) | vii vi | (LB) | @ |
| 194 | (2)/(3) | i | (LB) | * |
| 195 | (1) | x xi | . | $ |
| 196 | (4) | xi x | . | $ |
| 197 | (4) | x xi | (LB) | * |
| 198 | (4) | xi | (LB) | [] |
| 199 | (4) | xi | . | $ |
| 200 | (4) | viii iii | . | $ |
| 201 | (2)/(3) | ii viii | . | $ |
| 202 | (1) (4) | ix viii | (MB) (LB) | * |
| 203 | (1) | i | (MB) (LB) | * |
| 204 | (4) | iii | . | $ |
| 205 | (2)/(3) | ii | (LB) | * |
| 206 | (4) | iii | (MB) (LB) | * |
| 207 | (2)/(3) | i | (MB) (LB) | * |
| 208 | (4) | vi | . | . |
| 209 | (2)/(3) | i | . | $ |
| 210 | (2)/(3) | iv | . | . |
| 211 | (4) | iii | . | . |
| 212 | (4) | iv | (MB) (LB) | * |
| 213 | (2)/(3) | ii iv | (LB) | * |
| 214 | (2)/(3) | iii | (LB) | * |
| 215 | (4) | vii ii | (LB) | * |
| 216 | (1) | ii vii | . | * |

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 217 | (4) | ii | . | $ |
| 218 | (4) | vii ii | . | . |
| 219 | (4) | iii ii | (LB) | * |
| 220 | (1) | ii | . | . |
| 221 | (4) | iii | . | $ |
| 222 | (4) | ii | (MB) (LB) | * |
| 223 | (4) | ii | . | . |
| 224 | (4) | ix | (MB) (LB) | [] |
| 225 | (4) | iii iv | . | . |
| 226 | (2)/(3) | ii | . | . |
| 227 | (4) | viii | . | $ |
| 228 | (1) | ii | (LB) | @ |
| 229 | (2)/(3) (4) | viii ii | (MB) (LB) | [] |
| 230 | (4) | xi | (LB) | [] |
| 231 | (2)/(3) | iii | (LB) | * |
| 232 | (4) | iii vii | . | . |
| 233 | (4) | ix | (LB) | * |
| 234 | (2)/(3) | i | (LB) | @ |
| 235 | (4) (2)/(3) | viii ix | (LB) | @ |
| 236 | (2)/(3) | ii i | . | $ |
| 237 | (4) | xi | . | * |
| 238 | (2)/(3) | ii | . | $ |
| 239 | (1) | vi | . | $ |
| 240 | (4) | xi | (LB) | * |
| 241 | (4) | ix viii | (MB) (LB) | @ |
| 242 | (2)/(3) | ii | . | . |
| 243 | (2)/(3) | ii viii | . | . |
| 244 | (4) | ii | . | . |
| 245 | (2)/(3) | viii | (LB) | @ |
| 246 | (2)/(3) | iii | . | . |
| 247 | (4) | iii ii | . | $ |
| 248 | (4) | iv | (LB) | @ |
| 249 | (1) | ii | . | $ |
| 250 | (2)/(3) | vii ii | . | $ |
| 251 | (4) | vii | . | $ |
| 252 | (4) | iv | . | $ |
| 253 | (4) | iii | . | . |
| 254 | (1) | ii | (LB) | * |
| 256 | (4) | iii | . | $ |
| 257 | (4) | ii | . | $ |
| 258 | (1) | viii | . | $ |
| 259 | (4) | iii | . | . |
| 260 | (4) | vi | (LB) | * |
| 261 | (4) | iii | (LB) | * |
| 262 | (4) | ii | . | $ |
| 263 | (1) | i | . | $ |
| 264 | (1) | viii | (LB) | @ |
| 265 | (4) | viii iii vii | (MB) (LB) | @ |
| 266 | (4) | iv vii | (LB) | @ |
| 267 | (4) | iv | (LB) | * |
| 268 | (4) | ii viii vii xi | (MB) (LB) | [] |
| 269 | (4) | vii ii | . | . |
| 270 | (4) | vi | . | $ |
| 271 | (4) | ii vii | (MB) | * |

| Site No. | McKee Type | Topography | Occupation | Classification |
|---|---|---|---|---|
| 272 | (4) | ii vii v | . | S |
| 273 | (4) | iii viii | (LB) | * |
| 274 | (1) | ii | (MB) (LB) | * |
| 275 | (1) | ii | (MB) (LB) | * |
| 276 | (4) | v | . | S |
| 277 | (4) | vi | (MB) (LB) | @ |
| 278 | (4) | iv | (MB) | * |
| 279 | (4) | ii | (MB) (LB) | * |
| 280 | (4) | ii viii | (MB) (LB) | * |
| 281 | (1) | ii | . | S |
| 282 | (1) | ii | . | . |
| 283 | (4) | ii | . | . |
| 284 | (4) | ii | . | . |
| 285 | (4) | ii | (LB) | * |
| 286 | (4) | vi | . | S |
| 287 | (4) | ii | (LB) | * |
| 288 | (4) | ii | (MB) (LB) | @ |
| 289 | (4) | ii | (LB) | * |
| 290 | (4) | ii | (MB) (LB) | □ |
| 291 | (4) | ii | (LB) | * |
| 292 | (4) | ii vii | . | $ |
| 293 | (4) | vi | (LB) | * |
| 294 | (2)/(3) | ii | . | . |
| 295 | (2)/(3) | ii | . | S |
| 296 | (2)/(3) | ii i | . | S |
| 297 | (2)/(3) | viii | (MB) (LB) | * |
| 298 | (2)/(3) | v i | (MB) (LB) | * |
| 299 | (2)/(3) | iii | (MB) (LB) | * |
| 300 | (2)/(3) | i | (MB) | * |
| 301 | (2)/(3) | iii | (MB) (LB) | * |
| 302 | (4) | ii | . | . |
| 303 | (2)/(3) | v | (MB) (LB) | * |
| 304 | (2)/(3) | iv | (MB) | * |
| 305 | (4) | ii vii | (MB) | * |
| 306 | (4) | v | (MB) (LB) | * |
| 307 | (1) | ii | . | S |
| 308 | (4) | vii | (MB) (LB) | □ |
| 309 | (4) | ix | (LB) | * |
| 310 | (2)/(3) | viii | . | S |

LIST OF FIGURES RELATING TO THE TEXT

Fig. II.1 Egyptian seagoing vessels, c. 1500 BC, after Casson 1971: Fig.18.

Fig. II.2 Capabilities of vessels prior to the positioning of the mast amidships.

Fig. II.3 Effect of following and changeable winds on vessels with the mast set fore of amidships compared with amidships.

Fig. II.4 Effect of the wind on the beam with the mast set fore of amidships, compared to the mast set amidships.

Fig. II.5 Comparisons between high and low aspect ration sails.

Fig. II.6 Thera sailing ship, after Morgan 1988: Fig.70.

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# BIBLIOGRAPHY

Acts 27
*The Bible, Good News. Today's English version.* Published 1976 by The Bible Societies. London: Collins/ Fontana.

Afetinan, A.
1975 *Life and works of Pirî Reis. The oldest map of America.* (transl. L. Yolaç & E. Uzmen). Ankara: Turkish Historical Association.

Ahituv, S.
1970 On the conduct of trade in Canaan during the Late Bronze Age. Pp. 318-30 in *Bible, archaeology, linguistics and the history of Israel.* Shmuel Yeivin volume, studies presented in his honour, eds. S. Abramski, Y. Aharoni, H.M.Y. Gabriyahu & B. Luria. Jerusalem: Israel Exploration Society (Hebrew).

Ahituv, S.
1978 Economic factors in the Egyptians conquest of Canaan. *IEJ* 28: 93-105.

Ahituv, S.
1984 *Canaanite toponyms in ancient Egyptian documents.* Jerusalem: Magnes Press.

Akurgal, E.
1985 *Ancient civilistaions and ruins of Turkey.* Istanbul: Haşet Kitabevi.

Al-Said, F. (ed.)
1991 *Oman a seafaring nation.* Ministry of Information and Culture, the Sultanate of Oman.

Albright, W.F.
1950 Some important recent discoveries: alphabetic origins and the Idrimi statue *BASOR* 118: 11-20.

Alexiou, S.
1987 Minoan palaces as centres of trade and manufacture. Pp. 251-253 in *The function of the Minoan palaces. Proceedings 4th International Symposium at Swedish Institute Athens,* eds. R. Hägg & N. Marinatos. Athens: Svenska Institutet.

Alkim, U.B.
1969 The Amanus region in Turkey. *Archaeology* 22.4: 280-289.

Altman, A.
1988 Trade between the Aegean and the Levant in the Late Bronze Age: some neglected questions. Pp 229-238 in *Society and economy in the Eastern*

*Mediterranean (c.1500-1000 BC)*. Proceedings International Symposium, University of Haifa, April/May 1985, Orientalia Lovaniensia Analecta 23, eds. M. Heltzer & E. Lipinski. Leuven: Uitgeverij Peeters.

Anati, E.
1959 Excavation at the cemetery of Tell Abu Hawam (1952). *Atiqot* 2: 89-102.

Anati, E.
1975 Tell Abu Hawam. *AY.I*: 9-12.

Arsenson, S.
1990 *The Encircled Sea*. London: Constable.

Artzy, M.
1980 Supply and demand: A study of 2nd millenium Cypriote pottery in the Levant. Pp. 93-99 in *Prehistoric production and exchange, the Aegean and East Mediterranean*, eds. A.B. Knapp & T. Stech, Monograph XXV. California: Institute of Archaeology, UCLA.

Artzy, M., Perlman, I., Asara, F.
1981 Cypriot pottery imports at Ras Shamra. *IEJ* 31: 37-47.

Artzy, M.
1986 Fortress and settlement - anchorage system during the second millennium at Tell Nami? Pp. 14-17 in *Cities in the Sea - Past and Present, First International symposium on harbours, port cities and coastal topography. Summaries. Haifa, Israel. September 22 - 29 1986*, eds. A. Raban and E. Linder. Haifa.

Artzy, M.
1988b Tel Nami project, 1987. *CMS* 15: 2-3.

Artzy, M.
1988 Development of war/ fighting boats of the second millennium BC in the eastern Mediterranean. *RDAC* (1): 181-186.

Artzy, M.
1989 Tel Nami: Land and Sea project, 1988. *CMS* 16.

Artzy, M.
1990 Nami land and sea projects, 1985-1988. *IEJ* 40.1: 73-76.

Artzy, M.
1991 Nami regional project, 1990. *CMS* 18.

Artzy, M. & Marcus, E.

1991 The MBIIa coastal settlement at Tel Nami. *Michmanim* 5: 5-16.

Artzy, M.
1994b On boats, on rocks and on 'nomads of the sea'. *CMS* 21.

Artzy, M.
1994 Incense, camels and collasred rim jars: Desert trade routes and maritime outlets in the second millennium. *OJA* 13.2: 121-147.

Astour, M.C.
1964 Semitic names in the Greek world. *JNES* 23: 193-201.

Astour, M.C.
1965 *Hellenosemitica: An ethnic and cultural study in Western Semitic impact on Mycenaean Greece*: 16. Leiden, Netherlands: E.J. Brill.

Astour, M.C.
1965b New evidence on the last days of Ugarit. *AJA* 69: 253-256

Astour, M.C.
1970 Ma'hadu, the harbour of Ugarit. *JESHO* 13: 113-127.

Astour, M.C.
1973 Ugarit and the Aegean. A brief summary of the archaeology and epigraphic evidence. Pp. 17-27 in *Orient and Occident: essays presented to Cyrus H. Gordon*, ed. H.A. Hoffner, Jr. Alter Orient und Atles Testament, 22. Kevelaer: Butzon & Bercker.

Astour, M.C.
1981 Ugarit and the great powers. Pp. 5-29 in *Ugarit in retrospect*, ed. G.D. Young. Winona Lake: Eisenbrauns.

Åström, P.
1964 A handle stamped with the cartouche of Seti from Hala Sultan Tekke in Cyprus. *Opuscula Atheniensa* V: 115-121.

Åström, P.
1969 The economy of Cyprus and it's development in the 2nd millennium BC. *Archaeologia Viva* 2.1: 80-84.

Åström, P.
1972 *The Swedish Cyprus Expedition*. Vol.IV, Part 1C. The Late Cypriot Bronze Age architecture and pottery. Lund: Statens Humanistiska Forskningsräd.

Åström, P.
1972b *The Swedish Cyprus Expedition*. Vol.IV, Part 1B. The Middle Cypriot Bronze Age. Lund: Statens Humanistiska Forskningsräd.

Åström, P.
1978 Traces of the eruption of Thera in Cyprus. Pp. 231-234 in *Thera and the Aegean World I*.1, ed. C. Doumas. London: Thera and the Aegean World.

Åström, P.
1979 The find contexts of some Minoan objects in Cyprus. Pp. 56-62 in *The relations between Cyprus and Crete c. 2000-1400 BC*. Acts of the International Symposium. Nicosia April 1978, ed. V. Karageorghis. Cyprus: Dept. Antiquities.

Åström, P.
1986 Hala Sultan Tekke and its foreign relations. Pp. 63-68 in *Cyprus between the Orient and the Occident*. Acts of the International Archaeological Symposium, ed. V. Karageorghis. Nicosia: Deptartment of Antiquities, Cyprus.

Åström, P.
1994 Hala Sultan Tekke: An international harbour town. *Res Maritimae, 1994*. The second in the series 'Cities on the Sea'. CARRI symposium. In press.

Avi-Yonah, M. & Eph'al, Y.
1975 Ashkelon. *AY*.I: 121-130.

Avigad, N.
1960 Excavations at Makmish, a preliminary report. *IEJ* 10: 90-96.

Avigad, N.
1976 Tell Jerishe *AY*.II: 575-578.

Avigad, N.
1977 Tel Michal. *AY*.III: 768-770.

Avnimelech, M.
1959 Remarks on the geological features of the surroundings of Tell Abu Hawam and the cemetery in the area of the Qishon mouth. *Atiqot* 2: 103-105.

Bailey, M.
1991 World's oldest ships found in the sand. *The Observer* 22.12.1991.

Baines, J. & Malek, J.
1980 *Atlas of Ancient Egypt*. Oxford: Facts On File.

Balensi, J.

1985 Revising Tell Abu Hawam. *BASOR* 257: 65-74.

Balensi, J.
1988 Tell Abu Hawam. Un cas exceptionne. Pp. 305-312 in *Society and economy in the Eastern Mediterranean (c. 1500-1000 BC)*, eds. M. Heltzer & E. Lipinski. Leuven: Uitgeverij Press.

Balensi, J., Herrera, M.D. & Artzy, M.
1993 Tell Abu Hawam. *EAEHL*: 7-14.

Barag, D.
1993 Nahariya. *EAEHL*: 1088-1094.

Baramki, D.C.
1973 The impact of the Mycenaeans on ancient Phonecia. Pp 193-195 in *Mycenaeans in the Eastern Mediterranean*. Acts of International Symposium, foreword, V. Karageorghis. Nicosia: Deptartment of Antiquities.

Barbar, E.J.W.
1990 *Prehistoric textiles: the development of cloth in the Neolithic and Bronze Age with special reference to the Aegean*. Princeton, New Jersey: Princeton University Press.

Basch, L.
1978 Le navire mnš et autres notes de voyage en Egypte. *MM* 64: 99-123.

Basch, L.
1981 The sewn ships of Bon-Porté. *MM* 67.3: 244.

Basch, L. & Artzy, M.
1985 Ship graffiti at Kition. Pp. 322-336 in *Excavation at Kition*. V. The Pre-Phoenician levels. Part I. Appendix II, eds. V. Karageorghis & M. Demas. Cyprus: Dept. of Antiquitites.

Basch, L.
1986 The Aegina pirate ships of c. 1700 BC. *MM* 72.4: 415-437.

Basch, L.
1987 *Le musée imaginaire de la marine antique*. Athèns: Institut Hellénique pour la préservation de la tradition nautique.

Bass, G.F.
1967 Cape Gelidonya: a Bronze Age shipwreck. *Transactions of American Philosophical Society* 57, Part 8.

Bass, G.F. (ed.)
1974 *A history of seafaring*. London: Thames & Hudson.

Bass, G.F.
1986 A Bronze Age shipwreck at Ulu Burun (Kaş): 1984 campaign. *AJA* 90: 269-296.

Bass, G.F.
1987 Splendors of the Bronze Age: Oldest Known shipwreck reveals. *National Geographic* 172.6: 692-734.

Bass, G.F.
1991 Evidence of trade from Bronze Age shipwrecks. Pp. 69-82 in *Bronze Age Trade in the Mediterranean.* Papers presented to a conference held in Oxford, Dec. 1989. SIMA XL, ed. N.H. Gale. Jonsered: Paul Åströms Förlag.

Bates, O.
1927 Excavation at Mersa Matruh. *Harvard Africa Studies* 8: 125-197.

Bauval, R. & Gilbert, A.G.
1994 *The Orion Mystery: unlocking the secrets of the pyramids.* London: Heinemann.

Bean, G.E. & Mitford, T.B.
1965 *Journeys in Rough Cilicia in 1962 & 1963.* (Vienna) Wein: Österreichische Academie der Wissenschaften.

Bean, G.E.
1979 *Lycian Turkey.* London: John Murray.

Bean, G.E.
1989 *Turkey's southern shore.* London: John Murray.

Beaufort, F. Capt. Sir.
1817/8 *Karamanian or a brief description of the coast of Asia Minor.* London: R. Hunter.

Beniot, F.
1961 L'Épave du grand congloué à Marseille. *Supplementaire à Gallia Centre Nationale de la Recherche Scientifique, Paris* XIV: 128-9.

Bent, J.T.
1891 A journey in Cilicia Tracheia. *Journal of Hellenic Studies* XII: 206-224.

Bermant, C. & Weitzman, M.
1979 *Ebla: An archaeological enigma.* London: Weidenfeld & Nicolson.

Betancourt, P.P., Wheeler, T.S., Maddin, R. & Muhly, J.D.
1978 Metallurgy at Gournia. *MASCA Research Papers in Science and Archaeology Journal* I.1: 7-8.

Betancourt, P.P. & Banou, E.S.
1991 Pseria and Minoan sea-trade. Pp. 107-111 in *Thalassa: l'égée prehistorique et la mer. Aegaeum* 7, eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Bevan, E.
1902 *The House of Selecus*. Book I. London: Edward Arnold.

Bezold, C. (ed.)
1892 *The Tell el-Amarna tablets in the British Museum*. London: Trustees British Museum.

Bietak, M.
1975 Tell el-Dab'a II. *Untersuchugen der Zweigstelle Kairo des Österreichischen Archäologischen Institutes* I. Vienna.

Bietak, M.
1979 Urban archaeology and the town problem. Pp. 95-144 in *Egyptology and the social sciences*, ed. K. Weeks. Cario: American University in Cairo Press.

Bietak, M.
1986 *Avaris and Piramesse: Archaeological exploration the Eastern Nile Delta*. Mortimer Wheeler Archaeology Lecture, 1979. Proceedings of the British Academy LXV: 225-289. Oxford: Oxford University Press.

Bietak, M.
1987 Canaanites in the Eastern Nile Delta. Pp. 41-56 in *Egypt, Isreal, Sinai: Archaeological and historical relationships in the biblical period*, ed. A. Rainey. Tel Aviv University: Tel Aviv.

Bietak, M.
1991 Egypt and Canaan in the Middle Bronze Age. *BASOR* 281: 29-72.

Bietak, M.
1992 Minoan wall-paintings unearthed at ancient Avaris. *Egyptian Archaeology* 2: 26-28.

Bietak, M. & Dorner, J.
1993 III. Der palastgartenfriedhof der frühen 13 Dynastie (Grabungsplatz F/I). *Ägypten und Levante* 4: 15-19.

Bintliff, J.L.
1977 *Natural environment and human settlement in prehistoric Greece*. Part II. BAR Supplementary Series, 28 (ii). Oxford.

Bird, E.F.C.

1985 *Coastal Changes: a global review*: 96. Chichester: Wiley.

Blackman, D.J.
1973 The harbours of Phaselis. *IJNA* 2.2: 355-364.

Blackman, D.J. & Branigan, K.
1975 An archaeological survey on the south coast of Crete, between the Ayiofarango and Chrisostomas. *BSA* 70: 17-36.

Blackman, D.J. & Branigan, K.
1977 The sites. Survey of the lower catchment of the Ayiofarango valley. *BSA* 72: 32-84.

Blackman, D.J.
1982 Ancient harbours in the Mediterranean. Part I & II. *IJNA* 11.2: 79-104; 11.3: 185-212.

Blue Guide
1988 *Blue Guide. Crete.* ed. P. Cameron. London: A. & C. Black.

Boardman, J.
1966 Evidence for the dating of Greek settlements in Cyrenaica. *BSA* 61: 149-156.

Boardman, J.
1973 *The Greeks Overseas: the archaeology of their early colonies and trade.* Second edition. Pelican Books. Harmondsworth: Penguin.

Bosanquet, R.C.
1901-2 Excavations at Palaikastro. *BSA* VIII.

Bosanquet, R.C.
1904 Some 'Late Minoan' vases found in Greece. *JHS* 24: 317-329.

Bosanquet, R.C.
1939-40 Dikte and the temples of Dictaean Zeus. *BSA* 40: 60-77.

Bothwell, D. & Dimbley, G. (eds.)
1981 *Environmental aspects of coasts and islands.* BAR International Series 94.

Bounni, A.J., Largarce, E., Saliby, N. & Badre, L.
1979 Rapport préliminaire sur la troisieme campagne de fouilles (1977) à Ibn Hani (Syrie). *Syria* LVI: 217-315.

Bourriau, J.
1987 Kom Rabi'a (Memphis). *Bulletin de Liason du Groupe Internationale d'Étude de la Céramique Égyptienne* 12: 10-11.

Bowen, Baron, Le R. (Jr.)
1960 Egypt's earliest sailing ships. *Antiquity* 34: 117-131.

Boyd, H. A.
1904 *Gournia. Report of the American Exploration Society Excavation at Gournia, Crete 1901-3.* Pennsylvania: Dept. of Archaeology, University of Pennsylvania.

Braidwood, R.J.
1937 *Mounds in the Plain of Antioch.* Chicago: University of Chicago Press.

Braidwood, R.J.
1940 Report on two sondages on the coast of Syria, south of Tartous. *Syria* 21: 183-221.

Braidwood, R.J. & Braidwood, L.S.
1960 *Excavation in the Plain of Antioch I. The earliest assemblages. Phases A-J.* Chicago, Illinos: University of Chicago Press.

Branigan, K.
1972 Minoan settlements in East Crete. Pp. 751-759 in *Man, settlement and urbanism*: proceedings of a meeting of the Research Seminar in archaeology and related subjects. Institute of Archaeology, eds. P.J. Ucko, R. Tringham & G.W. Dimbleby. London: Duckworth.

Branigan, K.
1991 Mochlos - An early Aegean 'Gateway community ?'. Pp. 97-195 in *Thalassa: l'égée prehistorique et la mer. Aegaeum 7*, eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Braudel, F.
1972 *The Mediterranean world in the age of Philip II.* I. Transl. S. Reynolds. London: Collins.

Breasted, J.H.
1906 *Ancient records of Egypt.* III. Chicago: University of Chicago Press.

Breasted, J.H.
1907 *Ancient records of Egypt.* IV. Chicago: University of Chicago Press.

Breslau, L.R. & Edgerton, H.E.
1972 The Gulf of La Spezia, Italy. A case history of seismic-sedimentological correlation. Pp. 177-188 in *The Mediterranean Sea*, ed. D.J. Stanley. Pennsylvannia: Dowden, Hutchinson Ross, Stroudsborg.

Broodbank, C.
1989 The long boat and society in the Cyclades in the Keros-Syros culture. *AJA* 93: 319-337.

Broshi, M.
1977 Tel Megadim. *AY*.III: 823-826.

Bryce, T.R.
1974 Some geographical and political aspects of Mursilis' Arzawan campaign. *AS* 24: 103-116.

Buchholz, H.-G.
1987 *Ägäische Bronzezeit*. Darmstadt: Wissenschafliche Buchesellschaft.

Burney, C.
1977 *From village to empire: An introduction to Near Eastern Archaeology*. Oxford: Phaidon.

Butzer, K.W.
1971 *Environment and Archaeology: an introduction to pleistocene geography*. London: Methuen.

Butzer, K.W.
1976 *Early hydraulic civilisation in Egypt: a study in cultural ecology*. Chicago: University of Chicago Press.

Cadogan, G.
1973 Patterns in the distribution of Mycenaean pottery in the eastern Mediterranean. Pp. 166-174 in *MEM*.

Cadogan, G.
1976 *Palaces of Minoan Crete*. London: Barrie & Jenkins.

Cadogan, G.
1979 Cyprus and Crete c. 2000-1400 BC. Pp. 63-68 in *The relations between Cyprus and Crete c. 2000-500 BC*. Acts of the International Symposium. Nicosia: Department of Antiquties, Cyprus.

Cadogan, G.
1986 Maroni in Cyprus, between West and East. Pp. 104-113 in *Cyprus between the Orient and Occident*, Acts in International Archaeology Symposium, ed. V. Karageorghis. Nicosia: Department of Antiquities.

Cadogan, G.
1992 Gournia. Pp. 104-112 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Cadogan, G.

1993 Cyprus, Mycenaean pottery, trade and colonisation. Pp. 91-99 in *Pottery as evidence for trade in the Aegean Bronze Age 1939-1989*. Proceedings of the International Conference, Wace and Blegen, eds. C. Zerner, P. Zerner & J. Winder. Amsterdam: Gleben.

Cambridge Expedition
1977 *The Cambridge Expedition to Gemili and Kekova, 1977*. Cambridge: Cambridge University Underwater Exploration Group.

Carter, R.S.
1978 The submerged seaport of Aperlae, Turkey. *IJNA* 7.3: 177-185.

Casson, L.
1950 The Isis and her voyage. *American Philological Association, Transactions Proceedings* 81: 43-56.

Casson, L.
1967 The river boats of Mesopotamia. *MM* 53: 286-288.

Casson, L.
1971 *Ships and seamanship in the ancient world*. New Jersey: Princeton University Press.

Casson, L.
1975 Bronze Age ships. The evidence of the Thera paintings. *IJNA* 4.1: 3-11.

Castle, E.W.
1992 Shipping and trade in Ramesside Egypt. *Journal of Economic and Social History of the Orient*. 35.3: 239-277.

Catling, H.W. & Karageorghis, V.
1960 Minoika in Cyprus. *BSA* 55: 109-127.

Catling, H.W.
1963 Patterns of Settlement in Bronze Age Cyprus. *Opuscula Atheniensa* IV: 129-169. Lund: CWK Gleerup.

Catling, H.W.
1964 *Cypriot bronzework in the Mycenaean world*. Monographs on Classical Archaeology. Oxford: OUP.

Catling, H.W.
1966 Cyprus in the Neolithic and Early Bronze Age period. *CAH*. Revised edition of volume I & II. Cambridge: CUP.

Catling, H.W.
1973 Cyprus in the Middle Bronze Age. Pp. 165-175 in *CAH* II.1 (Third edition). Cambridge: CUP.

Catling, H.W.
1973b The Achaean settlement of Cyprus. Pp. 34-39 in *MEM*.

Catling, H.W.
1975 Cyprus in the Late Bronze Age. Pp. 188-216 in *CAH* II.2 (3rd edition). Cambridge: CUP.

Chapouthier, F. & Demargne, P.
1962 Fouilles exécutées à Malia. Quatrième rapport: Exploration du Palais. *Études Cretoises*. XII. Paris: Libraire Orientaliste Paul Geuthner.

Chester, G.J.
1880 A journey to the Biblical sites of Lower Egypt. *Palestine Exploration Fund Quarterly Studies* : 140-158.

Cledat, M.J.
1916-17 Fouilles à Khirbet el-Flousiyeh. *Annales du Service des Antiquités de l'Égypte* 16: 1-32.

Clerc, G., Karageorghis, V., Lagarce E. & Leclant, J.
1976 Objects égyptiens et égyptisants. *Fouilles de Kition* II. Nicosia: Zavallis Press.

Cline, E.
1987 Amenhotep III and the Aegean: A reassesment of Egyto-Aegean relations in the 14th century BC. *Orientalia* 56: 1-36.

Cline, E.H.
1994 *Sailing the wine-dark sea. International trade and the Late Bronze Age Aegean*. BAR International Series 591. Oxford: Tempvs Reparatum.

Coates, J.F.
1987 Interpretations of ancient ship representations. *MM* 73: 197,notes.

Collombier, A.M.
1987 Modifications des lignes de rivage et ports antiques de Chypre: état de la question. Pp. 159-172 in *Déplacements des lignes de rivage en Méditerranée*. Aix-en-Provence, 5th-7th Sept. 1985. CNRS. Colloques Internationaux du CNRS. Paris: Editions du Centre National de la recherche Scientifque.

Collombier, A.M.
1988 Harbour or harbours of Kition on the SE coast of Cyprus. Pp. 35-46 in *The Archaeology of coastal changes*, ed. A. Raban. BAR International Series, 404. Oxford.

Conder, C.R. (translated by)

1894 *The Tell Amarna Tablets*. London: Committee of the Palestine Exploration Fund.

Courbin, P.
1972 Rapport sur la fouille de Ras el Bassit 1971. *Annals Archéologie Arabes Syriennes* 22: 45-61.

Courbin, P.
1973 Ras el Basit. Rapport sur la campagne de 1972. *Annales Archéologie Arabes Syriennes* 23: 25-38.

Courbin, P.
1986 Bassit. *Syria* 63: 175-220.

Courtois, J-C., Lagarce, J. & Lagarce, E.
1986 *Enkomi et le Bronze Récent à Chypre*. Nicosie, Chypre: Fondation A.G. Leventis.

Davaras, C.
1976 *Guide to Cretan antiquities*. Park Ridge, New Jersey: Noyes Press.

Davaras, C.
1982 *Hagios Nikolaos Museum*. Athens: Hannibal.

Davaras, C., Betancourt, P. & W. & Farrand, R.
1992 Pseria. Pp. 262-268 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Davies, N. de G.
1903 *The rock tombs of El Amarna. Part I - The tomb of Meyra*. Archaeological survey of Egypt. London: Egyptian Exploration Fund.

Davies, N. de G.
1906 *The rock tombs of El Amarna. Part IV - Tombs of Penthu, Mahu and others*. Archaeological survey of Egypt. London: Egyptian Exploration Fund.

Davies, N. de G.
1908 *The rock tombs of el Amarna. Part V - Smaller tombs and boundary stelae*. Archaeological survey of Egypt. London: Egyptian Exploration Fund.

Davies, N. de G.
1926 *The tomb of Huy*. London.

Davies, N. de G.
1933 *The tomb of Nefer-Hotep*. New York: Metropolitan Museum of Art, Egypt Expedition.

Davies, N. de G. & Faulkner, R.O.
1947 A Syrian trading venture to Egypt. *Journal of Egyptian Archaeology* 33: 40-46.

Demitzakis, M.D.
1973 Recent tectonic movements and old shorelines along the coasts of Crete. *Bulletin of the Geological Society of Greece* 10.1: 48-64.

Denham, H.M.
1964 *The Eastern Mediterranean. A sea-guide to its coasts and islands*. London: John Murray.

Denham, H.M.
1986 *The Aegean. A sea-guide to its coasts and islands*. London: John Murray.

Des Gagniers, J. & Tinh, T.T.
1985 *Soloi. Dix campagnes de fouilles (1964-1974)*. Premier volume. Sainte-Foy: Les Presses de l'Université Laval.

Detournay, B., Poursat, J.-C. & Vandenabeele, F. (eds.)
1980 *Fouilles exécutées à Malia, Le Quartier Mu II. Études Crétoises* 26. Paris: Libraire Orientaliste Paul Geuthner.

Dikaios, P.
1969 *Enkomi: excavations 1948-1958*. Vol.IIIb. Plates. Mainz, Rhein: P. von Zabern.

Dikaios, P.
1971 *Enkomi: excavations 1948-1958*. Vol.II. Mainz: von Zabern.

Doe, A.
1973 *Aspects of Agiofarango geography*. Undergraduate dissertation. Department of Geography, University of Bristol.

Dossin, G.
1939 Les archives economiques du Palais de Mari. *Syria* 20: 97-113.

Dossin, G.
1970 La route de l'étain en Mésopotamie au temps de Zimri-Lim. *Revue d' Assyriologie* 64.2: 97-106.

Dossin, G. & Birot, M.
1947-82 *Archive Royales de Mari 1-32*. Musée du Louvre, Department des antique orientales. Textes cunéiformes. Paris.

Dothan, M.
1960 Excavations at Tell Mor, 1959. *Bulletin of the Israeli Exploration Society* 24.2-3: 120-132.

Dothan, M.
1973 The foundation of Tell Mor and of Ashdod. *IEJ* 23.1: 1-17.

Dothan, M.
1976 Akko: Interim excavation report. First season, 1973/4. *BASOR* 224 (Dec.): 1-48.

Dothan, M.
1977 Tel Mor. *AY*.III: 889-890.

Dothan, M.
1977b Nahariya. *AY*.III: 908-912.

Dothan, M.
1988 The significance of some artisans workshops along the Canaanite coast. Pp. 295-303 in *Society and economy in the Eastern Mediterranean, c. 1500-1000 BC*. Orientalia Lovaniensia Analecta 23, eds. M. Heltzer & E. Lipinski. Leuven: Uitgeverij Press.

Dothan, T. & Dothan, M.
1992 *People of the Sea: the search for the Philistines*. Canada: Maxwell Macmillan.

Dothan, M.
1993 Deir el-Balah. *EAEHL*: 343-347.

Downey, G.
1961 *A history of Antioch in Syria from Seleucus to the Arab conquest*. Princeton, New Jersey: Princeton University Press.

Drower, M.S.
1968 Ugarit. *CAH* (Revised edition of) II. Ch.XXI (b). Cambridge: CUP.

Drower, M.S.
1973 Syria c. 1550-1400 BC. Pp. 417-525 in *CAH* II.1 (3rd edition). Cambridge: Cambridge University Press.

Drower, M.S.
1975 Ugarit. Pp. 130-160 in *CAH* II.2 (3rd edition). Cambridge: Cambridge University Press.

Dunand, M.
1938 *Fouilles de Byblos 1926-1939, I. Text and Atlas*. Paris: Paul Geuthner.

Dunand, M.
1950 *Chronolgie des plus anciennes installations de Byblos*. Extract Revue Biblique, tome 57. Paris.

Dunand, M.
1954 *Fouilles de Byblos II*. Paris: A. Maisonneune.

Dunand, M.
1963 *Byblos son histoire, ses ruines, ses légendes*.

Beyrouth: Librairie Adrien-Maisonneuve.

Dussaud, R.
1927 *Topographie historique de la Syrie antique et Médiévale*. Paris: Librairie Orientaliste Paul Geuthner.

Earle, T.K. & Ericson, J.E. (eds.)
1977 *Exchange systems in prehistory. Studies in Archaeology*. New York: Academic Press.

Effenterre, H. van
1980 *Le palais de Malia et le cité Minoenne, I.* Roma: Edizioni dell' Ateneo.

Effenterre, H. van
1992 Malia. Pp. 216-221 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Eiselen, F.C.
1907 *Sidon: a study in oriental history*. Columbia University Oriental Studies IV. New York.

Eişma, D.
1978 Stream deposition and erosion by the eastern shore of the Aegean. Pp. 67-81 in *The environment of the Near and Middle East since the last Ice Age*, ed. Brice, W. London: Academic Press.

Elgavish, J.
1975 Shiqmona 1975. News and Notes. *IEJ* 25: 258.

Elgavish, J.
1977 Shiqmona 1976. News and Notes. *IEJ* 27: 167.

Elgavish, J.
1978 Shiqmona. News and Notes. *IEJ* 28: 122-123.

Emery, K.O. & Neev, D.
1960 Mediterranean beaches of Israel. *Bulletin Geological Survey of Israel* 26: 1-24.

Emery, W.B.
1961 A preliminary report on the excavation of the Egyptian Exploration at Buhen, 1959-1960. *Kush (Journal of Sudan Antiquities Service)* 9: 81-86.

Empereur, J-V. & Verlinden, C.
1987 The underwater excavation at the ancient port of Amathus in Cyprus. *IJNA* 16.1: 7-18.

ENALIA
1995 The 1991 underwater survey of the Late Bronze Age wreck at Point Iria. *Hellenic Institute of Marine Archaeology* 3: 4-16.

Engvig, O.T. and Åström, P.
1975 *The Cape Kiti Survey. An underwater archaeological survey. Hala Sultan Tekke II.* SIMA XLV.2. Göteborg: Paul Åström Förlag.

Erinç, S.
1961 On the Pleistocene terraces of Çukurova (Cilician Plain). *Abstract of Papers. VIth International Congress INQUA.* Poland.

Erinç, S.
1978 Changes in the physical environment of Turkey since the end of the last Glacial. Pp. 87-108 in *Environmental history of the Near and Middle East since the last Ice Age*, ed. W. Brice. London: Academic Press.

Erman, A.
1927 *The literature of the ancient Egyptians: poems, narratives and manuals of instruction, from the third and second millennia BC.* Tansl. A.M. Blackman. London: Methuen & Co.

Erol, O.
1967 Observations on the Anatolian coastline during the Holocene. Pp. 95-102 in *Convegno Internationale de Studi Sulle Antichita di Classe. 14-17 Oct.1967.* Ravenna, Italy: Congress publication.

Evans, A.
1921 *Palace of Minos, I.* London: Machmillian & Co., Ltd.

Evans, A.
1928 *Palace of Minos, II*: Part I. London: Machmillian & Co., Ltd.

Evans, A.
1935 *Palace of Minos, IV.* London: Machmillian & Co., Ltd.

Evans, G.
1971 The recent sedimentation of Turkey and the adjacent Mediterranean and Black Seas: A review. Pp. 385-406 in *Geology and History of Turkey*, ed. A.S. Campbell. Tripoli: Petrological Exploration Society of Libya.

Evans, G.
1973 Recent coastal sedimentation: a review. Pp. 89-114 in *Marine Archaeology. Proceedings of the 23rd Symposium of the Colston Research Society, 1971*, ed. D.J. Blackman. London: Butterworths.

Evans, G., Morgan, P., Evans, W., Evans, T. & Woodside, J.

1978 Faulting and halokinetics in the NE Mediterranean between Cyprus and Turkey. *Geology* 6: 392-396.

Fairbridge, R.W.
1958 Dating the latest movements of the Quaternary sea-level. *Transactions, New York Academy of Sciences* 20: 471-482.

Fairbridge, R.W.
1972 Quaternary sedimentation in the Mediterranean region controlled by tectonics, paleoclimates and sea level. Pp. 99-113 in *The Mediterranean Sea*, ed. D.J. Stanley. Pennsylvannia: Dowden, Hutchinson Ross, Stroudsborg.

Fatimi, S.Q.
1995 History of the development of the Kamal. in *Techno-Archaeological perspectives of seafaring in the Indian Ocean*. Proceedings of a seminar in Delhi Feb/ March 1994. In press.

Faure, P.
1963 Toponymes Créto-Mycéniens dans une liste d'Aménophis III. *Kadmos* 7: 139-149.

Febvre, L.
1932 *A geographical introduction to history*. London: Kegan, Trench, Trubner & Co. Ltd.

Fensham, F.C.
1967 Shipwreck in Ugarit and ancient Near Eastern law codes. *Oriens Antiquvs* VI: 221-224.

Fevret, M. & Sanlaville, P.
1965 Contributions à l'étude du littoral libanais. *Mediterranee* Rev. Géographie (Aix-en-Provence) 2.

Fevret, M. & Sanlaville, P.
1966 De l'utilisation des Vermets dans à la determination des anciens niveaux marins. *Mediterranée*. Rev. Géographie (Aix-en-Provence) 4 (Oct.-Dec.): 357-364.

Fevret, M., Picard, J. & Sanlaville, P.
1967 Sur la possibilité de datation de niveaux marins quaternaires par les Vermets. *C.R.Acad.Science* (Paris) 264: 1407-1409.

Fevrier, J.G.
1950 L'ancienne marine phenicienne et les decouvertes recontes. *La Nouvelle Clio* 2: 135.

Finkelstein, I.
1992 MBA fortifications: A reflection of social organisation and political formations. *Tel Aviv* 19.2: 201-220.

Flemming, N.C.
1969 Archaeological evidence for eustatic change of sea level and earth movements in the western Mediterranean during the last 2000 years. *Geological Society of America, Special paper* 109.

Flemming, N.C.
1972 *Cities in the sea*. New York: Doubleday.

Flemming, N.C.
1972b Eustatic and tectonic factors in the relative vertical displacement of the Aegean coast. Pp. 189-202 in *Sedimentation of the Meditarranean*, ed. D.J. Stanley. Smithsonian Institute.

Flemming, N.C.
1973 *Survey of change of sea and land level* (unpublished).

Flemming, N.C., Czartoryska, N.M.G. & Hunter, P.M.
1973 Archaeological evidence for eustatic and tectonic components of relative sea level change in the South Aegean. Pp. 1-66 in *Marine Archaeology*. Colston Papers 23, ed. D.J. Blackman. London: Butterworths.

Flemming, N.C.
1974b Report of preliminary under water investigations at Salamis, Cyprus. *RDAC* :163-173.

Flemming, N.C.
1974 Changes of land and sea level in the Aegean area since the Bronze Age. *Bulletin Institute of Classical Studies* 21: 155-157.

Flemming, N.C.
1978 Holocene eustatic changes and coastal tectonics in the NE Mediterranean: Implications for models of crustal consumption. *Philosophical Transactions of the Royal Society of London* 289.1362: 405-458.

Flemming, N.C., Raban, A. & Goetschel, C.
1978 Tectonic and eustatic changes on the Mediterranean coast of Israel in the last 9000 years. Pp. 33-94 in *Progress in Underwater Science*, 3, eds. J.C. Gamble & R.A. York. London: Pentech Press.

Flemming, N.C.
1980b *Coastal archaeological sites in the NE Mediterranean: An inventory* (Unpublished).

Flemming, N.C.
1980 Cities under the Mediterranean. Pp. 162-167 in *Archaeology underwater: an atlas of the world's*

*submerged sites*, ed. K. Muckelroy. New York: McGraw-Hill Book Company.

Flemming, N.C. & Pirazzoli, P.A.
1981 Archeologie des côtes de la Crete. *Histoire et Archeologie (Les Dossiers)* 50: 66-87.

Flemming, N.C.
1983 Survival of submerged lithic and Bronze Age artifact sites. A review of case studies. Pp. 135-174 in *Quaternary coastlines and marine archaeology*, eds. P.C. Masters & N.C. Flemming. London: Academic Press.

Flemming, N.C.
1986 *The Medsite Database - A reference catalogue of coastal archaeological sites in the Mediterranean.*

Flemming, N.C. & Webb, C.O.
1986 Tectonic and eustatic coastal changes during the last 10,000 years derived from archaeological data. *Z. Geomorph. N.F. Suppl.-Bd.* 62. Berlin: Stuttgart.

Flemming, N.C.
1995 Sea level, neotectonics and changes in coastal settlements: threat and response. *The Sea and History, 24th January 1995, Wolfson College Lecture Series*. In press.

Flourentzos, P.F.
1991 *Excavations in the Kouris Valley I. The tombs.* Nicosia: Republic of Cyprus, Department of Antiquities.

Frazer, J.G. (transl.)
1898 *Pausanias's description of Greece.* London: MacMillian & Co. Ltd.

Frost, H.
1963 *Under the Mediterranean.* London.

Frost, H.
1963b From rope to chain, the development of anchors in the Mediterranean. *MM* 49: 1-20.

Frost, H.
1964 Rouad, Ses récifs et mouillages. Prospection sous-marine. *Annals Archéologies de Syrie* 14: 67-74.

Frost, H.
1966 The Arwad Plans, 1964. *Annales Archéologies de Syrie* 16: 13-28.

Frost, H.
1969b The stone anchors of Ugarit. Pp. 235-245 in *Ugaritica VI*. XXXeme campagne de fouilles à Ras Shamra (1968). Tome XVII, ed. C.F.A. Schaeffer. Paris: Mission Archéologiques de Ras Shamra.

Frost, H.
1969 On the plotting of vast and partly submerged harbour works from aerial and underwater photographs in *Surveying in archaeology underwater*. Colt Monograph, eds. P. Throckmorton et al. No.5: 31-45. London.

Frost, H.
1970 The case for a Bronze Age dating for the submerged harbourworks at Arwad. P. 63-71 in *Sociétés et compagnies de commerce en orient et dans l'océan Indien*. Actes du huitème colloque international d'histoire maritime, symposium entitled, ed. M. Mollat. Paris.

Frost, H.
1970a Some Cypriot stone anchors from land sites and from the sea. *RDAC* : 14-24.

Frost, H.
1970b Bronze Age stone-anchors from the eastern Mediterranean. Dating and identification. *MM* 56: 377-394.

Frost, H.
1970c Stone-anchors as indicators of early trade routes. Pp. 55-61 in *Sociétés et compagnies de commerce en orient et dans l'océan Indies*. Actes du huitème collogue international d'historie maritime, ed. M. Mollart. Paris.

Frost, H.
1971 Recent observations on the submerged harbourworks at Tyre. *Bulletin du Musée de Beyrouth* 24: 103-111.

Frost, H.
1972 Ancient harbours and anchorages in the eastern Mediterranean. Pp. 95-114 in *Underwater Archaeology. A nascent discipline*. Paris: UNESCO.

Frost, H.
1973 The offshore island harbour at Sidon and other Phoenician sites in the light of new dating evidence. *IJNA* 2.1: 75-94.

Frost, H.
1973b Anchors: The potsherds of marine archaeologists: on the recording of pierced stones from the Mediterranean. Pp. 397-410 in *Marine Archaeology*.

*Colston Papers* 23, ed. D.J.Blackman. London: Butterworths.

Frost, H.
1974 Mediterranean harbours and ports of call in the Bronze Age and Iron Age. *Les Grandes Escales.* Acts du 10eme Colloque de la Commission Int. de Histoire Maritime, Soc. Jean Bodin. No.32: 35-41. Bruxelles.

Frost, H.
1980 *Proto-harbours in the eastern Mediterranean.* Bulgarian conference. In press.

Frost, H.
1995 Where did Bronze Age ships keep their stone anchors? Pp. 167-175 in *Tropis III, 3rd International Symposium on ship construction in antiquity*, ed. H. Tzalas. Athens: Hellenic Institute for the presevation of nautical tradition.

Frost, H.
1995b Harbours and Proto-harbours; Early Levantine engineering. Pp. 1-21 in *Cyprus and the Sea.* Proceedings of the International Symposium, eds. V. Karageorghis & D. Michaelides. Nicosia: University of Cyprus.

Gale, N.H.
1991 Copper oxhide ingots: their origin and their place in the Bronze Age metals in the Mediterranean. Pp. 197-239 in *Bronze Age trade in the eastern Mediterranean.* SIMA 90, ed. N.H. Gale. Göteborg: Paul Åström Förlag.

Galili, E.
1985 A group of stone anchors from Newe-Yam. *IJNA* 14.2: 143-153.

Galili, E. & Weinstein-Evron, M.
1985 Prehistory and Palaeoenvironments of submerged sites along the Carmel coast of Israel. *Paléorient* 11.1: 37-52.

Galili, E.
1986 Underwater survey, 1986. *ESI* 5: 109-110.

Galili, E., Raban, A. & Engert, A.
1990 Sedot Yam, Jetty. *ESI* 10: 40.

Galili, E., Dahari, U. & Sharvit, J.
1993 Underwater surveys and rescue excavation along the Israeli coast. *IJNA* 22.1: 61-77.

Galili, E. & Sharvit, J.

1994 Classification of underwater archaeological sites along the Mediterranean coast of Israel: Finds from underwater and coastal archaeological research. *Thracia Pontica* 5. Varna.

Galili, E., Sharvit, J. & Artzy, M.
1994b Reconsidering Byblian and Egyptian stone anchors using numeral methods: new finds from the Israeli coast. *IJNA* 23/2: 93-107.

Gardiner, A.
1909 *The admonitions of an Egyptian sage from a hieratic papyrus in Leiden.* (Pap. Leiden 344 recto). Leipzig: J.C. Hinrichs.

Gardiner, A.H.
1920 The ancient military road between Egypt and Palestine. *Journal of Egyptian Archaeology* 6: 99-111.

Gardiner, A.H.
1947 *Ancient Egyptian Onomastica I-II.* Oxford: OUP.

Garstang, J.
1921 The Fund's excavation of Ashkalon. The excavation of Ashkalon, 1920-21. Ashkalon reports. *Palestine Exploration Fund Quarterly Statement*: 12-16,73-75,162-163.

Garstang, J.
1924a Tantura (Dora). *Bulletin of the British School of Archaeology at Jerusalem* 6: 65-75.

Garstang, J.
1924 Tantura (Dora). *Bulletin of the British School of Archaeology at Jerusalem* 4: 34-45.

Garstang, J.
1938 Explorations in Cilicia. The Neilson Expedition Preliminary Report II. *University of Liverpool Annals of Archaeology & Anthropology* 25.1-2 (June): 12-23.

Garstang, J.
1940 Exploration in Cilicia 1938-9. The Neilson Expedition. 4th Interim Report. Excavation at Mersin, 1938-39. *University of Liverpool Annals of Archaeology & Anthropologyy* 27: 38-50.

Garstang, J.
1941 Arzawa and the Lugga lands. *Belleten* 5: 18-46.

Garstang, J.
1943 Discoveries at Mersin and their significance. *American Journal of Archaeology* 47: 1-12.

Garstang, J.
1953 *Prehistoric Mersin. Yümük Tepe in southern Turkey*. Oxford: Claredon Press.

Gates, M-H. & Özgen, I.
1992 *Kinet Hüyük*. Report for the IAA conference.

Gates, M-H.
1992 *Second and final report on the 1992 Bilkent University/Hatay Museum excavation at Kinet Höyük (Yeşil-Dörtyol, Hatay)*. Unpublished.

Geo. Handbook
1941 *Geographical Handbook Series. Dodecanese*. Naval Intelligence Division. B.R.500.

Geo. Handbook
1942 *Geographical Handbook Series. Turkey* Vol.I & II. Naval Intelligence Division. B.R.507.

Geo. Handbook
1943 *Geographical Handbbok Series. Syria*. Naval Intelligence Division. B.R.513.

Geo. Handbook
1943b *Geographical Handbbok Series. Palestine and Jordan*. Naval Intelligence Division. B.R.514.

Geo. Handbook
1945 *Geographical handbook Series. Greece*. Vol.III. Naval Intelligence Division. B.R.516B.

Georgiou, H.
1979 Relations between Cyprus and the Near East in the Middle and Late Bronze Age. *Levant* 11: 84-99.

Georgiou, H.S.
1991 Bronze Age ships and rigging. Pp. 61-71 in *Thalassa: l'égée prehistoique et la mer. Aegeaum* 7, eds. R. Laffineur & L. Basch. Liége: Univerité de Liége.

Geva, S.
1982 Tell Jerishe. The Sukenik excavation of the Middle Bronze Age fortitications. *QEDEM* 15. Jerusalem: Monographs of the Institute of Archaeology, Hebrew University.

Giangrande, C., Richards, G., Kennet, D. & Adams, J.
1987 Cyprus underwater survey, 1983-4. A preliminary report. *RDAC* : 185-197.

Gifford, J.A.
1978 *Palaeogeography of archaeological sites of the Larnaca Lowlands, SE Cyprus*. Unpublished Ph.D. dissertation, University of Minnesota.

Gifford, J.A.
1985 Palaeogeography of ancient harbour sites of the Larnaca Lowlands, SE Cyprus. Pp. 45-48 in *Harbour Archaeology, Proceedings in the 1st International workshop on ancient Mediterranean harbours Caesarea Maritima*, ed. A. Raban. BAR International Series 257.

Gifford, J.A.
1985b Post-Bronze Age coastal change in the vicinity of Kition. Pp. 375-387 in *Excavations at Kition V.1. Text. The Pre-Phoenician Levels, Areas I and II.* Appendix IV, eds. V. Karageorghis & M. Demas. Nicosia: Dept. of Antiquities, Cyprus.

Gifford, J.A. & Rapp, G.Jr.
1989 Palaeogeography of the Central Sharon coast. Pp. 203-208 in *Excavations at Tel Michal, Israel*, eds. Z. Herzog, G. Rapp (Jr.) & O. Negbi. Minneapolis: University of Minnesota Press.

Gifford, J.A.
1992 The gromorphology of Crete. Pp. 17-26 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Gillmer, T.
1985 The Thera ships as sailing vessels. *MM* 71: 401-416.

Gilmour, G.H.
1991 *Mycenaeans in the East? An assessmant of the contacts between the Mycenaean world and southern Levant in the Late Bronze Age*. August 1991. Masters Degree. Hebrew University. Jerusalem.

Gittlen, B.M.
1975 Cypriot White Slip pottery in its Palestinian stratigraphic context. Pp. 111-120 in *The Archaeology of Cyprus*, ed. N. Robertson. New Jersey: Noyes Press.

Gjerstad, E.
1926 *Studies in Prehistoric Cyprus*. Uppsala: A.-B. Lundequistska Bokhandeln.

Gjerstad, E.
1934 Cilician survey. Cilician Studies III-IV. *Revue Archéologique* 104-105. 6th Series. 158: 155-203.

Gjerstad, E., Lindros, J., Sjöqvist, E., & Westholm, A.
1934 *The Swedish Cyprus Expedition. Finds and results of excavations in Cyprus. 1927-1931. Vol.I Text.* The Swedish Cyprus Expedition: Stockholm.

Glanville, S.R.K.

1931 Records of the Royal Dockyard of the time of Tuthmosis III. Papyrus B.M. 10056. *Zeitschrift für Ägyptische Sprache und Altertum Skunde* 66: 105-109.

Glanville, S.R.K.
1932 Part II Commentary. *Zeitschrift für Ägyptische Sprache und Altertum Skunde* 68: 7-41.

Goedicke, H.
1975 *The report of Wenamun*. Baltimore: John Hopkins University Press.

Goldman, H.
1935 Preliminary exploration of Cilicia and excavation. *AJA* 39: 526-549.

Goldman, H.
1950 *Excavation at Gözlu Kule, Tarsus*. Princeton, New Jersey: Princeton University Press.

Gomez, B.
1987 The alluvial terraces and fills of the lower Vasilikos valley, in the vicinity of Kalavassos, Cyprus. *Transactions of the Institute of British Geographers* 12: 345-359.

Gomez, B. & Pease, P.P.
1992 Early Holocene Cypriot coastal palaeogeography. *RDAC* : 1-8.

Godwin, H., Suggate, R.P. & Willis, E.H.
1958 Radiocarbon dating of the eustatic rise in ocean level. *Nature* 181: 1518-1519.

Gophna, R. & Kokhavi, M.
1966 Tell Girit. News and Notes. *IEJ* 16: 143-144.

Gophna, R.
1973 The Middle Bronze Age II. Fortifications at Tel Poleg. *Eretz Israel* 11: 111-119. (Hebrew).

Gophna, R.
1978 Tel Poleg. *AY*.IV: 959-960.

Gophna, R.
1978b An archaeological survey of the Plain of Sharon. *AY*.IV: 1071-1074.

Gophna, R.
1993 Nahal Poleg and Tel 'Ashir. *EAEHL*: 1193-1195.

Gordon, C.H.
1958 Abraham and the merchants of Ura. *Journal of Near Eastern Studies* 17: 28-31.

Gordon, C.H.
1947 *Ugaritic textbook* I. Analecta Orientalia, 25. Rome.

Gordon, C.H.
1965 *Ugaritic textbook* II. Analecta Orientalia, 38. Rome.

Goudie, A.
1983 *Environmental Change. Contemporary problems in Geography*. Oxford: Claredon Press.

Goyon, G.
1971 Les ports des pyramids et le grand canal de Memphis. *Revue d'Égyptologie* 23: 136-153.

Grace, V.R.
1940 A Cypriot tomb and Minoan evidence for its date. *AJA* 44: 10-52.

Grace, V.
1956 The Canaanite jar. Pp. 80-109 in *The Aegeans and the Near East*. Studies presented to H. Goldman, ed. S.S. Weinberg. New York: J.J. Augustin.

Green, J.N.
1973 An underwater archaeological survey of Cape Andreas, Cyprus, 1969-1970: a preliminary report. Pp. 141-178 in *Marine Archaeology. Colston Papers*, ed. D.J. Blackman. London: Butterworths.

Grossman, E.
1989-90 Apollonia and Tel Michal, underwater survey. *ESI* 9: 139.

Guest-Papamanoli, A. & Treuil, R.
1979 Bâtiment immergé. *BCH* 103: 668-669.

Guest-Papamanoli, A.
1989 Les carrières de grès dunaire à Malia. *BCH* 113: 113-122.

Gurney, O.R.
1962 Anatolia, c. 1750-1600 BC. Pp. 228-255 in *CAH* II.1 (2nd edition). Cambridge: Cambridge University Press.

Gurney, O.R.
1975 *The Hittites*. London: Allenlane.

Güterbock, H.G.
1967 The Hittite conquest of Cyprus reconsidered. *JNES* 26: 73-81.

Guy, P.L.O.
1924 Mount Carmel. An early Iron Age cemetery.

*Bulletin of the Palestine Museum* 1: 47-55. Jeruslem.

Hadjidaki, E.
1977 *Ancient harbours in the Mediterranean, with particular reference to Greece and the Aegean.* Sept. 1977. MA Thesis. Manchester University.

Hägg, R. & Marinatos, N. (eds.)
1984 *The Minoan thalassocracy: myth and reality.* Proceedings 3rd International Symposium, Swedish Institute in Athens, June 1982. Göteberg: P. Åström's Förlag.

Hägg, R. & Marinatos, N. (eds.)
1987 *Function of Minoan Palaces.* Proceedings 4th International Symposium, Swedish Institute in Athens, June 1986. Göteberg: P. Åström's Förlag.

Haifa Survey
1987/8 *Survey along the coast of southern Turkey*, ed. A. Raban. CMS Haifa University. Unpublished.

Halstead, P.
1988 On redistribution and the origin of Minoan-Mycenaean palatial economies. Pp. 519-530 in *Problems in Greek Prehistory*, eds. E.B. French & K.A. Wardle. Bristol: Bristol Classical Press.

Hamilton, W.J.
1842 *Researches in Asia Minor.* London.

Hamilton, R.W.
1934 Tell Abu Hawam. Interim report. *Quarterly of the Dept. of the Antiquities in Palestine* 3: 74-80.

Hamilton, R.W.
1934b Tell Abu Hawam. *Quarterly of the Dept. of the Antiquities in Palestine* 4: 1-69.

Hanauer, J.E.
1903 The traditional 'harbour of Solomon' and the Crusader castle at Jaffa. *PEFQS*: 258-264.

Hankey, V.
1967 Mycenaean pottery in the Middle East: Notes on finds since 1951. *BSA* 62: 107-147.

Hankey, V.
1973 The Aegean deposit at El Amarna. Pp. 128-132 in *Mycenaeans in the Eastern Mediterranean.* Acts of International Symposium, foreword, V. Karageorghis. Nicosia: Department of Antiquities.

Hankey, V.
1993 Pottery as evidence for trade: The Levant from

the mouth of the River Orontes to the Egyptian border. Pp. 101-108 in *Pottery as evidence for trade in the Aegean Bronze Age, 1939-1989*. Proceedings of the International Conference, Wace and Blegen, eds. C. Zerner, P. Zerner and J. Winder. Gleben: Amsterdam.

Harding, A.F.
1984 *The Mycenaeans and Europe*. London: Academic Press.

Haya, H. & Kaplan, J.
1976 Jaffa. *AY*.II: 532-41.

Heikell, R.
1989 *Turkish Waters Pilot*. Imray, Laurie, Norie & Wilson Ltd.

Hellbing, L.
1979 *Alasia Problems*. SIMA 57. Göteberg: P.Åström Förlag.

Hellenkemper, H. & Hild, F.
1986 *Neue Forschungen in Kilikein*. Wien: Österreichischen Akademie der Wissenschaften.

Heltzer, M.
1977 Metal trade of Ugarit and the problems of transportation. *Iraq* 39: 203-211.

Heltzer, M.
1978 *Goods, prices and the organisation of trade in Ugarit*. Wiesbaden: Dr. Ludwig Reichert.

Heltzer, M.
1989 The trade of Crete and Cyprus with Syria and Mesopotamia and their eastern tin-sources in the XVIII-XVII century BC. *Minos* N.S. XXIV: 7-28.

Hermary, A.
1987 Amathonte de Chypre et les Phéniciens. Pp. 374-388 in *Phoenicians and the eastern Mediterranean in the first millennium BC. Studia Phoenicia V*, ed. E. Lipínski. Leuven: Uitgeverij Press.

Herodotus
*The Histories*. Translated by A. de Sélincourt. 1972. Middlesex: Penguin Books.

Herscher, E.
1975 New light from Lapithos. Pp. 39-60 in *The Archaeology of Cyprus. Recent developments*, ed. N. Robertson. New Jersey: Noyes Press.

Herzog, Z., Negbi, O. & Moshkovitz, S.
1978 Excavation at Tel Michal, 1977. *Tel Aviv* 5: 99-

130.

Herzog, Z.
1984 Tell Gerisa, 1983. Notes and News. *IEJ* 16: 143.

Herzog, Z., Rapp, G.(Jr.) & Negbi, O. (eds.)
1989 *Excavations at Tel Michal, Israel*. Publication of the University of Tel Aviv, No.8. University of Minnesota Press, Minneapolis & The Sonia and Marco Nadle Institute of Archaeology, Tel Aviv University.

Herzog, Z.
1993 Tel Michal. *EAEHL*: 1036-1041.

Herzog, Z.
1993b Tell Gerisa. *EAEHL*: 480-484.

Hesoid
*Works and Days*, ed. M.L. West, 1978. Oxford: Claredon Press.

Heywood, H.C.
1982 The archaeological remains of the Akrotiri Peninsula. Pp. 162-175 in *An archaeological guide to the ancient Kourion area and the Akrotiri Peninsula*, ed. H.W. Swiny. Nicosia: Department of Antiquities.

Hiller, S.
1982 Amnisos in den mykenischen texten. *Kadmos* 21: 33-63.

Hirth, K.G.
1978 Inter-regional trade and the formation of prehistoric gateway communitites. *American Antiquity* 43: 35-45.

Hiscock, E.C.
1950 *Cruising under sail*. London: OUP.

Hogarth, D.G.
1889 *Devia Cypria; notes on an archaeological journey in Cyprus in 1888*. London.

Hogarth, D.G.
1900/1 Excavations at Zakro, Crete. *BSA* 7: 121-149.

Hohlfelder, R.L. & Leonard, J.R.
1994 Underwater explorations at Paphos, Cyprus: The 1991 preliminary survey. *American School of Oriental Research Annual* 51: 45-62.

Holmes, D.L.
1993 Rise of the Nile Delta. *Nature* 363: 402-4.

Holmes, Y.L.
1971 The location of Alashiya. *JAOS* 91: 426-429.

Holmes, Y.L.
1975 The foreign trade of Cyprus during the Late Bronze Age. Pp. 90-110 in *The Archaeology of Cyprus. Recent Developments*, ed. N. Robertson. New Jersey: Noyes Press.

Hölscher, U.
1951 *The mortuary temple of Ramses III*, Part II. Chicago.

Homer
*The Odyssey*. Translated E.V. Rieu. 1946. Middlesex: Penguin Books.

Homer
*The Iliad*. Translated E.V. Rieu. 1950. London: Penguin Books.

Hood, S., Warren. P. & Cadogan, G.
1964 Travels in Crete. 1962. *BSA* 59: 50-99.

Hood, S.M.F.
1971 *The Minoans: Crete in the Bronze Age*. London: Thames & Hudson.

Hood, M.S.F.
1978 *The Arts and Prehistoric Greece*. Harmondsworth: Pelican History of Art.

Hooker, J.T.
1976 *Mycenaean Greece*. London: Routledge & Kegan.

Hopkins, K.
1983 Models, ships and staples. Pp. 84-103 in *Trade and famine in Classical antiquity*, ed. P. Garnsey & C.R. Whittaker. London: Chatto & Windus.

Hornell, J.
1946 *Water transport: origins and early evolution*. Cambridge: CUP.

Hue, M. & Pelon, O.
1991 Malia et la mer. Pp. 117-126 in *Thalassa: l'égée préhistorique et la mer. Aegaeum* 7, eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Hult, G. & McCaslin, D.
1978 *Hala Sultan Tekke IV. Excavation in Area 8 in 1974 and 1975* and *The 1977 underwater report*. SIMA XLV.4. Göteborg: Paul Åström Förlag.

Hult, G.
1983 *Bronze Age ashlar masonry in the eastern*

*Mediterranean. Cyprus, Ugarit and neighbouring regions*. SIMA LXVI. Göteborg: Paul Åström Förlag.

Hutchinson, R.W.
1962 *Prehistoric Crete*. Harmondsworth & Co.: Pelican Books.

Inman, D.L.
1983 Application of coastal dynamics to the reconstruction of palaeocoastlines in the vicinity of La Jolle, California. Pp. 1-27 in *Quaternary coastlines and Marine Archaeology: Towards the prehistory of landscapes and continental shelves*, ed. Masters & N.C. Flemming. London: Academic Press.

Isserlin, J.B.S.
1961 Excavating an ancient port in Israel. *Annual of the Leeds University Oriental Society* 2: 3-5.

Jelgersma, S.
1966 Sea-level changes in the last 10,000 years. Pp. 54-69 in *Royal Meteorological Society International Symposium on World Climate from 8000-0 BC*.

Jidejian, N.
1968 *Byblos through the Ages*. Beirut: Dar el-Machreq.

Johns, C.N.
1933 Excavation at Piligrim's Castle, Atlit (1932): The ancient tell and the outter defences of the castle. *QDAP* :145-164.

Johnson, J.
1980 *Maroni de Chypre*. SIMA LIX. Göteborg: Paul Åström Förlag.

Johnston, P. Forsythe.
1985 *Ship and boat models in ancient Greece*. Annapolis: Naval Institute Press.

Johnstone, P.
1988 *The sea-craft of prehistory*. New York & London: Routledge.

Jondet, G.
1916 Les ports submergés de l'ancienne Ile de Pharos. *Mémoires de l'Institut Égyptien* 9. Cairo.

Kahanov, J.
1994 Ma'agan Michael ship - Wood preservation. *CMS Newsletter* 21.

Kaplan, J.
1955 Tell Aviv. *Atiqot* 1: 1-12.

Kaplan, J.
1964 Excavations at Jaffa. *IEJ* 14: 285-6.

Kaplan, J.
1969 Notes and news. Yavne Yam. *IEJ* 19: 120-121.

Kaplan, J.
1978b Yavne-Yam. *AY*.IV: 1216-1218.

Kaplan, J.
1978 Tel Aviv. *AY*.IV: 1159-1168.

Karageorghis, V.
1970 *Cyprus: Ancient civilizations*. London: Barrie & Jenkins.

Karageorghis, V.
1976 *Kition. Mycenaean and Phoenician discoveries in Cyprus*. London: Book Club Associates.

Karageorghis, V.
1979 Some reflections on the relations between Cyprus and Crete during the Late Minoan IIIB period. Pp. 199-203 in *The relations between Cyprus and Crete c. 2000-500 BC*. Acts of the International Symposium, ed. V. Karageorghis. Nicosia: Department of Antiquities.

Karageorghis, V.
1981 *Ancient Cyprus. 7,000 years of art and archaeology*. Athens: E. Hellados S.A.

Karageorghis, V. & Demas, M.
1984 *Pyla-Kokkinokermos. A late 13th century BC fortified settlement in Cyprus*. Nicosia: Department of Antiquities.

Karageorghis, V. & Demas, M.
1985 *Excavations at Kition V.I. Text. The Pre-Phoenician levels*. Nicosia: Department of Antiquities.

Karageorghis, V. & Demas, M.
1988 *Excavations at Maa-Palaeokastro. 1979-1986*. Text. Nicosia: Department of Antiquities.

Karageorghis, V.
1990 *The end of the Late Bronze Age in Cyprus*. Nicosia: The Pierides Foundation.

Karmon, Y.
1985 Geographical components in the study of ancient Mediterranean ports. Pp. 1-6 in *Harbour Archaeology. Proceedings of the 1st International workshop on Ancient Harbours. Caesarea Maritima*, ed. A. Raban. BAR International Series 257.

Katenstein, H.J.
1973 *The history of Tyre. From the beginning of the second millennium BCE until the fall of the Neo-Babylonian Empire in 538 BCE.* Jerusalem: The Schocken Institute for Jewish Research.

Kees, H.
1961 *Ancient Egypt. A cultural topography*, ed. T.G.H. James. London: Faber & Faber.

Kemp, B.J.
1972 Temple and town in ancient Egypt. Pp. 657-680 in *Man, settlement and urbanism*, eds. P.J. Ucko, R. Tringham & G.W. Dimbley. London: Duckworth.

Kemp, B. & O'Connor, D.
1974 An ancient Nile harbour 'Birket Habu'. *IJNA* 3.1: 101-136.

Kemp, B.J. & Merrillees, R.S.
1980 *Minoan pottery in second millennium Egypt*. Mainz: von Zabern.

Kemp, P. (ed.)
1988 *The Oxford Companion to Ships and the Sea*. Oxford: OUP.

Killen, J.T.
1985 The Linear B tablets and Mycenaean economy. Pp. 241-298 in *Linear B: a 1985 survey*. Proceedings of the Mycenaean colloquium of the VIIIth congress of International Federation of the Society of Classical Studies, eds. A. Morphou-Davies & Y. Dunoux. Louvain-La-Neuve: Cabay.

Kingsley, S. & Raveh, K.
1994 A reassment of the northern harbour of Dor, Israel. *IJNA* 23.4: 289-296.

Kischen, M. (ed.)
1991 *Yavne Yam and its surroundings*. Kibbutz Palmahim Publications.

Kislev, M.E., Artzy, M. & Marcus, E.
1993 Impact of an Aegean food plant to a MBIIA coastal site in Israel. *Levant* 25: 145-154.

Kitchen, K.A.
1965 Theban topographical lists, old and new. *Orientalia NS* 34: 1-9.

Kitchen, K.A.
1966 Aegean place names in a list of Amenophis III. *BASOR* 181: 23-24.

Knapp, A.B.

1980 KBo I26. Alasyia and Hatti. *JCS* 32: 43-47.

Knapp, A.B.
1983 An Alashiyan merchant at Ugarit. *Tel Aviv* 10.1: 38-45.

Knapp, A.B.
1985 Production and exchange in the Aegean and Eastern Mediterranean: An overview. Pp. 1-11 in *Prehistoric production and exchange. The Aegean and the eastern Mediterranean*, eds. A.B. Knapp & T. Stech. Los Angeles: Institute of Archaeology, University of California.

Knapp, A.B.
1986 Production, exchange and socio-political complexity on Bronze Age Cyprus. *OJA* 5.1: 35-60.

Knapp, A.B.
1988 Hoards d'oeuvres: Of metals and men on Bronze Age Cyprus. *OJA* 8: 147-176.

Knapp, A.B.
1990 Mediterranean international island relations in the Late Bronze Age. *BSA* 85: 115-153.

Knapp, A.B.
1992 Bronze Age Mediterranean island cultures and the ancient Near East, Part 1 & 2. *Biblical Archaeology* June & 53.3: 52-72, 112-128.

Knapp, A.B.
1993 Thalassocracies in Bronze Age eastern Mediterranean: making and breaking a myth. *World Archaeology* 24.3: 332-347.

Knapp, A.B.
1994 Emergence, development and decline on Bronze Age Cyprus. Pp. 271-304 in *Development and decline in the Mediterranean Bronze Age*, eds. C. Mathers & S. Stoddart. Sheffield Archaeological Monographs, 8. J.R. Collis.

Kochavi, M.
1993 Tel Zeror. *EAEHL*: 1524-1526.

Kraft, J.C., Aschenbrenner, S.E. & Rapp, G.Jr.
1977 Palaeographic reconstructions of coastal Aegean archaeological sites. *Science* 195: 941-947.

Lacombe, H. & Tchernia, P.
1972 Caractères hydrologiques et circulation des eaux en Méditerranée. Pp. 25-36 in *The Mediterranean Sea*, ed. D.J. Stanley. Stroudsborg, Pennsylvannia: Dowden, Hutchinson & Ross Inc.

Lagarce, J., Lagarce, E., Bounni, A. & Saliby, N.
1983 Fouilles à Ras Ibn Hani en Syrie. *Académie des Inscriptions et Belles Lettres Comptes Rendus*: 249-290.

Lagios, E. & Hipkin, R.G.
1986 High precision gravity observations on Crete, Greece. *Tectnophysics* 126: 165-180.

Lambrou-Phillipson, C.
1990 *Hellenorientalia. The Near Eastern presence in the Bronze Age ca. 3000-1100 BC*. Göteborg: Paul Åström Förlag.

Lambrou-Phillipson, C.
1991 Seafaring in the Bronze Age Mediterranean: The parameters involved in maritime travel. Pp. 11-21 in *Thalassa: l'égée prehistorique et la mer. Aegaeum 7*, eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Lambrou-Phillipson, C.
1993 Ugarit: A Late Bronze Age thalassocracy? The evidence of textual sources. *Orientalia* 62: 163-170.

Landström, P.
1970 *Ships of the Pharoahs: Four thousand years of Egyptian shipbuilding*. London: Allen & Unwin.

Laroche, E.
1971 Catalogue des textes Hittites. *Etudes et commentaires* 75. Paris: Klincksieck.

La Rosa, V.
1992 Ayia Triada. Pp. 70-77 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Larsen, M.T.
1967 *Old Assyrian caravan procedures*. Istanbul: Utgaven van het Netherlands Historisch-Archaeologisch Instituutte. Istanbul, 22.

Lauffray, J., Sauneron, S., Sa'ad, R. & Anus, P.
1970 Rapport sur les travaux de Karnak: Activité du centre Franco-Égyptien en 1968-1969. *Kêmi* 20: 57-99.

Leatham, J. & Hood, S.
1958-59 Submarine exploration in Crete, 1955. *BSA* 53-54: 263-280.

Leclant, J. & Clerc, G.
1987 Fouilles et travaux en Égypte et au Soudan, 1985-1986. *Orientalia* 56: 292-389.

Lehmann-Hartleben, K.
1923 *Die Antiken Hafenanlagen des Mittelmeers*. Klio Beiheft XIV. Leipzig.

Leonard, A.
1987 The significance of Mycenaean pottery found east of the Jordan River. Pp. 261-266 in *Studies in the history and archaeology of Jordan III*, ed. A. Hadidi. Amman: Department of Antiquities.

Leonard, A. Jr.
1994 *An index to the Late Bronze Age. Aegean pottery from Syria-Palestine*. SIMA CXIV. Jonsered: Åström Förlag.

Levy, Y.
1988-9 Yavne Yam. *ESI* 7/8: 188.

Lewis, D.
1972/94 *We the navigators*. Honolulu: University of Hawaii Press.

Lewy, Z., Neev, D. & Prausnitz, M.W.
1986 Late Holocene tectonic movements at Achziv. Mediterranean coastline in North Israel. *Quaternary Research* 25: 177-188.

Lichtheim, M.
1973 *Ancient Egyptian literature. The Old and Middle kingdoms*. Vol.1. Berkley: University of California Press.

Linder, E. & Raban, A.
1965 Atlit - Underwater survey. *Bemtzulot-Yam* 5-6: 18-20.

Linder, E.
1970 *The maritime texts of Ugarit*. PhD Dissertation. Brandeis University.

Linder, E.
1972 A seafaring merchant-smith from Ugarit and the Cape Gelidonya wreck. *IJNA* 1: 163.

Linder, E.
1973 Naval warfare in the El-Amarna age. Pp. 317-324 in *Marine Archaeology*. Colston Papers, ed. D.J. Blackman. London: Butterworths.

Linder, E.
1981 Ugarit: A Canaanite Thalassocracy. Pp. 31-42 in *Ugarit in retrospect*, ed. G.D. Young. Winona Lake, Indiana: Eisenbrauns.

Lipke, P.
1984 *The Royal ship of Cheops*. National Maritime

Museum. Oxford: BAR International Series 225.

Liverani, M.
1987 The collapse of the Near East regional system at the end of the Late Bronze Age. Pp. 66-73 in *Centre and periphery in the ancient world*, eds. M. Rowlands et al. Cambridge: CUP.

Lorimer, H.L.
1950 *Homer and the monuments*. London: Macmillian.

MacGillivray, J., Sackett, L.H., Driessen, J. & Smith, D.
1987 Excavations at Palaikastro, 1986. *BSA* 82: 135-154.

MacGillivray, J. & Driessen, J.
1990 Minoan settlement at Palaikastro. *L'habitat égée préhistorique. BCH Supplementary* XIX: 413-420.

MacGillivray, J. & Sackett, L.H.
1992 Palaikastro. Pp. 222-231 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

MacGillivray, J.
1995 *Palaikastro*. Lecture given as part of the Mycenaean Seminar Series, Institute of Archaeology, UCL London. 8.03.1995.

MacKenzie, D.P.
1970 Plate tectonics of the Mediterranean region. *Nature* 226: 239-243.

Maddin, R., Stech Wheeler, T. & Muhly, J.D.
1977 Tin in the ancient Near East. Old questions and new finds. *Expedition* 19: 35-47.

Maier, F.G.
1973 Evidence for Mycenaean settlement at Old Paphos. Pp. 68-78 in *MEM*.

Maier, F.G. & Karageorghis, V.
1984 *Paphos: history and archaeology*. Nicosia: A.G. Levantis Foundation.

Malamat, A.
1971 Syro-Palestinian destinations in a Mari tin inventory. *IEJ* 21: 31-38.

Malkin, I. & Fichman, A.
1987 Homer, Odyssey III, 153-85: A maritime commentary. *Mediterranean History Review* 2: 250-258.

Manning, S.W. et al.
1994 Tsaroukkas, Mycenaeans and trade project:

Preliminary report on the 1993 season. *RDAC*. In press.

Manning, S.W.
1994 Tsaroukkas, Mycenaeans and trade project: Informal preliminary report on the 1994 season. Unpublished.

Mantzourani, E.K. & Theodorou, A.J.
1991 An attempt to delineate the sea-routes between Crete and Cyprus during the Bronze Age. Pp. 39-56 in *'The civilisations of the Aegean and their diffusion in Cyprus and the eastern Mediterranean 2000-600 BC'*, Proceedings of an International symposium 18-14th Sept. 1989, ed. V. Karageorghis. Pierides Foundation: Larnaca.

Marcus, E.S.
1990 *Pictorial representations of harbours and harbourworks in Egypt during the second millennium BCE*. Unpublished seminar paper. Dept. Maritime Studies. University of Haifa.

Marcus, E.S.
1991 *Tel Nami: A study of a Middle Bronze IIA period coastal settlement*. MA Degree. University of Haifa. August 1991.

Marinatos, Sp.
1926 Excavations at Nirou Khani, Crete. *Praktika les Arch. Etaireias*: 141-147.

Marinatos, Sp.
1933 La marine Créto-Mycénienne. *BCH* LVII: 170-235.

Marinatos, S.
1974 *Excavations at Thera, VI*. Athens: Zeno.

Masson, O.
1969 Documents Chypro-Minoens de Ras Shamra. Pp. 379-392 in *Ugaritica VI*, XXXeme campagne de fouilles á Ras Shamra (1968). Tome XVII, ed. C.F.A. Schaeffer. Paris: Mission Archéologique de Ras Shamra.

Masson, O.
1973 A propos de l'île d'Alasia. *Kadmos* 12: 98-99.

Matthiae, P.
1977 *Ebla: un impero ritrovato*. ed. Giulio Einaudi. Torino.

Matthiae, P.
1980 *Ebla: An empire rediscovered*. Transl. C. Holme. London: Hodder & Stoughton.

Mazar, A.
1980 Excavation at Tell Qasile. *QEDEM* 12: 13-21.

Mazar, A.
1985 Excavation at Tell Qasile. *QEDEM* 20: 119.

Mazar, A.
1988 Some aspects of the 'Sea Peoples' settlement. Pp 251-260 & Introduction Pp. 1-5 in *Society and economy in the Eastern Mediterranean (c.1500-1000 BC)*. Proceedings International Symposium, University of Haifa, April/May 1985, Orientalia Lovaniensia Analecta 23, eds. M. Heltzer & E. Lipinski. Leuven: Uitgeverij Peeters.

Mazor, E.
1974 On the stability of the Mediterranean coast of Israel since Roman times: A discussion. *Israel Journal of Earth Science* 23: 149-150.

McCaslin, D.E.
1978 The 1977 Cape Kiti, Cyprus underwater report. Pp. 97-157 in *Hala Sultan Tekke IV*, SIMA XLV: 4. Göteborg: Paul Åström Förlag.

McCaslin, D.E
1980 *Stone anchors in antiquity: coastal settlements and maritime trade-routes in the eastern Mediterranean ca. 1600-1050 BC*. SIMA LXI. Göteborg: Paul Åströms Förlag.

McGrail, S.
1983 Cross-channel seamanship and navigation in the first millennium BC. *OJA* 2.3: 299-337.

McGrail, S.
1987 *Ancient boats in NW Europe. The archaeology of water transport in AD 1500*. London: Longman Archaeology Series.

McGrail, S.
1991 Navigation techniques in Homer's Odyssey. *4th International symposium on ship construction in antiquity. Tropis IV*. Athens 1991, ed. H. Tzalas. Forthcoming.

McGrail, S.
1991b Bronze Age seafaring in the Mediterranean - a view from North West Europe. Pp. 83-91 in *Bronze Age trade in the Mediterranean*. Oxford Dec. 1989. SIMA XL, ed. N.H. Gale. Jonsered: Paul Åström Förlag.

McKee, E.
1983 *Working boats of Britain. Their shape and purpose*. Pp. 19-28. London: Conway Maritime

Press.

Mee, C.
1978 Aegean trade and settlement in Anatolia in the second millennium BC. *AS* 28: 121-156.

Meiggs, R.
1982 *Trees and timber in the ancient Mediterranean world*. Oxford: Claredon Press.

Mellaart, J.
1954 Preliminary report on a survey of Pre-Classical remains in Southern Turkey. *AS* 4: 175-240.

Mellink, M.J.
1983 Archaeology in Asia Minor. *AJA* 87: 427-442.

Mellink, J.
1985 Archaeology in Asia Minor. *AJA* 89: 427-442.

Mercer, S.A.B. (ed.)
1939 *The Tell el-Amarna tablets*. Vols. I & II. Toronto: The MacMillian Co. Canada Ltd.

Merrillees, R.S.
1968 *The Cypriot Bronze Age pottery found in Egypt*. SIMA 39. Göteberg: P. Åström's Förlag.

Merrillees, R.S.
1973 Mycenaean pottery from the time of Akhenaten in Egypt. Pp. 175-186 in *MEM*.

Merrillees, R.S.
1974 *Trade and transcendence in the Bronze Age Levant*. SIMA 39. Göteberg: P. Åström Förlag.

Merrillees, R.S.
1984 Ambelikou-Aletri: A preliminary report. *RDAC* : 1-13.

Michaelides, P.
1988 The ancient port of Amathus (Cyprus) - Its construction, foundation conditions and final abandonment. Pp. 1597-1603 in *Engineering Geology of Ancient Works, Monuments and Historical Sites, eds. Marinos & Koukis*. Balkerna: Rotterdam.

Millet, N.B.
1987 The first appearance of the loose-footed square sail rig in the Mediterranean. *Journal for the Society for the study of Egyptian Antiquaries* 17.3: 89-91.

Moran, W.L. (transl.)
1987 *Les lettres d'el-Amarna*. Paris: Les Éditions du Cerf.

Morcos, S.A.
1985 Submarine archaeology and its future potential. Alexandria casebook. Pp. 193-212 in *Managing the Ocean* 19, ed. J. Richardson. USA.

Morgan, L., Brown
1978 The ship procession in the miniature fresco. Pp. 629-644 in *Thera and the Aegean world I*, ed. C. Doumas. London: Thera and the Aegean World.

Morgan, L., Brown
1988 *The Miniature wall paintings of Thera: a study in Aegean culture and iconography*. Cambridge: CUP.

Mörner, N.A.
1971 Eustatic and climatic oscillations. *Artic and Alpine Research* 3: 167-171.

Morrison, J.S. & Coates, J.F.
1986 *The Athenian Trireme. The history and reconstruction of an ancient Greek warship*. Cambridge: CUP.

MP 1976/ V
1976 *Mediterranean Pilot* 1976 Vol. V. 5th edition. Hydrographic Office, Admiralty. London.

MP
1880-1980 *Mediterranean Pilot* I-V. Admiralty Series. Hydrographer of the Navy.

MP 1915/ V
1915 *Mediterranean Pilot* 1915 Vol. V. 1st edition. Hydrographic Office, Admiralty. London.

Muckelroy, K.
1978 *Maritime Archaeology*. (New Studies in Archaeology). Cambridge: CUP.

Muckelroy, K. (ed.)
1980 *Archaeology Underwater: an atlas of the worlds submerged sites*. New York: McGraw-Hill Book Company.

Muhly, J.D.
1972 The land of Alashiya: References to Alashiya in the texts of the second millennium BC and the history of Cyprus in the Late Bronze Age. Pp. 201-219 in *Proceedings of the First International Congress of Cypriot Studies*, Vol. I. Nicosia: Society for Cypriot Studies.

Muhly, J.D.
1973 Copper and tin: the distribution of mineral resources and the nature of the metals trade in the Bronze Age. Pp. 155-535 in *Transactions of*

*the Connectic Academy of Arts and Sciences* 42. Hamden, CT: Archon Books.

Muhly, J.D.
1975 Near Eastern chronology and the date of Late Cypriot I period. Pp. 76-89 in *The Archaeology of Cyprus: Recent developments*, ed. N. Robertson. New Jersey: Noyes Press.

Muhly, J.D.
1982 The nature of Bronze Age trade in the Late Bronze Age eastern Mediterranean. Pp. 251-269 in *Early metallurgy in Cyprus*, eds. J.D. Muhly, R. Maddin & V. Karageorghis. Nicosia: Antiquities Department.

Muhly, J. Stech, T. & Maddin, R.
1988 Cyprus, Crete and Sardina. Copper ox-hide ingots and Bronze Age metals trade. *RDAC* (1): 281-298.

Myers, J.W., Myers, E.E. & Cadogan, G. (eds.)
1992 *The aerial atlas of ancient Crete*. London: Thames & Hudson.

Na'aman, N.
1981 Economic aspects of the Egyptian occupation of Canaan. *IEJ* 31: 172-185.

Naville, E.
1887 *The mound of the Jew and the city of Onias*. London: Egypt Exploration Fund Memories, 7.

Neev, D., Almagar, G., Arad, A., Ginzburg, A. & Hall, J.K.
1973 The geology of the SE Mediterranean sea. *Report Geological Survey Israel*. MG/73.5: 43.

Neev, D., Almagar, G., Arad, A., Ginzburg, A. & Hall, J.K.
1976 The Geology of the Southeastern Mediterranean. *Geological Survey of Israel Bulletin* 68: 1-51.

Neev, D. & Bakler, N.
1978 Recent tectonic activity along the Israeli coastline. *Hofve-Yam*: 9-30.

Neev, D., Bakler, N. & Emery, K.O.
1987 *Mediterranean coasts of Israel and Sinai - Holocene tectonism from geology, geophysics and archaeology*. New York/ London: Taylor & Francis.

Nelson, N. & Hölscher, U.
1934 Work in Western Thebes, 1931-1933. The Oriental Institute of the University of Chicago. Illinois. *Oriental Institute communications* no. 18.

Neumann, J.
1986 Wind and current conditions in the region of the

'Windy Ilios'. *Archäologischer Anzeiger* : 345-363.

Newman, W.S., Marcus, F., Pardi, R., Paccione, J. & Tomacek, S.
1980 Eustacy and deformation of the geoid: 1000 - 6000 rc. years BP. Pp. 555-561 in *Earth Rheology, Isostasy and Eustasy*, ed. N.A. Mörner. New York: Wiley.

Nicolaou, K. & Catling, H.
1968 Composite anchors in Late Bronze Age Cyprus. *Antiquity* XLII: 225-229.

Nicolaou, K.
1973b Archaeological news from Cyprus. *AJA* 77: 51-60.

Nicolaou, K.
1973 The first Mycenaeans in Cyprus. Pp. 51-61 in *MEM*.

Nicolaou, K.
1976 *The historical topography of Kition*. SIMA XLIII: 9-51, 71-85. Göteborg: Paul Åström Förlag.

Niemeier, W.D.
1991 Minoan artisits travelling overseas: the Alalakh frescoes and the painted floors at Tell Kabri (western Galilee). Pp. 189-201 in *Thalassa: l'égée prehistorique et la mer. Aegaeum* 7, eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Nir, Y.
1982 Asia, Middle East coastal morphology: Israel and Sinai. Pp. 86-99 in *The Encyclopedia of beaches and coastal environments*, ed. M.L. Schwartz.

Nir, Y. & Eldar, I.
1987 Ancient wells and their geoarchaeological significance in detecting tectonics of the Israeli Mediterranean coastline region. *Geology* 15: 3-6.

Nir, Y.
1993 *The coasts of Cyprus*. Jerusalem - Nicosia.

Nougayrol, J.
1952-56 *Les Palais Royal d'Ugarit (PRU)*. I-IV, under direction of C.F.A. Schaeffer. Paris: Mission de Ras Shamra.

Nougayrol, J.
1960 *Nouveaux textes accadiens de Ras Shamra*. CRAI.

Ohata, K. (ed.)
1970 *Tel Zeror* III. Report on the excavation. Third

season 1966. Japan: The Society of Near Eastern Studies.

Onomasticon
*Eusebius: Das Onomastikon der biblischen ortsnamen*, ed. E. Klosterman. 1966. Hildesheim: G.O. Verlasbuchhandlung.

Oren, E.D.
1973 The overland route between Egypt and Canaan in the Early Bronze Age. *IEJ* 23: 198-205.

Oren, E.D.
1993 Northern Sinai. *EAEHL*: 1386-1396.

Ovadiah, A.
1993 Gaza. *EAEHL*: 465

OXFORD CLASC. DIC. (OCD)
1970 *Oxford Classical Dictionary*, eds. N.G.L. Hammond & H.H. Scullard. Second edition. Oxford: Claredon Press.

Owen, D.I.
1981 Ugarit, Canaan and Egypt: Some new epigraphic evidence from Tel Aphek in Israel. Pp. 49-54 in *Ugarit in retrospect*, ed. G.D. Young. Indiana: Eisenbrauns.

Palaima, T.G.
1991 Maritime matters in the Linear B tablets. Pp. 273-310 in *Thalassa: l'égée prehistoique et la mer. Aegeaum* 7, eds. R. Laffineur & L. Basch. Liége: Univerité de Liége.

Papadakis, N.P.
1983 Koufonisi Island: Delos of the Libyan Sea. *Archaiologia* 6: 58-65 (Greek, with English summary).

Papadakis, N.P.
1986 *Ierápetra: The nymph of the Libyan Sea.*

Parrot, A.
1956-68 *Mari I-IV*. Mission archéologique de Mari. Institute Français d'archéologique de Beyrouth. Paris.

Parrot, A.
1974 *Mari. Capitale fabuleuse*. Paris: Payot.

Pecorella, P.E.
1973 Mycenaean pottery from Ayia Irini. Pp. 19-24 in *MEM*.

Peleg, M. & Reich, R.

1985 Caesarea (Sedot Yam). *ESI* 4: 16-17.

Peltenburg, E.J.
1986 Ramesside Egypt and Cyprus. Pp. 149-179 in *Cyprus between the Orient and the Occident*. Acts of the International Archaeological Symposium, ed. V. Karageorghis. Nicosia: Dept. of Antiquities, Cyprus.

Perlès, C.
1979 Des navigateurs Méditerranée il y a 10,000 ans. *La Recherche* 96: 82-83.

Petrie, F.
1931-34 *Ancient Gaza I-IV*, Tell el Ajjul. British School of Archaeology in Egypt 53-56. London: BSA Egypt.

Pettinato, G.
1976 The Royal Archives of Tell Mardikh-Ebla. *Biblical Archaeologist* 39.2: 44-52.

Pettinato, G.
1978 L'Atante Geogratico del Vicino Oriente Antico attestato ad Ella e ad Abu Salabikh (I). *Orientalia* 47: 50-73.

Pettinato, G.
1981 *The archives of Ebla. An empire inscribed in clay*. New York: Doubleday.

Phillips, J.S.
1991 *The impact and implications of the Egyptian and 'Egyptianizing' material found in Bronze Age Crete, c. 3000-1100 BC*. DPhil Thesis. University of Toronto.

Phillips, G.
1994 *Middle Bronze Age links between Tell el-Dab'a and the coast of the southern Levant*. Paper presented to the Near Eastern Seminar group, Oxford.

Pirazzoli, P.
1980 Formes de corrosion marine et vestige archaeologiques submergés: Interpretation neotectonic de quelque example en Crete et Yugoslavia. *Annual Institute Oceanographique* 56: 101-111.

Pirazzoli, P., Thommeret, J., & Y., Laborel, J. & Montagioni, L.
1982 Crustal block movements from Holocene shorelines: Crete and Antikythera (Greece). *Tectnophysics* 86: 27-43.

Pirazzoli, P.A.
1987 Sea-level changes in the Mediterranean. Pp. 152-

181 in *Sea-level changes*, eds. M.J. Tooley & I. Shennan. Oxford: Basil Blackwell.

Pirazzoli, P.A.
1987b Submerged remains of ancient Megisti in Castellorizon Island (Greece): A preliominary report. *IJNA* 16.1: 57-66.

Pirazzoli, P.A.
1988 Sea-level changes and crustal movements in the Hellenic Arc (Greece). The contribution of archaeological and historical data. Pp. 157-184 in *Archaeology of coastal changes*, ed. A. Raban. BAR International Series 404.

Plat Taylor, J. du (ed.)
1965 *Marine Archaeology: Developments during 60 years in the Mediterranean*. London: Hutchinson.

Plat Taylor, J. du
1980 Excavations at Ayios Philon, the ancient Carpasia. Part I. The Classical to Roman periods. *RDAC* :152-216.

Platon, N.
1971 *Zakros. The discovery of a lost palace of ancient Crete*. New York: Charles Scribner's Sons.

Platon, N.
1984 The Minoan Talassocracy and the golden ring of Minos. Pp. 65-69 *Minoan Thalassocracy*, eds. Hägg & Marinatos.

Platon, N.
1992 Zakros. Pp. 292-301 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Poidebard, A.
1939 *Un grand port disparu: Tyr. Recherches aeriennes et sous-marine, 1934-1936*. Bibilical Archaeology and History 29. Paris.

Poidebard, A. & Lauffray, J.
1951 *Sidon. Aménagements antique du port de Saida: étude árienne, au sol et sous-marine, 1946-1950*. Beyrouth: République Libanaise, Ministerè des travaux publics.

Polanyi, K., Arensberg, C.M. & Pearson, H.W. (eds.)
1957 *Trade and markets in early empires*. Glencoe, Illinois: The Free Press.

Polyani, K.
1963 Ports of trade in early societies. *Journal of Economic History* 23: 30-45.

Pomey, P.
1981 L'épave de Bon-Porté et les bateaux coucus de Méiterranée. *MM* 67.3: 225.

Poole, A.J. & Robertson, A.H.F.
1991 Quaternary uplift and sea level change at an active plate boundary, Cyprus. *Journal of Geological Society, London.* 148: 909-921.

Porada, E.
1984 The cylinder seal from Tell el-Dab'a. *AJA* 88: 485-488.

Porada, E.
1986 Late Cypriot cylinder seals between East and West. Pp. 289-299 in *Cyprus between the Orient and the Occident.* Acts of the International Archaeological Symposium, ed. V. Karageorghis. Nicosia: Dept. of Antiquities, Cyprus.

Porath, Y., Paley, S.M. & Stieglitz, R.
1993 Tel Mikhmoret. *EAEHL*: 1043-1046.

Portugali, Y. & Knapp, A.B.
1985 Cyprus and the Aegean: A spatial analysis of interaction in the seventeenth to fourteenth centuries BC. Pp. 44-69 in *Prehistoric production and exchange. The Aegean and the eastern Mediterranean*, eds. A.B. Knapp & T. Stech. Los Angeles: Institute of Archaeology, University of California.

Poursat, J.-C.
1978 *Fouilles exécutées à Malia: le Quartier Mu II: Introduction générale.* Études Crétoises 23. Paris: Geuthner.

Poursat, J.-C.,
1980 Les ancres du Quartier Mu. Pp. 235-238 in *Fouilles exécutées à Malia, Le Quartier Mu II.* Études Crétoises 26, eds. B. Detournay, J.-C. Poursat & F. Vandenabeele. Paris: Libraire Orientaliste Paul Geuthner.

Prausnitz, M.W.
1975 Plain of Accho. *AY.I*: 23-25.

Prausnitz, M.W.
1993 Plain of Accho. *EAEHL*: 31.

Princeton
1976 *The Princeton Encyclopedia of Classical Sites.* ed. R. Stillwell. Princeton: Princeton University Press.

Pritchard, J. (ed.)
1975 *Ancient Near East Texts*. II. Princeton: Princeton University Press.

Pritchard, J.B.
1971b The Phoenician city of Sarepta. *Archaeology* 24: 61-63.

Pritchard, J.B.
1971 The Roman port Sarafand (Sarepta). Preliminary report on the seasons of 1969 and 1970. *Bulletin du Musée de Beyrouth* 24: 39-56.

Pritchard, J.B.
1975 *Sarepta. A preliminary report on the Iron Age. Excavation of the University Museum of the University of Pennsylvania, 1970-1972*. University of Pennsylvania, Philadelphia: Museum Monograph.

Pritchard, J.B.
1978 *Recovering Sarepta. A Phoenician city*. Princeton: Princeton University Press.

Pritchard, J.B. et al.
1985/88 *Sarepta I-IV. The Late Bronze And Iron Age strata Area II*. The University Museum of the University of Pennsylvania. Excavation at Sarafend. Lebanon: Publications de l'Université Libanise.

Pryor, J.H.
1988 *Geography, technology and war studies in the maritime history of the Mediterranean, 649-1571*. Cambridge: Cambridge University Press.

Psychoyos, O.
1988 *Déplacements de la ligne de rivage et sites archéologiques dans la région côtières de la mer Egée, au néolithique et à l'âge du bronze*. SIMA pocket handbook 62. Texte revu et corrigé de la thèse de Doctorat présentée le 19 Nov. 1986. Université de Paris I - Panthéon - Sorbonne. Jonsered: Paul Åströms Förlag.

Pulak, C.M.
1988 The Bronze Age shipwreck at Ulu Burun, Turkey. 1985 campaign. *AJA* 92: 1-37.

Pulak, C.
1994 The Bronze Age shipwreck at Uluburun. *Res Maritimae. Cyprus and the eastern Mediterranean. Prehistory through the Roman Period. The second in the series 'Cities on the Sea'*. CAARI, 1994. In press.

Raban, A.

1981 Recent maritime archaeological research in Israel. *IJNA* 10.4: 287-308.

Raban, A.
1983 Recent maritime archaeological research in Israel. *IJNA* 12.3: 229-251.

Raban, A.
1983a The Biblical port of Akko on Israel's coast. *Archaeology* Jan/Feb 36: 60-61.

Raban, A.
1983b Submerged prehistoric sites of the Mediterranean coast of Israel. Pp. 215-232 in *Quaternary coastlines and marine archaeology: towards the prehistory of land bridges and contienental shelves*, eds. P.C. Masters & N.C. Flemming. London: Academic Press.

Raban, A. & Galili, E.
1985 Recent maritime archaeological research in Israel. A preliminary report. *IJNA* 14.4: 321-356.

Raban, A. & Balensi, J.
1985 Tell Abu Hawam, the early coastline. *ESI* 4: 1-2.

Raban, A.
1985 The ancient harbours of Israel in Biblical times. Pp. 11-44 in *Harbour Archaeology. Proceedings of the First International Workshop on Ancient Mediterranean Harbours. Caesarea Maritima 24 - 28.6.1983*, ed. A. Raban. BAR International Series 257. Oxford.

Raban, A.
1986 Archaeological evidence for ancient sea levels at the Mediterranean coast of Israel. Abstract. Pp. 102-105 in *Israel Geological Society Annual Meeting*. Ma'alot.

Raban, A.
1987 Alternated river courses during the Bronze Age along the Israeli coast. Pp. 173-189 in *Déplacements des lignes de rivage en Méditérranée*. Collques Internationaux Aix en Provence, eds. R. Paskoff & P. Trosset. Paris: CNRS.

Raban, A. & Galanti, I.
1987 Tell Abu Hawam, 1985. *IEJ* 37: 179-181.

Raban, A.
1988 Coastal processes and ancient harbour engineering. Pp. 185-208 in *Archaeology of coastal change*, ed. A. Raban. BAR International Series 404. Oxford.

Raban, A.
1988b The constructive maritime role of the Sea Peoples in the Levant. Pp. 261-294 in *Society and economy in the eastern Mediterranean, c. 1500-1000 BC*. Proceedings of the International Symposium, University of Haifa, 1985, eds. M. Heltzer & E. Lipínski. Leuven: Uitgeverij Peeters.

Raban, A.
1989 Oceanographic understanding of ancient harbour engineers of the Levant. Pp. 1-33 in *Ocean Sciences: their history and relation to man. Deutsche Hydrographische Zeitschrift* 22, eds. W. Lenz & M. Deacon. Ergänzungsheft Reihe B.

Raban, A.
1991b The port city of Akko in Middle Bronze II. *Michmanim* 5: 17-34.

Raban, A.
1991 Minoan and Canaanite Harbours. Pp. 129-146 in *Thalassa: l'Égée prehistoric et la mer. Aegaeum* 7, Annales d'archéologie égéenne de l'Université de Liège, eds. R. Laffineur and L. Basch. Liège: Université de Liège.

Raban, A.
1993b Misrefot-Yam. *EAEHL*: 963.

Raban, A.
1993 Tel Mikhmoret. *EAEHL*: 964.

Raban, A. & Linder, E.
1993 Maritime 'Atlit. *EAEHL*: 117-120.

Raban, A.
1995 The heritage of ancient harbour engineering in Cyprus and the Levant. Pp. 139-188 in *Cyprus and the Sea*. Proceedings of the International Symposium, eds. V. Karageorghis & D. Michelides. Nicosia: University of Cyprus.

Rainey, A.F.
1963 Business agents at Ugarit. *IEJ* 13: 313-321.

Raveh, K. & Kingsley, S.A.
1991 The status of Dor in Late Antiquity. A maritime perspective. *Biblical Archaeologist* 54.4 (Dec.): 198-207.

Redford, D.B.
1992 *Egypt, Canaan and Israel in ancient times*. New Jersey: Princeton University Press.

Reisner, G.A. & Smith, W.S.

1955 *The history of Giza necropolis*, vol.2. Cambridge, Mass.

Renan, E.
1864 *Mission en Phénice*. Paris.

Renfrew, C., Cann, M. & Dixon, L.
1965 Obsidian in the Aegean. *BSA* 60: 225-247.

Renfrew, A.C.
1972 *The emergence of civilization*. London: Methuen.

Revere, R.B.
1957 No man's coast. Ports of trade in the eastern Mediterranean. Pp. 38-64 in *Trade and markets in early empires*, eds. K. Polanyi, C.M. Arensberg & H.W. Pearson. Glencoe, Illinois: The Free Press.

Riis, P.J.
1963 L'activité de la Mission archéologique danoise sur la côte Phénicienne en 1961. *Les Annales Archéologiques de Syrie* 13: 211-225.

Riis, P.J.
1965 L'activité de la Mission archéologique danoise sur la côte Phénicienne en 1963. *Les Annales Archéologiques de Syrie* 15.2: 57-82.

Riis, P.J.
1970 *Sūkās I. The Northeast sanctuary and the first settling of Greeks in Syria and Palestine*. København: Kong. Danske Vid. Selsk.

Riis, P.J.
1973 The Mycenaean expansion in the light of the Danish excavation at Hama and Sukas. Pp. 198-206 in *MEM*.

Roberts, O.T.P.
1991 The development of the brail into a visible sail control for Aegean boats of the Bronze Age. Pp. 55-60 in *Thalassa: l'égée prehistoique et la mer. Aegeaum* 7, eds. R. Laffineur & L. Basch. Liége: Univerité de Liége.

Robertson, N. (ed.)
1975 *The archaeology of Cyprus. Recent Developments*. New Jersey: Noyes Press.

Ronen, A. & Olami, Y.
1978 *Archaeological survey of Israel. 'Atlit Map*. Jerusalem.

Ronen, A. & Olami, Y.
1983 *Archaeological Survey of Israel. Map of Haifa East (23)*: 15-24. Jerusalem.

Ronen, A.
1983 Late Quaternary sea levels inferred from coastal stratigraphy and archaeology in Israel. Pp. 121-134 in *Quaternary coastlines and Marine Archaeology: Towards the prehistory of land bridges and continental shelves*, eds. P.M. Masters & N.C. Flemming. London: Academic Press.

Rosenbaum, E., Huber, G. & Onurkan, S.
1967 A survey of coastal cities in West Cilicia: A preliminary report. *Türk Tarih Kurumu Yayinlarindan Belleten* 8. Ankara.

Rougé, J.
1966 *Récherches sur l'organisation du commerce maritime en Méditerranée sous l'empire romain*. Paris: S.E.V.P.E.N.

Rowe, A.
1954 Archaeology of the Western Desert. *Bulletin of the John Rylands Library, Manchester*. 36.2: 128-141, 484-500.

Rowlands, M., Larsen, M.T. & Kristiansen, K. (eds.)
1987 *Centre and periphery in the ancient world*. Cambridge: CUP.

Runnels, C.N.
1985 Trade and the demand for millstones. Pp. 42-43 in *Prehistoric production and exchange*, eds. A.B. Knapp & T. Stech. Monograph XXV. Los Angeles: Institute of Archaeology, UCLA.

Rupp, D.W.
1987 Contacts and contrasts in Late Bronze Age Cyprus: The Vasilikos Valley and the West. Pp. 83-95 in *Western Cyprus Connections*, ed. D.W. Rupp. SIMA LXXVIII. Göteborg: Paul Åström Förlag.

Russel, R.J.
1954 Alluvial morphology of Anatolian rivers. *Annual Association of American Geographers* XLIV: 363-391.

Saadé, G.
1954 *Ras-Shamra. Ruines d'Ugarit. Guide to*. Beyrouth.

Sackett, L.H., Popham, M.R. & Warren, P.M.
1965 Excavation at Palaikastro VI. *BSA* 60: 248-315.

Safriel, U.N.
1975 The role of vermetid gastropods in the formation of Mediterranean and Atlantic reefs. *Oecologia Berl*. 20: 85-101.

Saghieh, M.

1983 *Byblos in the third millennium. A reconstruction of the stratigraphy and a study of the cultural connections*. Warminster: Aris & Phillips.

Sakellarakis, E. & Sakellarakis, Y.
1984 The Keftiu and the Minoan Thalassocracy. Pp. 197-203 in *The Minoan Thalassocracy*, eds. R. Hägg & N. Marinatos.

Sandars, N.K.
1987 *The Sea Peoples. Warriors of the ancient Mediterranean*. London: Thames & Hudson.

Sanlaville, P.
1972 Vermetus dating of changes in sea level. Pp. 185-191 in *Underwater Archaeology: A nascent discipline*. Paris: UNESCO.

Sasson, J.
1966 Canaanite involvement in the second millennium BC. *JAOS* 86: 126-138.

Säve-Söderbergh, T.
1946 *The navy of the eighteenth Egyptian dynasty*. Uppsala, Leipzig: Otto Harrassowitz.

Saville, Sir L.H.
1941 Ancient harbours. *Antiquity* 15: 209-232.

Schaeffer, C.F.A.
1929 Les fouilles de Minet el-Beida et de Ras Shamra (Campagne du printemps 1929) *Syria* 10: 285-297.

Schaeffer, C.F.A.
1931 Les fouilles de Minet el-Beida et de Ras Shamra. Deuxième Campagne (Printemps 1930) *Syria* 12: 1-14.

Schaeffer, C.F.A.
1932 Les fouilles de Minet el-Beida et de Ras Shamra. Troisième Campagne (Printemps 1931) *Syria* 13: 1-27.

Schaeffer, C.F.A.
1933 Les fouilles de Minet el-Beida et de Ras Shamra. Quatrième Campagne (Printemps 1932) *Syria* 14: 93-127.

Schaeffer, C.F.A.
1935 Les fouilles de Ras Shamra (Ugarit). Sixième Campagne (Printemps 1934). *Syria* 16: 141-176.

Schaeffer, C.F.A.
1939 *Ugaritica I. Études relative aux découvertes de Ras Shamra*. 1st Series. Mission de Ras Shamra. Haut-Commissanat de la République Française en

syrie et au Liban, services des Antiquites, Bibliothèque Archéologique et Historique. Paris: Paul Geuthner.

Schaeffer, C.F.A.
1948 *Stratigraphie comparée et chronologie de l'Asie Occidentale. Syria, Palestine, Asia Minor.* Oxford.

Schaeffer, C.F.A.
1949 *Ugaritica II. Études relative aux découvertes de Ras Shamra.* 2nd Series. Mission de Ras Shamra. Haut-Commissanat de la République Française en syrie et au Liban, services des Antiquites, Bibliothèque Archéologique et Historique. Paris: Paul Geuthner.

Schaeffer, C.F.A.
1957 Résumé des résultats de la XIXe campagne de fouille à Ras Shamra-Ugarit, 1955. *Les Annales Archéologiques de Syrie* 7: 35-66.

Schaeffer, C.F.A.
1962 *Ugaritica IV. Études relative aux découvertes de Ras Shamra.* 4th Series. Mission de Ras Shamra. Haut-Commissanat de la République Française en syrie et au Liban, services des Antiquites, Bibliothèque Archéologique et Historique. Paris: Paul Geuthner.

Schaeffer, C.F.A.
1978 Remarques sur les ancres en pierre d'Ugarit. Pp. 371-381 in *Ugaritica VII. Études relative aux découvertes de Ras Shamra*, ed. Schaeffer. 7th Series. Mission de Ras Shamra. Haut-Commissanat de la République Française en syrie et au Liban, services des Antiquites, Bibliothèque Archéologique et Historique. Paris: Paul Geuthner.

Schaeffer, C.F.A.
1939-78 Fouilles a Ras Shamra (1923-33). *Ugaritica I - VII.* Mission de Ras Shamra. Haut-Commissanat de la République Française en syrie et au Liban, services des Antiquites, Bibliothèque Archéologique et Historique. Paris: Paul Geuthner.

Schäfer, J.
1991 Amnisos - Harbour town of Minos ?. Pp. 111-117 in *Thalassa: l'égée prehistorique et la mer. Aegaeum* 7. eds. R. Laffineur & L. Basch. Liège: Université de Liège.

Seager, R.B.
1909 Excavations on the island of Mochlos. *AJA* 13:

273-303.

Seager, R.B.
1910 *Excavations on the island of Pseira*. University of Pennsylvania. The Museum Anthropolgical Publications III.1. Philadelphia: The University Museum Publications.

Seton Williams, V.
1954 Cilician Survey. *AS* 4: 121-156.

Semple, E.C.
1932 *Geography of the Mediterranean Region: its relation to ancient history*. London: Constable & Co. Ltd.

Severin, T.
1987 *The Ulysses Voyage*. London: Arrow Books.

Shackleton, J.C., Van Andel, T.H. & Runnels, C.N.
1984 Coastal paleogeography of the central and western Mediterranean during the last 125,000 years and its archaeological implications. *Journal of Field Archaeology* 11: 307-314.

Shaw, J.W.
1981 Kommos: The southern entry into Central Crete. *Royal Ontario Museum. Archaeological Newsletter*, 196.

Shaw, J.W.
1981a Excavations at Kommos (Crete) during 1980. *Hesperia* 50.3: 211-251.

Shaw, J.W.
1982 Excavations at Kommos (Crete) during 1981. *Hesperia* 51: 164-194.

Shaw, J.W. & Blitzer, H.
1983 Stone anchors from Kommos, Crete. *IJNA* 12.2: 91-100.

Shaw, M.
1985 Late Minoan I building J/T and Late Minoan III buildings N and P at Kommos: their nature and possible uses as residences, palaces, and/or emporia. *Scripta Mediterranea* VI: 19-25. Benben Publications: Canada.

Shaw, J.W.
1986 Excavations at Kommos (Crete) during 1984-1985. *Hesperia* 55.3: 219-269

Shaw, J.W.
1990 Bronze Age Aegean harboursides. Pp. 420-436 in *Thera and the Aegean World III*.I, eds. D.A.

Hardy, C.G. Doumas, J.A. Sakellarakis & P.M. Warren. London: The Thera Foundation.

Shaw, J.W.
1992 Kommos. Pp. 148-153 in *The aerial atlas of ancient Crete*, eds. Myers, J.W., Myers, E.E. & Cadogan, G. London: Thames & Hudson.

Shepard, F.P.
1963 Thirty-five thousand years of sea-level. in *Essays in marine geology in honor of K.O. Emery*, ed. T. Clements. Los Angeles: California University Press.

Sherratt, E.S. & Crouwell, J.H.
1987 Mycenaean pottery from Cilicia in Oxford. *OJA* 6.3: 325-352.

Sherratt, E.S.
1990 Reading the texts, Archaeology and the Homeric question. *Antiquity* 64.245: 807-824.

Sherratt, A. & Sherratt, S.E.
1991 From luxuries to commodities: The nature of Mediterranean Bronze Age trading systems. Pp. 351-386 in *Bronze Age trade in the eastern Mediterranean*. SIMA XV, ed. N.H. Gale. Jonsered: Paul Åström Förlag.

Sibella, P.
1993 *La mer dans le monde égéen navigation et commerce maritime l'époque Mycénienne*. Thèse de doctorat de l'Université de Paris. Panthéon-Sorbonne. 12 Juin 1993.

Siculus, Diodorus
I, transl. by C.H. Oldfather, 1933. London: Leob Classical Library.

Sivan, D.
1981 *Palaeography and the history of the coast of Akko in the Holocene period*. Unpublished MA thesis, Dept. of Maritime Civilisations, University of Haifa (in Hebrew). Abstract (in English).

Smith, E., Cpt.
1840 *A chart of the coast of Syria*.

Smith, G.A.
1895 *The historical geography of the Holy Land*. London.

Sneh, Y.
1981 *The palaeography and history of the coast of Dor in the Holocene period*. Unpublished MA thesis, Dept. of Maritime Civilisations, University of

Haifa (in Hebrew). Abstract (in English).

Soles, J.S.
1992 Mochlos Pp. 186-193 in *The aerial atlas of ancient Crete*, eds. J.W. Myers, E.E. Myers & G. Cadogan. London: Thames & Hudson.

Sotirakis, D.
1992 *Ancient harbours of Crete*. Unpublished MA Thesis, submitted March 1992, St.Andrew's University, Scotland.

South, A. & Todd, I.A.
1985 In quest of Cypriot copper traders: excavations at Kalavasos. *Archaeology* 38: 40-47.

South, A.
1989 From copper to Kingship. Pp. 315-324 in *Early Societies in Cyprus* ed. E. Peltenburg. Edinburgh: Edinburgh University Press.

South, A.
1993 *Kalavasos-Ayios Dhimitiros, Cyprus: new evidence on organization of Late Bronze Age socities. A new Hittite object*. Paper presented to the British Association for Near Eastern Archaeology - Manchester 1993.

South, A.
1994 *Ayios Dhimitrios* - Kalavassos. Poster display presented at *Res Maritimae. Cyprus and the eastern Mediterranean. Prehistory through the Roman period*. Second in the series ' Cities on the Sea'. CAARI. Nicosia, Cyprus.

Spanakis, S.
1982 Mnimia tis Kritikis Istorias (1954) *Kriti II*.

Spratt, T.A.B. Admiral.
1865 *Travels and researches in Crete*. Vol. I. London: John van Voost.

STADIASMUS
*Stadiasmus*. Ancient portolan.

Stager, L.E.
1991 When Canaanite and Philistines ruled Askelon. *Biblical Archaeological Review* 17.2: 24-43.

Stager, L.E.
1993 Ashkelon. *EAEHL*: 103-112.

Stanley, D.J.
1972 *The Mediterranean Sea: A natural sedimentation laboratory*. Stroudsberg, Pennsylvannia: Dowden, Hutchinson & Ross Inc.

Stanley, D.J.
1988 Subsidence in the NE Nile Delta. Rapid rates, possible causes and consequences. *Science* (April) 240: 497-500.

Stanley, D.J., Arnold, D. & Warne, A.G.
1992b Oldest Pharaonic site. *National Geographic Research and Exploration* 8.3: 264-275.

Stanley, D.J., Warne, A.G., Davis, H. Bernasconi, M. & Chen, Z.
1992 Nile Delta. *National Geographic Research and Exploration* 8.1: 22-51.

Stanley Price, N.P.
1980 *Early Prehistoric settlements in Cyprus: A review and gazetteer of sites c.6500-3000 BC*. BAR International Series 65. Oxford.

Stark, F.
1956 *The Lycian Shore*. London.

Steffy, J.R.
1985 The Kyrenia Ship: An interim report on its hull construction. *AJA* 89: 71-101.

Steffy, J.R.
1994 *Wooden ship building and the interpretation of shipwrecks*. College Station: Texas A & M University Press.

Stern, E.
1978 Tell Mevorakh. *QEDEM* 9.

Stern, E.
1984 Excavations at Tell Mevorakh (1973-1976). Part Two: The Bronze Age. *QEDEM* 18.

Stern, E. & Sharon, I.
1987-8 Tel Dor. *ESI* 6: 49-53.

Stieglitz, R.
1972-5 An ancient terracotta ship from Cyprus. *Sefunium* 4: 44-46.

Stieglitz, R.R.
1944 The Minoan origin of Tyrian purple. *Biblical Archaeologist* 57/1: 46-54.

Strabo
*The Geography*. Transl. by H.L. Jones , 1969-1982. Cambridge, Mass.: Harvard University Press.

Strange, J.
1980 Caphtor/ Kftiu: a new investigation. *Acta Theologica Dancia* 14. Lieden: Brill.

Stubbings, F.H.
1951 *Mycenaean pottery from the Levant*. Cambridge: Cambridge University Press.

Stürmer, V.
1990 Zur organisation Minoischer Hafenanlagen. *L'habitat égéen préhistorique. BCH Supplementary* XIX: 413-420.

Susini, C.
1965 Supplemento epigrafico di Caso, Scarpanto, Saro, Chalchi, Alinnia e Tilo. *Scuola Archeologica di Athene NS* XXV-XXVI: 203-292.

Swiny, H.W. (ed.)
1982 *An archaeological guide to the ancient Kourion area and the Akrotiri Peninsula*. Nicosia: Dept. of Antiquities, Cyprus. Zavallis Press Ltd.

Swiny, S.
1981 Bronze Age settlement patterns in SW Cyprus. *Levant* 13: 51-87.

Tadmor, M. & Prausnitz, M.
1959 Excavation at Rosh Hanniqra. *Atiqot* 2: 72-88.

Tadmor, M. & Berman, A.
1974 Neolithic-Chalcolithic sites of Ashkelon. *IEJ* 24: 132.

Tadmor, M.
1993 Rosh Ha-niqra. *EAEHL*: 1288-1289.

Taşkiran, C. & Kurt, H.
1986 *Guide book to Kizkalesi*. Istanbul.

TAVO B 1113
1990 *Tübinger Atlas des Vorderen Orients Palästina und Syrien zur Zeit der ägyptisch-hethitischen Vorherrschaft (Palestine and Syria at the time of the Egypt-Hittite rule)*. MAP.

Taylor, E.G.R.
1971/58 *Haven finding art*. London: Hollis & Carter.

Tevenot, M. de.
1686 *Travels in the Levant*. London.

Thera and the Aegean World I
1978 *Thera and the Aegean World I*.1, ed. C. Doumas. London: Thera & the Aegean World.

Thera and the Aegean World III
1990 *Thera and the Aegean World III*.2. Earth Sciences & *III*.3. Chronology. Proceedings of the 3rd International Congress, 1989, eds. D.A. Hardy &

A.C. Renfrew. London: The Thera Foundation.

Thorarinsson, S.
1978 Some comments on the Minoan eruption of Santorini. Pp. 263-265 in *Thera and the Aegean World I*, ed. C. Doumas. London: Thera & the Aegean World.

Thucydides
*The Histories of Thucydides*, transl. by S.T. Bloomfield, 1829. Vol. I-III. London: Longman, Rees, Orme, Brown & Green.

Tibbetts, G.R.
1971 *Arab navigation in the Indian Ocean before the coming of the Portuguese*. London.

Tigrel, G.
1975 An ancient harbour in the district of Alanya. *Belleten* 39.156: 629-632.

Todd, I.A.
1979 Vasilikos Valley Project, 1977-1978: an interim report. *RDAC* : 13-68.

Toksöz, C.
1986 *Ancient cities of Lycia*. Istanbul: Hankur Matbaacilik Ltd.Şti.

Tooley, M.J. & Shennan, I. (eds.)
1987 *Sea-Level Change*. Oxford: Basil Blackwell.

Tufnell, O.
1962 The courtyard cemetery at Tell el-'Ajjul, Palestine. Excavations of 1931-2. *Bulletin Institute of Archaeology, London* :1-37.

Tufnell, O.
1975 Tell el-Ajjul. *AY.I*: 52.

Turner, W.M.
1971 Quaternary sea levels of western Cyprus. *Quaternaria* 25: 197-202.

Tzedakis, Y., Chryssoulaki, St., Venieri, Y. & Vaitsaki, S.
1989 Les routes Minoennes: Rapport préliminaire défense de la circulation ou circulation de la défense? *BCH* 113: 43-75.

Tzedakis, Y., Chryssoulaki, St., Venieri, Y. & Avogouli, M.
1990 Les routes Minoennes: Le poste de XOIPOMANDPES et le contrôle des communication. *BCH* 114: 43-65.

Urkunden I
1903 *Urkunden des ägyptischen Altertumus*, ed. von G. Steindorff. Abt.I. Urkunden des Alten Reichs.

Bearbeitat. Leipzig: K. Sethe.

Van Seters, J.
1966 *The Hyksos: a new investigation*. New Haven & Co.: Yale University Press.

Van Seters, J.
1979 What is trade? The nature of Egyptian trade in the eastern Mediterranean during the second millennium BC. *Archaeology News* 8.2/3: 35-39.

Van der Brink, E.C.M.
1987 A geographical archaeological survey in the NE Delta. *Mitteilungen des Deutschen Archaeological Institute Ableilung* 43. Kairo.

Vandenabeele, F.
1992 *Malia. The palace of Malia and Chersonissos*. Ekdotike Athenon S.A.: Athens.

Vann, R.L.
1991 *A survey of ancient harbours in Rough Cilicia: The 1991 preliminary survey*. In Press.

Veenhof, K.R.
1972 *Aspects of Old Assyrian trading and its terminology*. Leiden: Brill.

Vercoutter, J.C.
1954 *Essai sur les relations entre Égyptiens et Préhèllenes*. Paris: L'orient ancien Illustré.

Vercoutter, J.
1956 *L'Egypte et le monde égéen préhellenique: étude critique des sources égyptiennes, du début de la XVIII à la fin de la XIX dynastie*. Institute Français d'archeologie oreint. Bibliothèque d'étude, 22. Le Claire.

Vermeule, E.T.
1964 *Greece in the Bronze Age*. Chicago: University of Chicago Press.

Vermeule, E.T.
1972 Toumba tou Skourou (Abstract). *AJA* 76: 223-224.

Vermeule, E.T.
1973 Excavation at Toumba tou Skourou, 1971. Pp. 25-33 in *MEM*.

Vermeule, E.T.
1974 *Toumba tou Skourou. The mound of darkness. A Bronze Age town on Morphou Bay in Cyprus*. Harvard University Cyprus Archaeological Expedition & Museum of Fine Arts. Boston: Harvard University Press.

Vermeule, E.T. & Wolsky, F.
1978 New Aegean relations with Cyprus: The Minoan and Mycenaean pottery from Toumba tou Skourou, Morphou. *Proceedings of the Philosophical Society* 122: 294-317.

Vermeule, E.T. & Wolsky, F.
1990 *Toumba tou Skourou. A Bronze Age potter's quarter on Morphou Bay in Cyprus*. Harvard University Cyprus Archaeological Expedition & Museum of Fine Arts. Boston: Harvard University Press.

Vichos, Y. & Lolos, Y.
1994 The Cypro-Mycenaean wreck at Point Iria in the Argolic Gulf: First thoughts on the type and provenance of the ship and her final voyage. *Res Maritimae*. Second series 'Cities in the Sea'. CAARI. Nicosia, Cyprus. In press.

Villard, P.
1986 Un roi de Mari a Ugarit. *UF* 18: 378-412.

Vinson, S.
1993 The earliest reprsentations of brailed sails. *Journal American Research Centre in Egypt* XXX: 133-150.

Vinson, S.
1994 *Egyptian boats and ships*. Aylesbury: Shire Publications.

Vita-Finzi, C.
1969 *The Mediterranean Valleys. Geological changes in historical times*. Cambridge: Cambridge University Press.

Vita-Finzi, C.
1990 Radiocarbon dating of Late Quaternary uplift in western Cyprus. *Tectnophysics* 172: 135-140.

Vitto, F. & Edelstein, G.
1993 Tell Ridan. *EAEHL*: 1283.

Vogel, E.K.
1934 Bibliography of Holyland sites. *Quarterly Dept. of Antiquities of Palestine* 4.

Vogel, E.K.
1982 *Bibliography of Holyland sites. Part 2, 1970-1981*. Cincinnati: Hebrew Union College.

Wachsmann, S. & Raveh, K.
1984 A concise nautical history of Dor/ Tantura. *IJNA* 13.3: 223-241.

Wachsmann, S.

1987 Aegeans in the Theban tombs. *Orientalia Lovaniensia Analecta* 20.

Wachsmann, S.
1989 *Seagoing ships and seamanship in the Late Bronze Age Levant*. D.Phil thesis. Hebrew University.

Wainwright, G.A.
1939 Some sea-peoples and others in the Hittite archives. *Journal of Egyptian Archaeology* 45: 148-153.

Walberg, G.
1983 *Provincial Middle Minoan pottery*. Mainz: Zabern.

Walberg, G.
1991 A gold pendant from Tell el-Dab'a. *Ägypten und Levante* 2: 111-114.

Walberg, G.
1992 The finds at Tell el-Dab'a and Middle Minoan chronology. *Ägypten und Levante* 3: 157-159.

Ward Perkins, J.B.
1946 The monastery of Taposiris Magna. *Societé Royale d'archaeology - Alexandrie, Bulletin* 36: 48-53.

Warne, A.G. & Stanley, D.J.
1993 Archaeology to refine Holocene subsidence rates along the Nile delta margin, Egypt. *Geology* 21: 715-718.

Warren, P.
1972 *Myrtos. An Early Bronze settlement in Crete*. BSA Supplementary Series. London: Thames & Hudson.

Warren, P.
1975 *The Aegean civilisations (The making of the Past)*. Oxford: Elsevier.

Warren, P. & Hankey, V.
1989 *Aegean Bronze Age chronology*. Bristol: Bristol Classical Press.

Watrous, L.V.
1984 Ayia Triada: A new perspective on the Minoan villa. *AJA* 88: 123-134.

Watrous, L.V.
1992 *Kommos III. The late Bronze Age pottery*. Princeton, New Jersey: Princeton University Press.

Weather in the Mediterranean
1937 *Weather in the Mediterranean*. Vol. I Meterological Office.

Webb, M.C.
1974 *Exchange networks: Prehistory*. Dept. of Anthropology and Geography, University of New Orleans.

Wetzel, R. & Haller, J.
1945-48 Le quaternaire côtier de la région de Tripoli. Étudie géologique sue le Liban, le Syrie et le Moyen Orient. *Beyrouth*: 4577.

White, D.
1985 Excavations at Mersa Matruh, Summer 1985. *American Research Center in Egypt, Newsletter* 131: 3-17.

White, D.
1986 Excavations on Bate's Island, Mersa Matruh. *Journal of American Research Center in Egypt* 23: 51-84.

White, D.
1989 1987 excavations on Bate's island, Mersa Matruh. Second preliminary report. *Journal of American Research Center in Egypt* 26: 87-126.

Wiener, M.H.
1984 Crete and the Cyclades in the Late Minoan I: The tale of the conical cups. Pp 17-26 in *Minoan Thalassocracy*, eds. R. Hägg & N. Marinatos.

Wiener, M.H.
1987 Trade and rule in palatial Crete. Pp 261-267 in *The functions of Minoan palaces*, eds. R. Hägg & N. Marinatos.

Wiener, M.H.
1991 The nature and control of Minoan foreign trade. Pp. 325-350 in *Bronze Age trade in the Mediterranean*. Dec. 1989. Oxford. SIMA 90, ed. N.H. Gale. Jonsered: Paul Åström Förlag.

Will, E., Dentzer, J.M. & Thalman, J.P.
1973 La première campagne de fouilles à Tell 'Araqa. *Bulletin Musée de Beyrouth* 26: 61-79.

Williams, B.
1980 The lost pharaohs of Nubia. *Archaeology* 33.5: 12-21.

Wiseman, D.J.
1953 *The Alalakh Tablets*. London: British Institute of Archaeology in Ankara.

Woolley, L. Sir
1936 Tal Atchana'. *JHS* 56: 125-132.

Woolley, L. Sir
1938 Excavations at Al Mina, Sueidia. *JHS* 58: 1-30.

Woolley, L. Sir
1953 *A forgotten kingdom; being a record of the results obtained from the excavation of two mounds, Atchana and Al Mina, in the Turkish Hatay*. London: (Pelican) Penguin Books Ltd.

Wreschner, E.E.
1983 The submerged Neolithic village Neve-Yam on the Israeli Mediterranean coast. Pp. 325-333 in *Quaternary coastlines and marine archaeology*, eds. P.C. Masters & N.C. Flemming. London: Academic Press.

Wright, M.
1988 Contacts between Egypt and Syro-Palestine during the Old Kingdom. *Biblical Archaeology* 51.3: 143-162.

Yakar, J.
1979 Hittite involvement in western Anatolia. *AS* 26: 117-128.

Yannai, A.
1983 *Studies of trade between the Levant and the Aegean in 14th to 12th centuries BC*. D.Phil thesis. Oxford.

Yedaya, M. (ed.)
1986 *Qadmoniyot Galil Ha Ma'aravi. The western Galilee antiquities*. Antiquities of the western Galilee: selected articles. Tel Aviv: Ministry of Defense Publications (in Hebrew).

Yener, A. & Özbal, H.
1987 Tin in the Turkish Taurus mountians: the Bolkardağ mining district. *Antiquity* 61: 220-226.

Yener, K.A. & Vandiver, P.B.
1993 Tin processing at Gültepe, an Early Bronze Age site in Anatolia. *AJA* 97.2: 207-238.

Yon, M.
1992 The end of the Kingdom of Ugarit. Pp. 111-122 in *The Crisis years: the 12th century BC from beyond the Danube to the Tigris*, ed. W.A. Wood & M.S. Joukowsky. Dubuque, Iowa: Kendall/ Hunt Pub. Co.

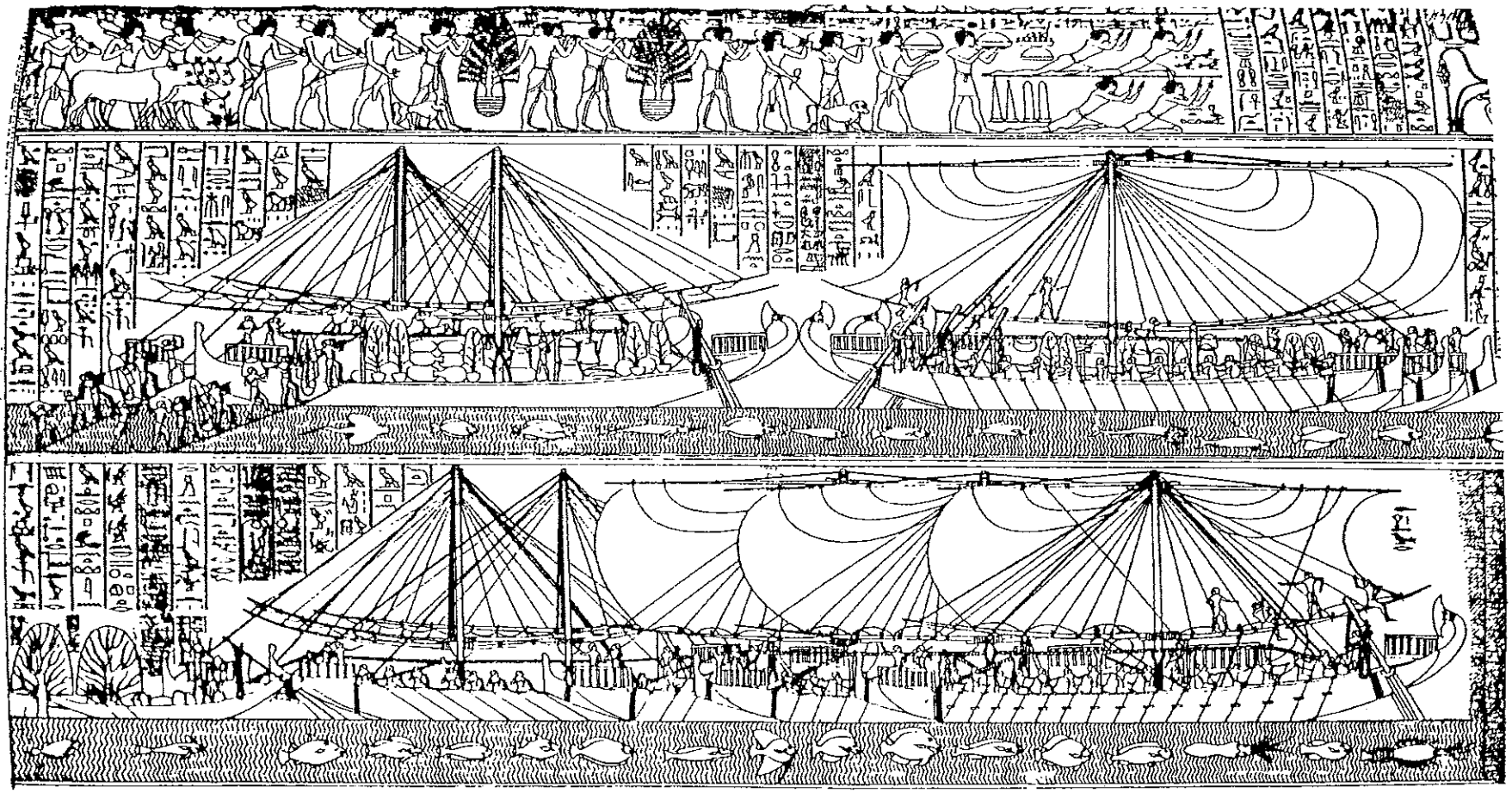


Fig. II.1 Egyptian seagoing vessels, c. 1500 BC, after Casson 1971: Fig.18.

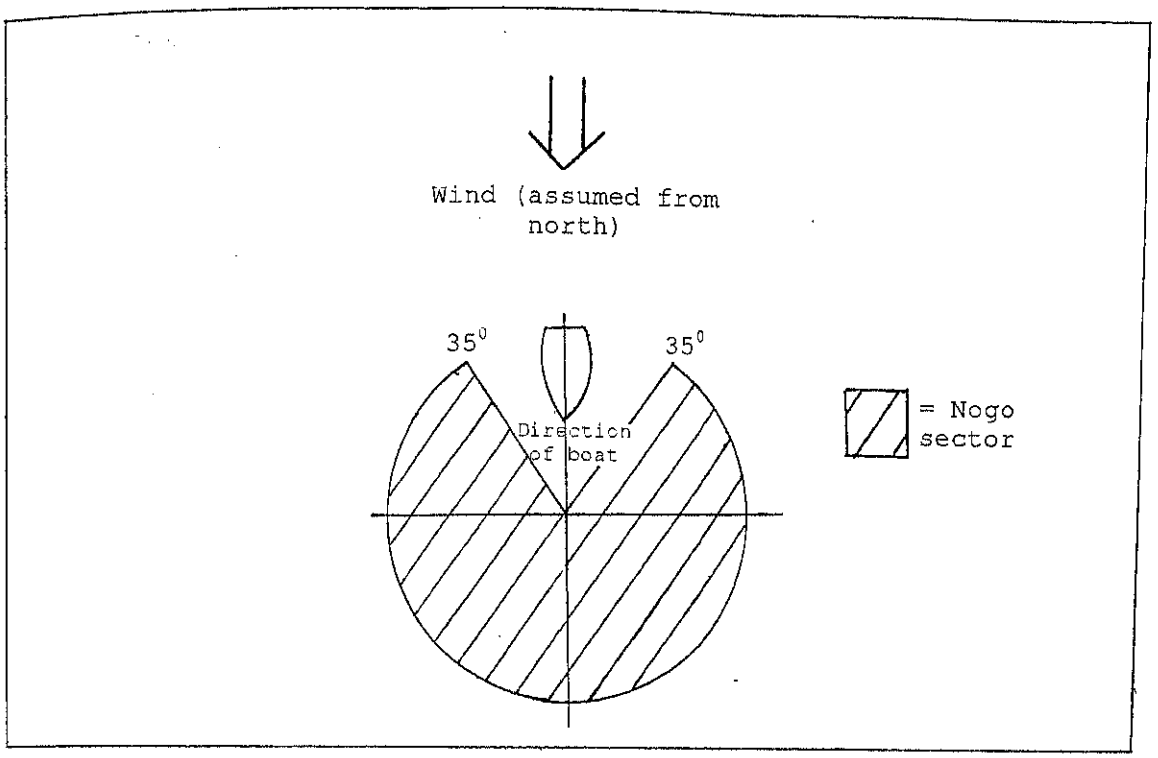



Fig. II.2 Capabilities of vessels prior to the positioning of the mast amidships.

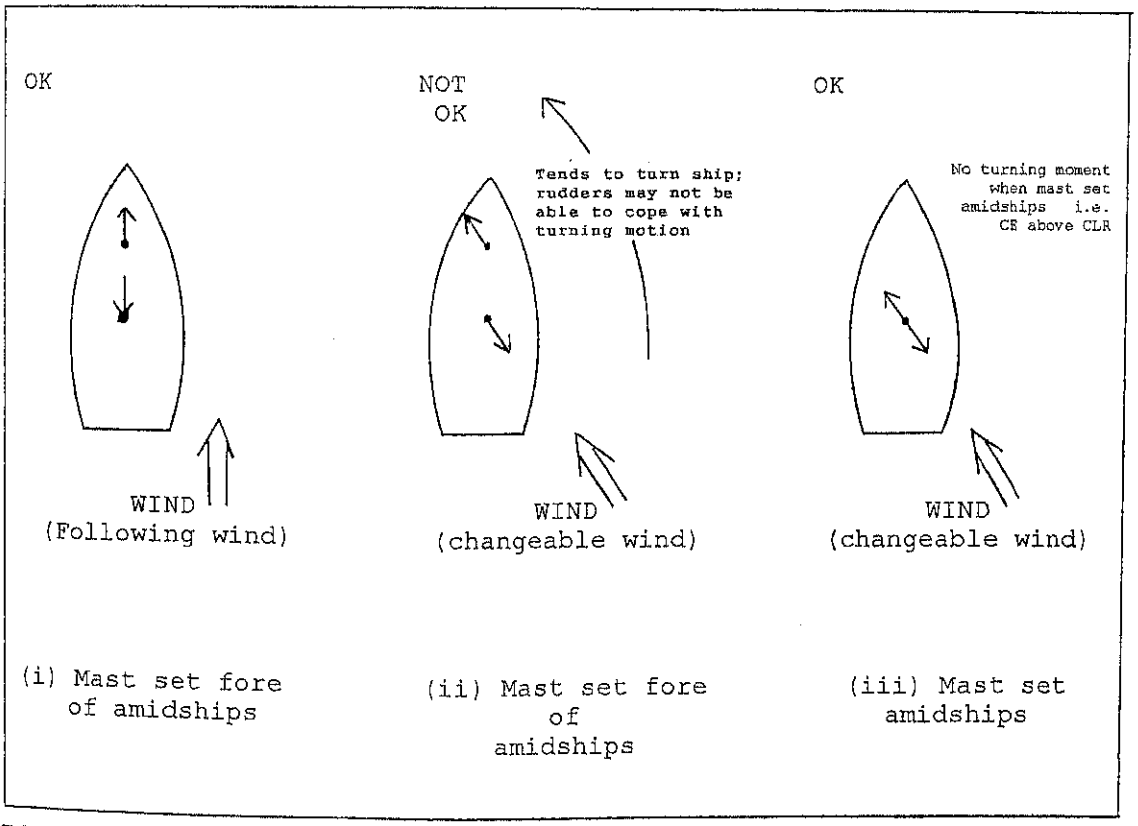
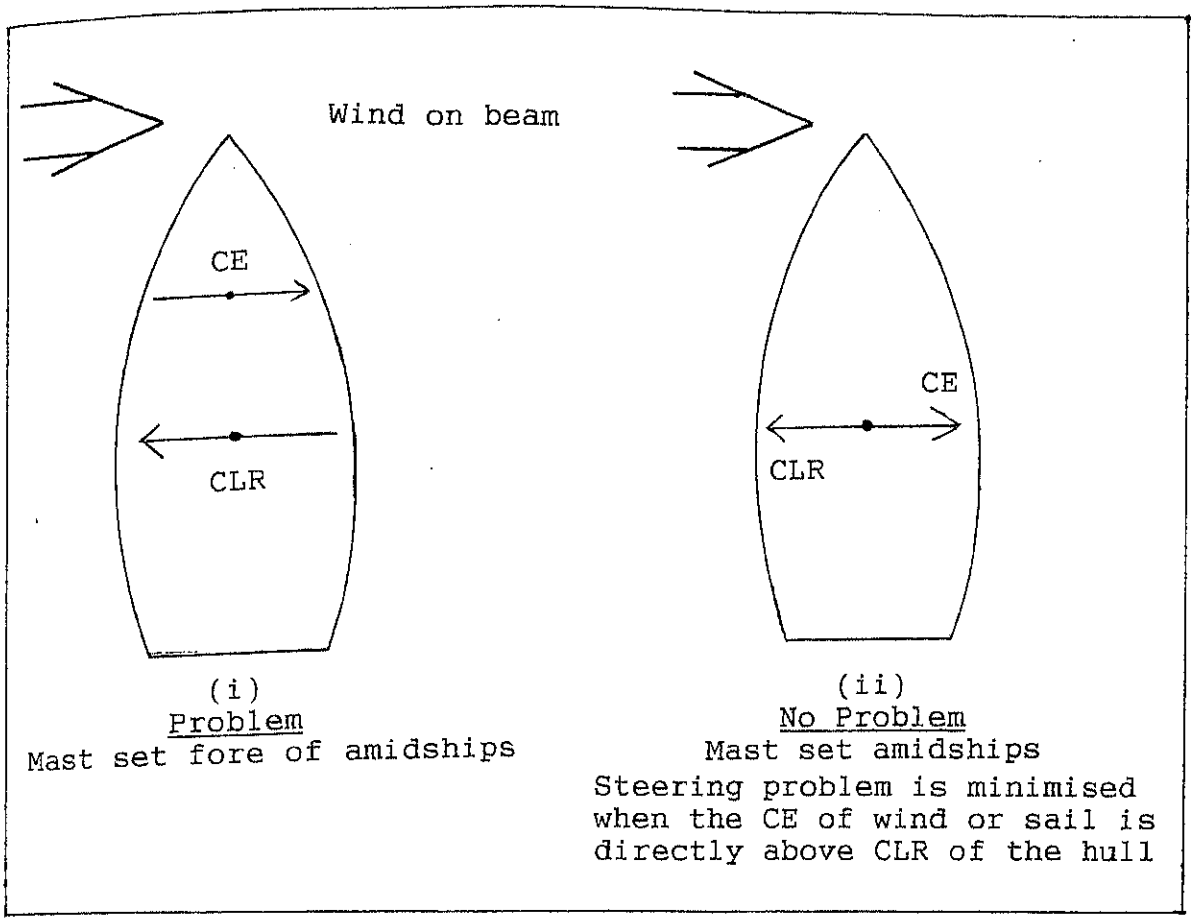


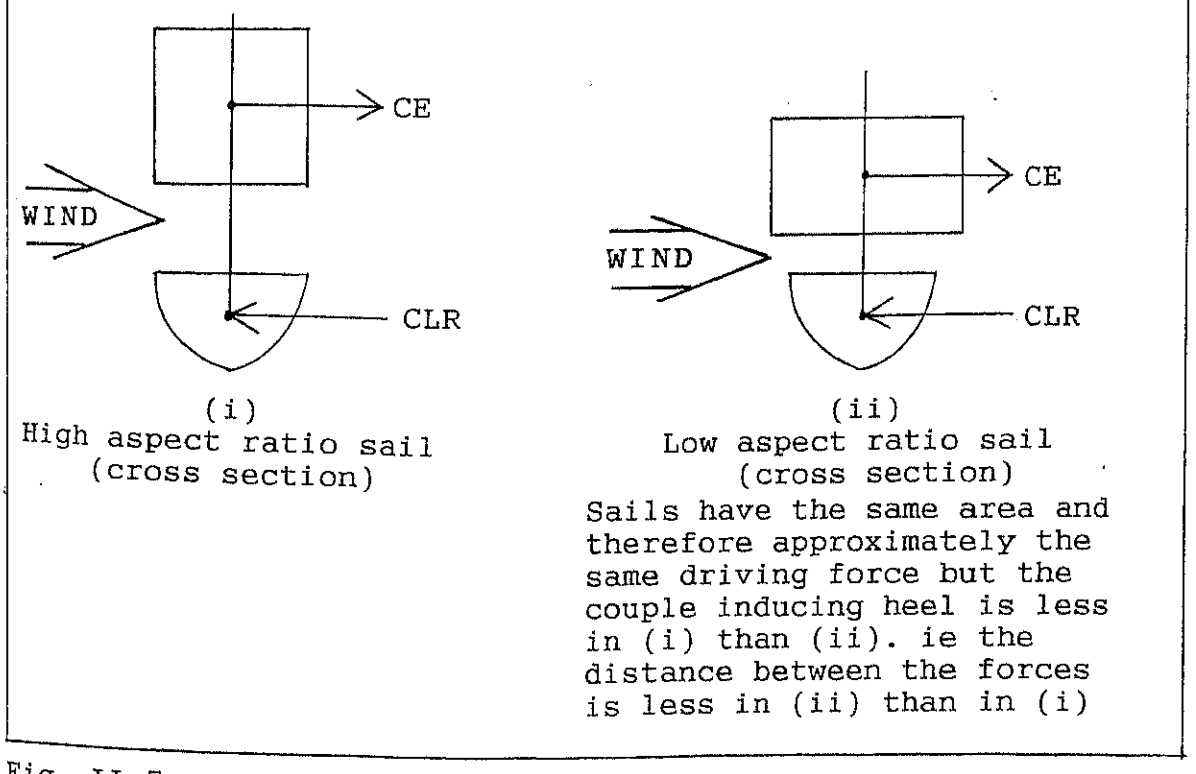

Fig. II.3 Effect of following and changeable winds on vessels with the mast set fore of amidships compared with amidships.




(i)
Problem
Mast set fore of amidships

(ii)
No Problem
Mast set amidships
Steering problem is minimised when the CE of wind or sail is directly above CLR of the hull

Fig. II.4 Effect of the wind on the beam with the mast set fore of amidships, compared to the mast set amidships.




(i)
High aspect ratio sail
(cross section)

(ii)
Low aspect ratio sail
(cross section)
Sails have the same area and therefore approximately the same driving force but the couple inducing heel is less in (i) than (ii). ie the distance between the forces is less in (ii) than in (i)

Fig. II.5 Comparisons between high and low aspect ratio sails.

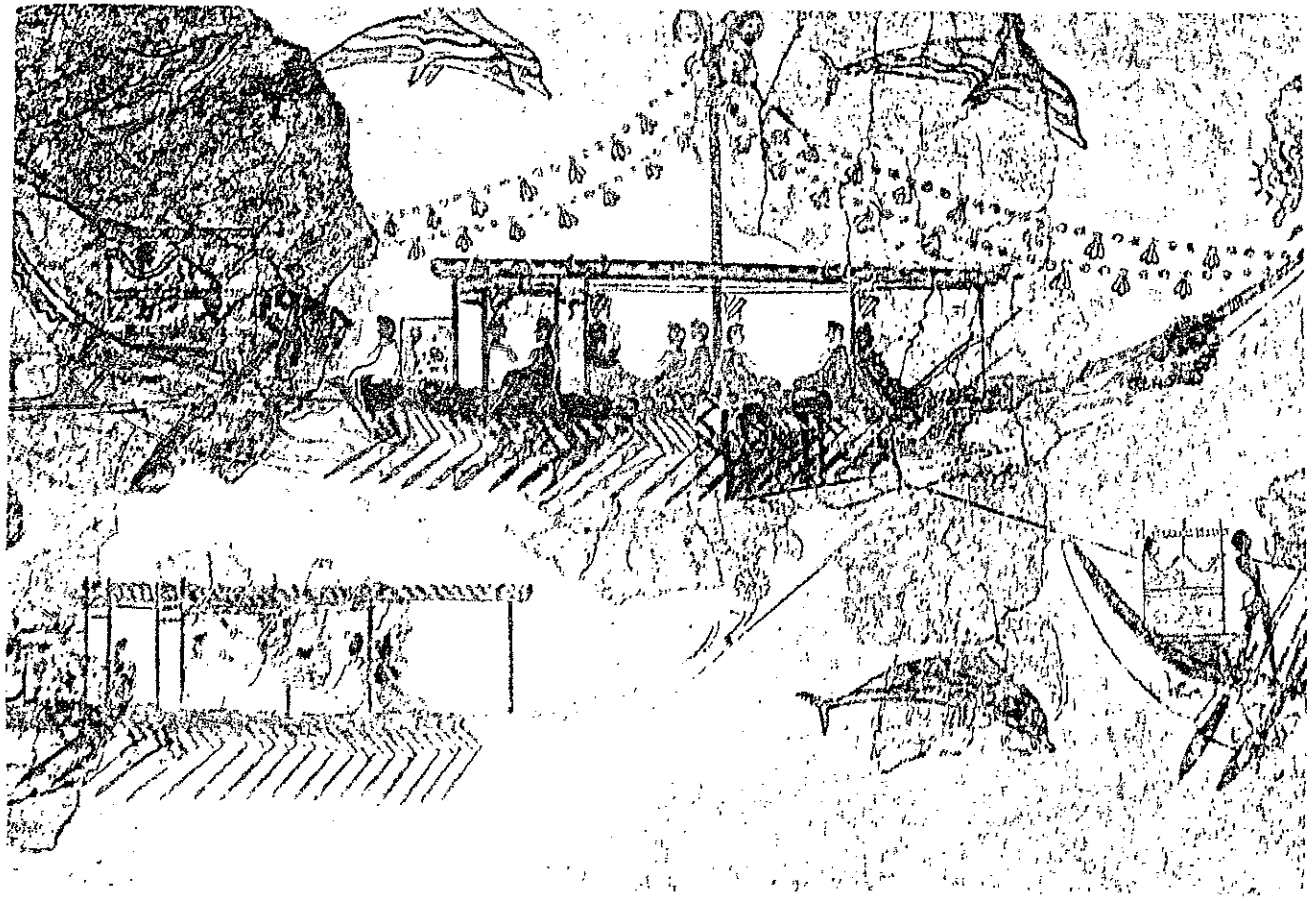


Fig. II.6 Thera sailing ship, after Morgan 1988: Fig.70.

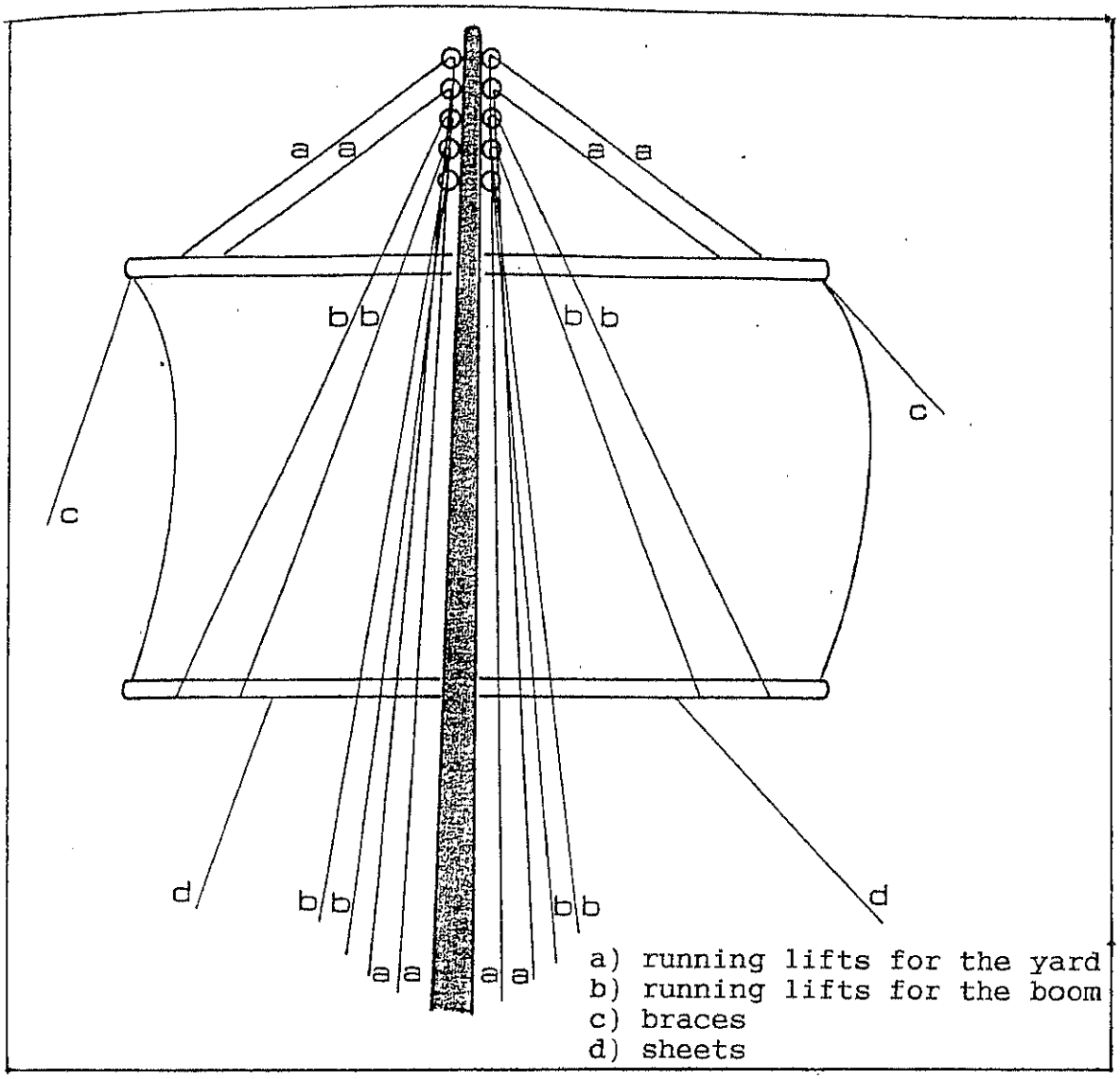



Fig. II.7 Reconstruction of the rigging of the Thera sailing ship, showing braces, lifts and sheets, after Georgiou 1991: Pl.XXII

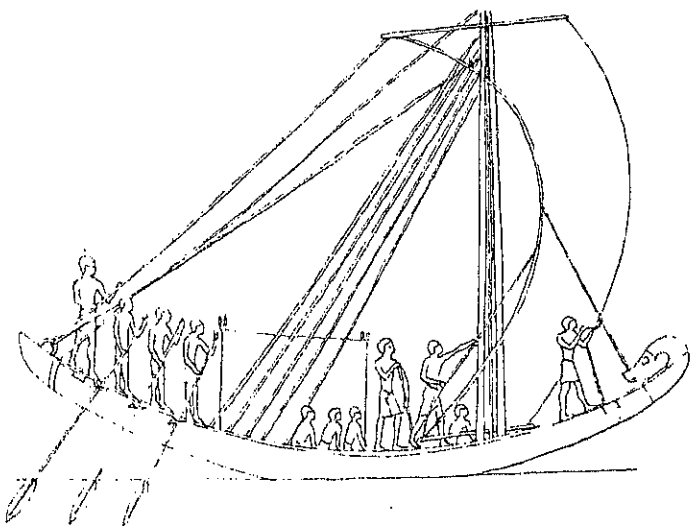


Fig. II.8 Fourth Dynasty cargo vessel showing bowlines, after Landström 1970: 37,fig.99.

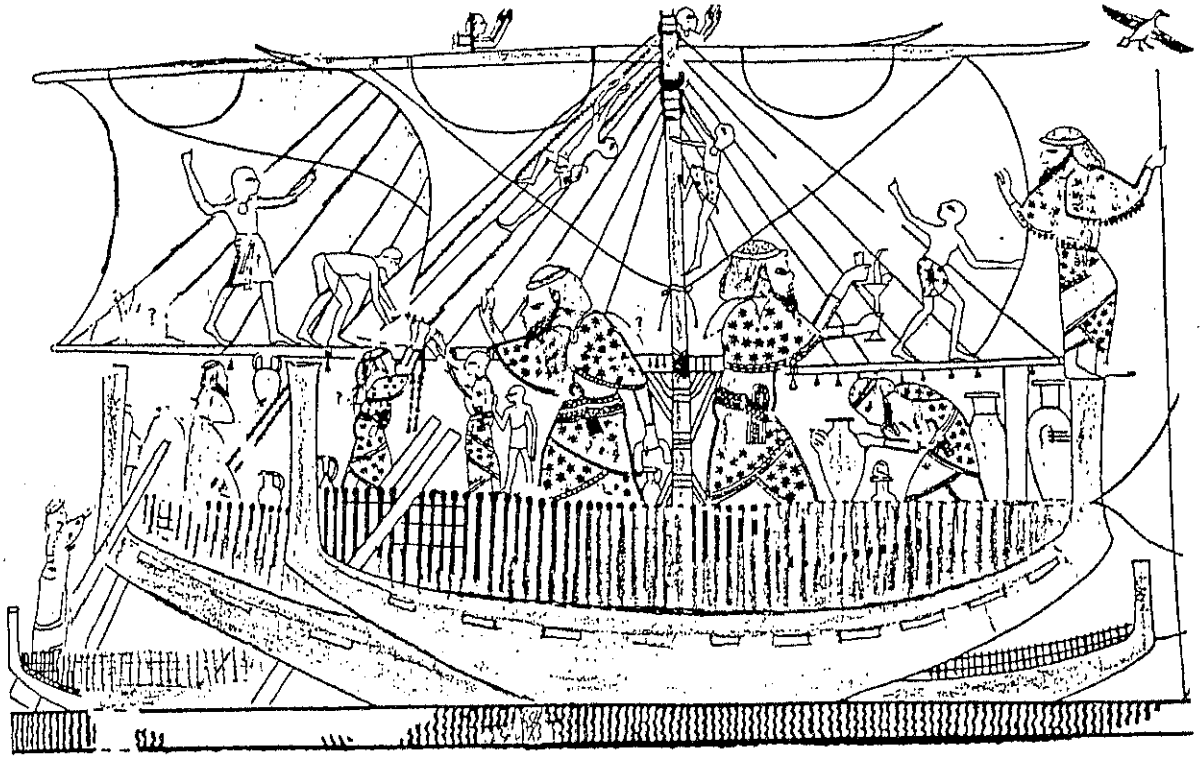


Fig. II.9 Relief in the tomb of Kenamun at Thebes c. 1400 BC, after Davies& Faulkner 1947: Pl.VIII.

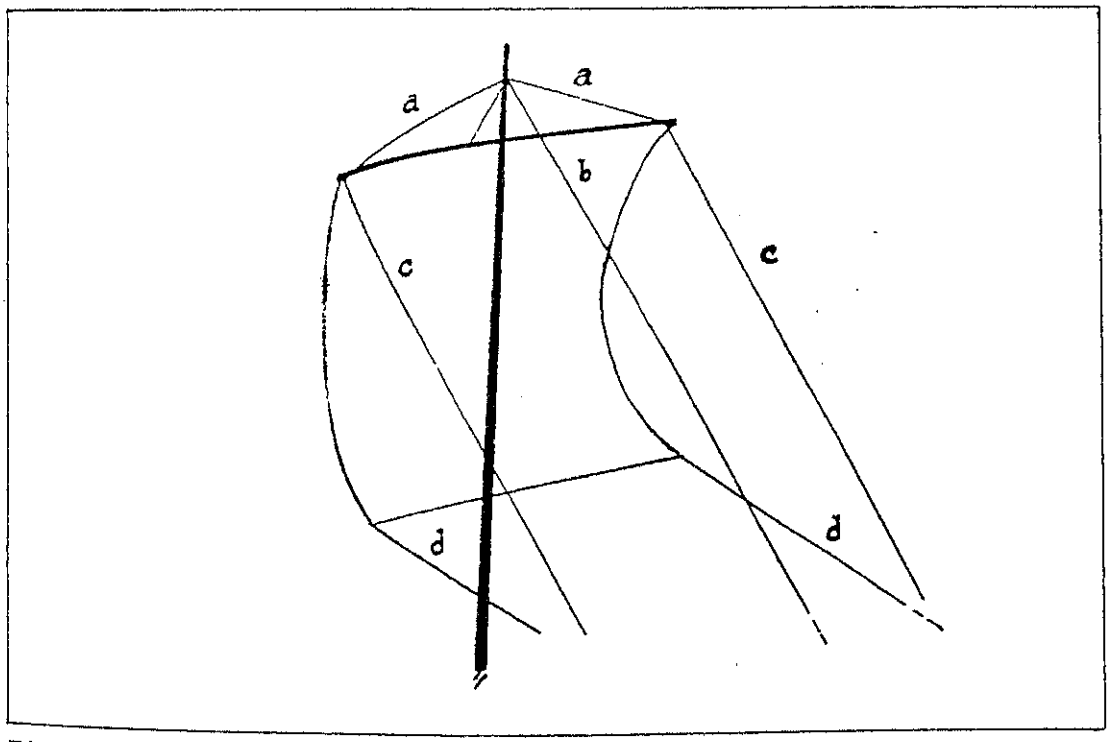



Fig. II.10 Sketch illustrating
a) standing lifts (not pass through pulley blocks)
b) halyard
c) braces
d) sheets
,after Casson 1971: Fig. 171.

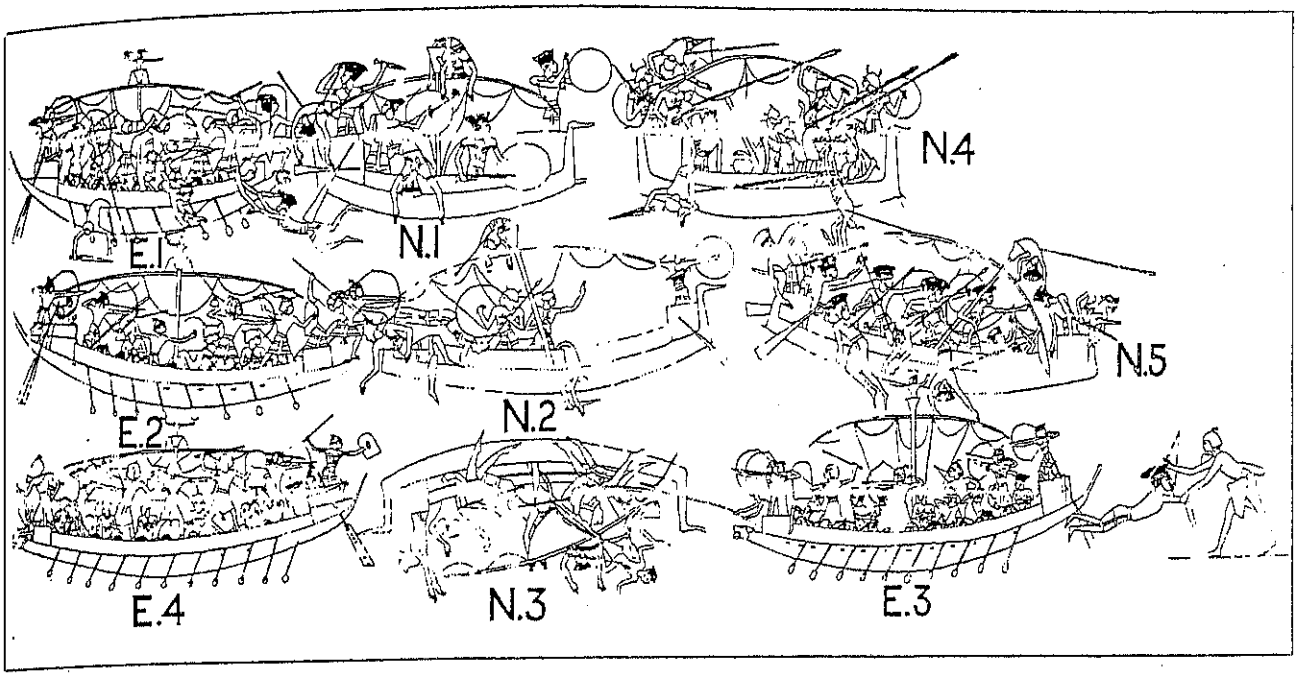



Fig. II.11 Naval battle depicted in Medinet Habu relief, after Casson 1971: Fig.61.

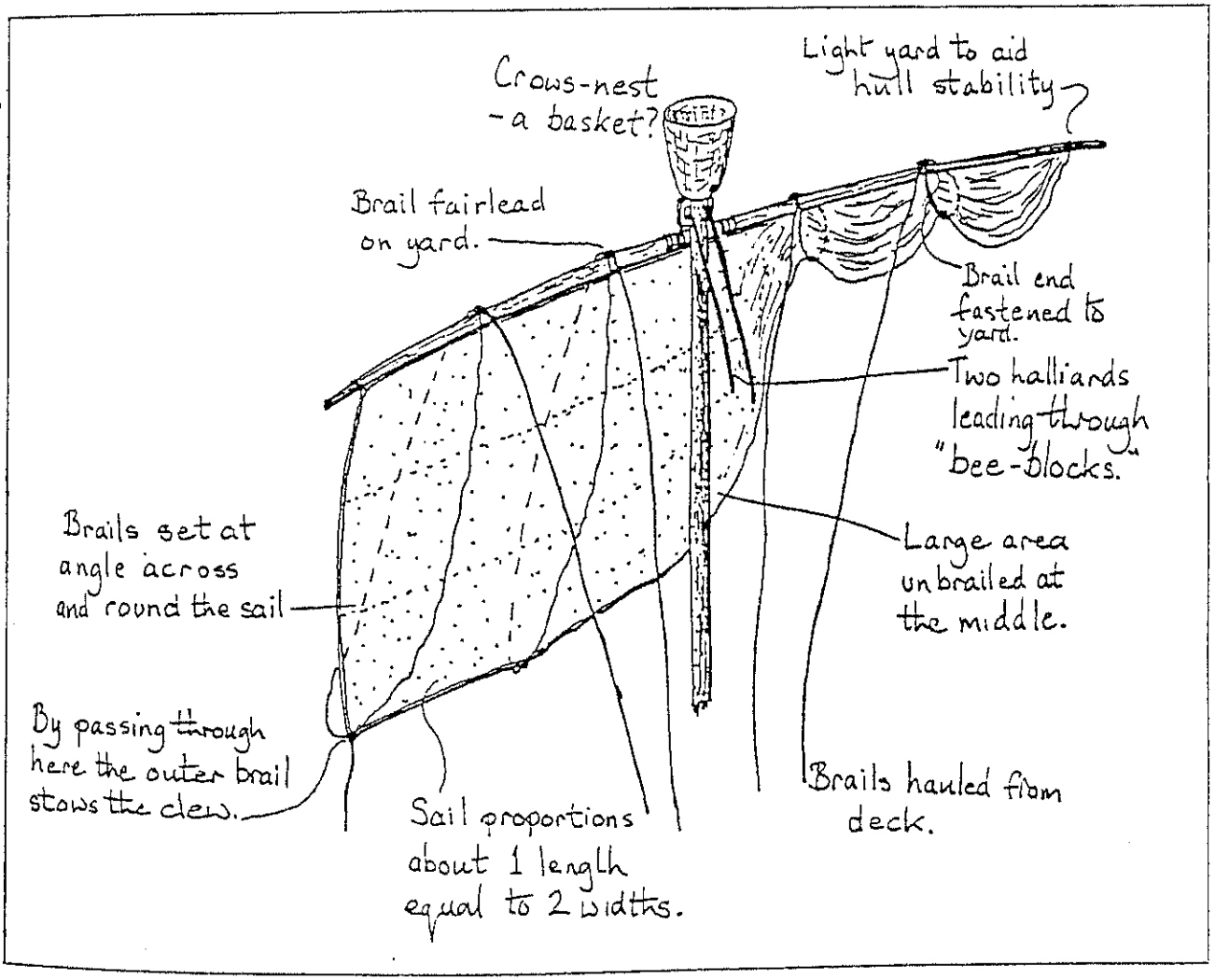



Fig. II.12 Partly brailed interpretation of the running rigging. A vessel from Ramesses III's fleet, after Roberts 1991: Pl.XVIIa.

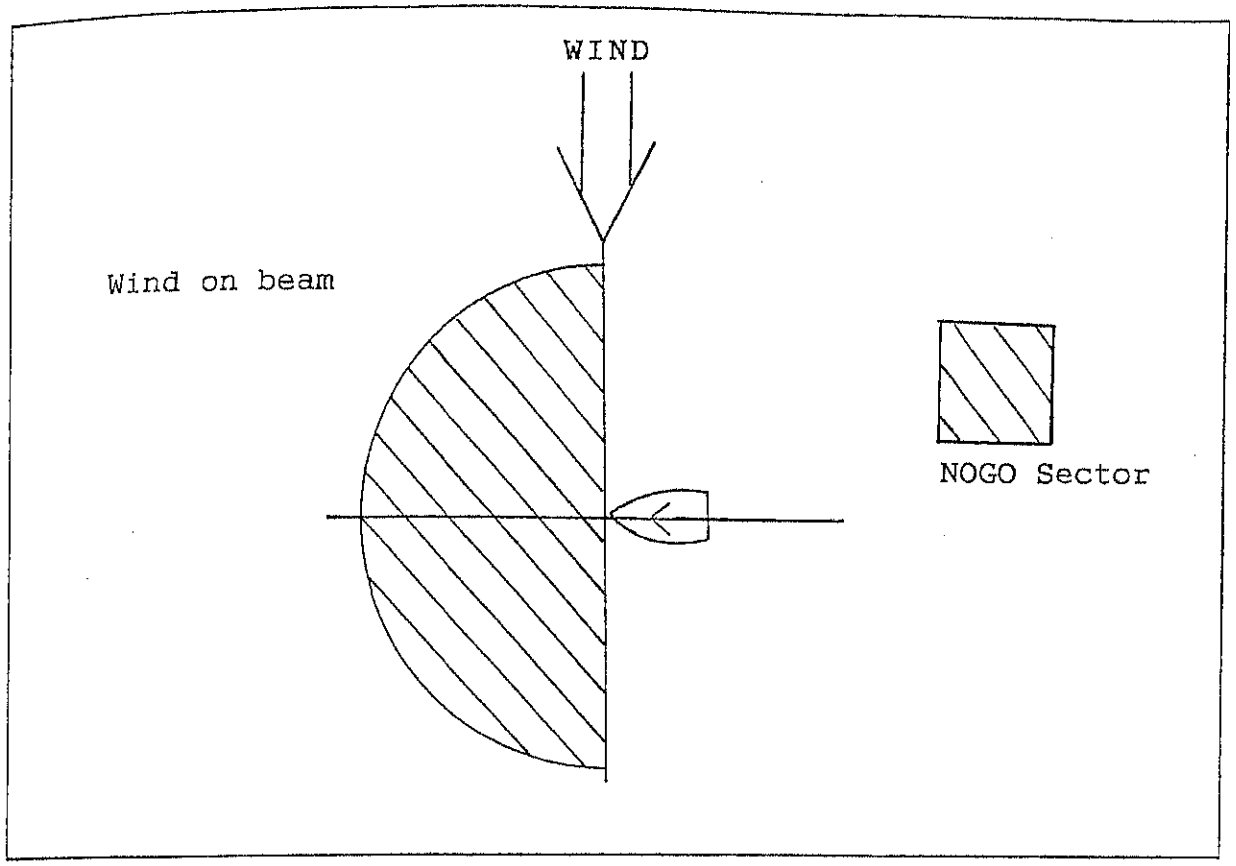



Fig. II.13 The area in which a vessel is unable to make headway due to opposing winds.

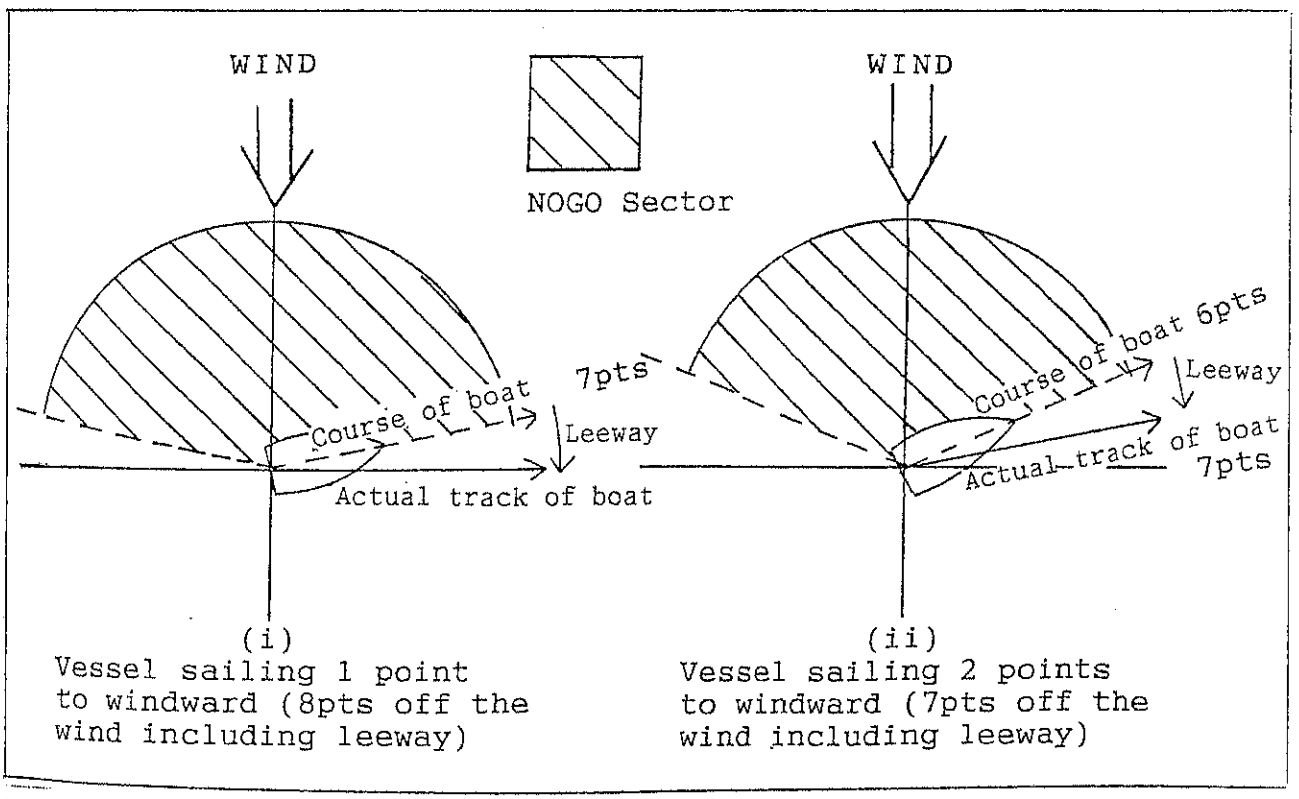
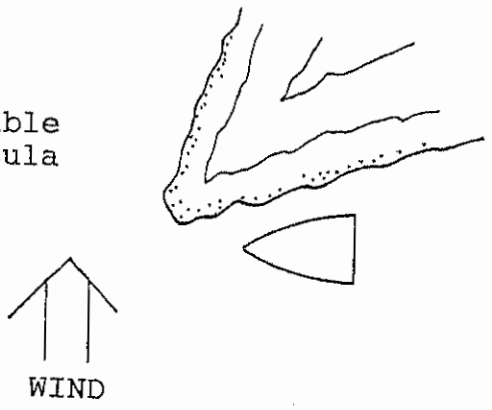
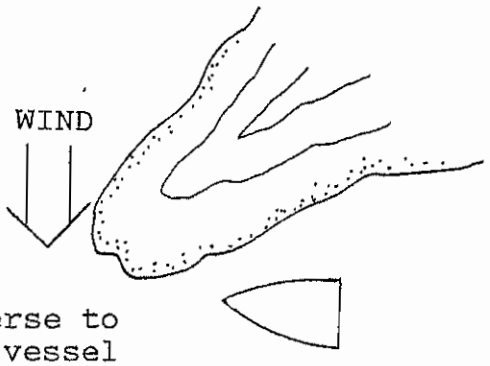



Fig. II.14 Vessels capable of sailing 1 or 2 points to windward.

a) Prevailing wind is favourable for vessel to round peninsula




b) Prevailing wind is adverse to the manoeuvring of the vessel round the peninsula, and therefore the vessel will have to wait for favourable winds

Fig. II.15 Manoeuvring of vessels around peninsulas.

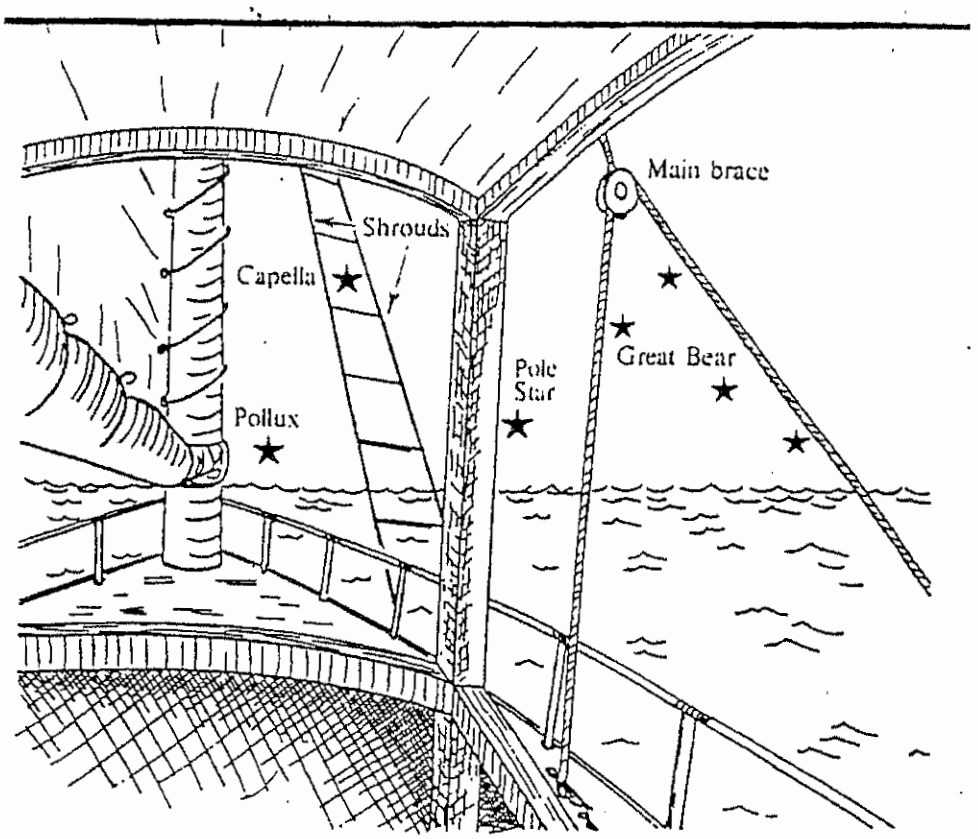



Fig. II.16 Steering by Ursa Major and other stars, after Lewis 1994: 91.

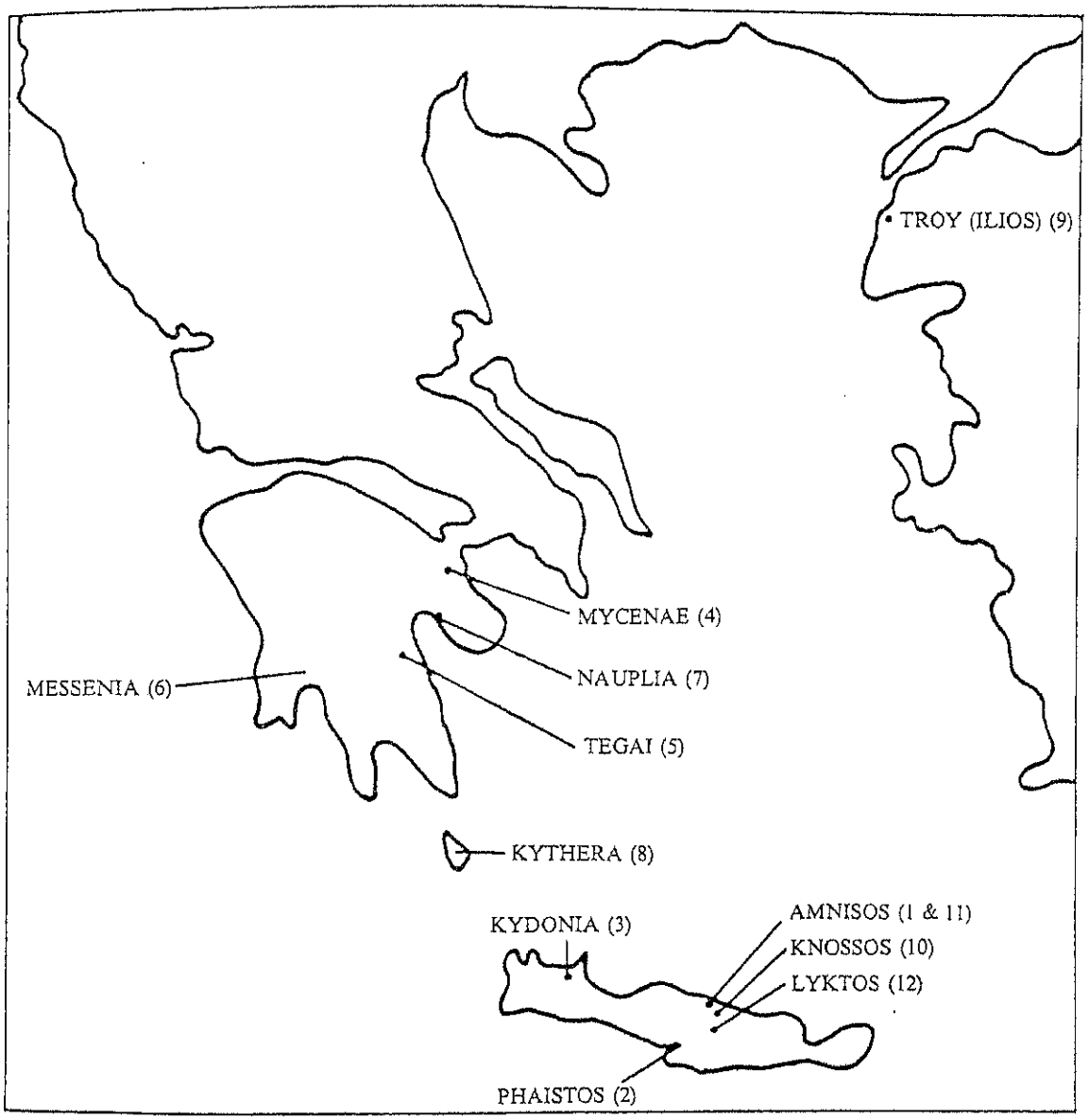



Fig. III.1 Map illustrating the sites mentioned in the topographic list of Aegean names from Amenhotep III's mortuary temple at Kom el-Hetan, after Wachsmann 1987: Pl.LXIX.

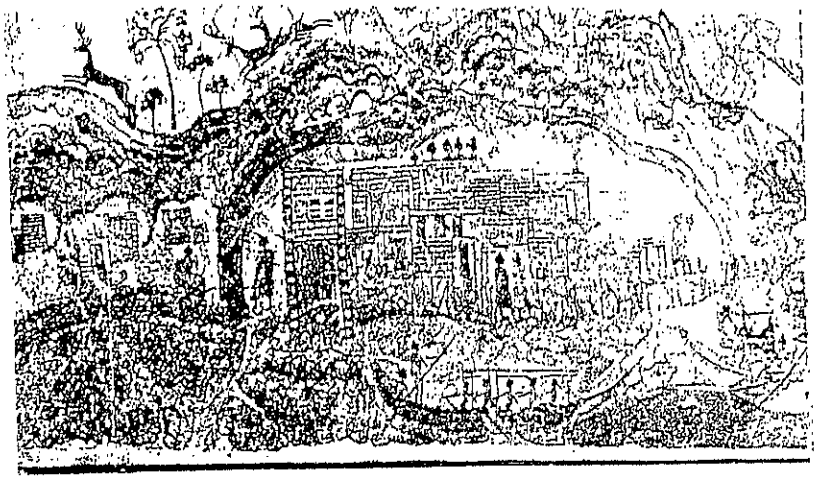


Fig. III.2.i Second town passed by ships, in the Miniature Frieze of a Ship Procession, from the south wall of Room 5 (the West House), Thera, after Morgan 1988: Pl.C.

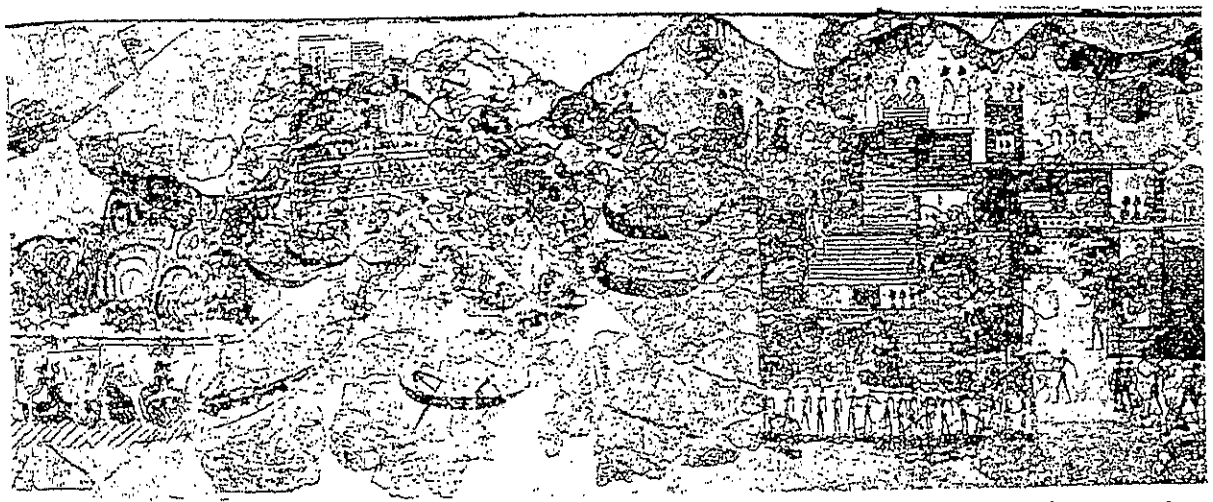


Fig. III.2.ii Third 'Arrival' town, in the Miniature Frieze of a Ship Procession, from the south wall of Room 5 (the West House), Thera, after Morgan 1988: Pl.C.

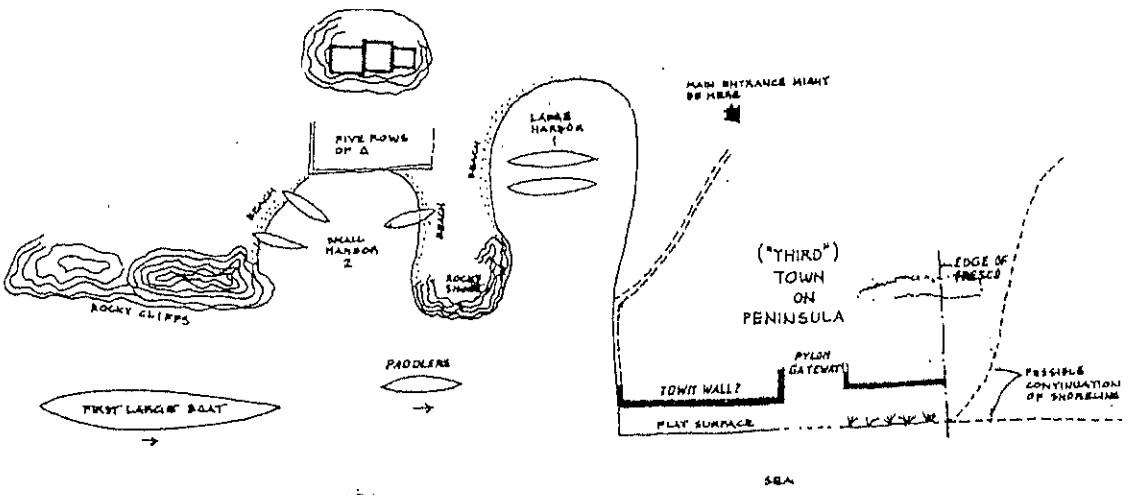



Fig. III.3 Sketch plan of the shoreline of the third 'Arrival' town in the Miniature Frieze of the Ship procession (the West House), Thera, after Shaw 1990: 431,fig.19.

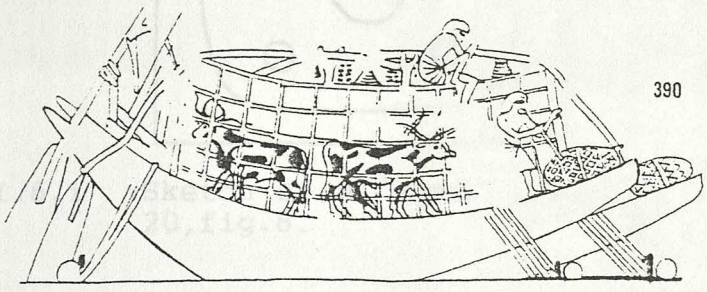



Fig. III.4 Depiction of ships moored to bollards on a quay in the 18th Dynasty tomb of Viceroy Huy, after Landström 1970: 134,fig.390.

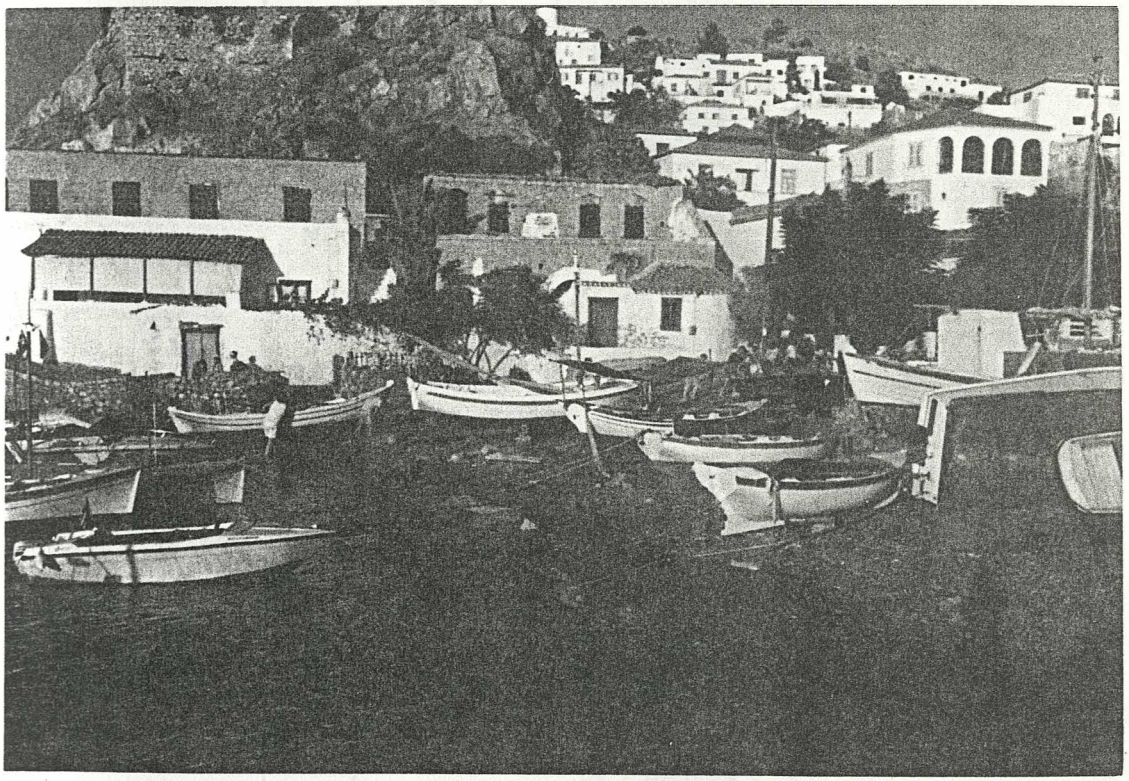


Fig. III.5 Vessels seen being dragged ashore with the use of rollers, Hydra, Greece. (Photo L. Blue 1991).

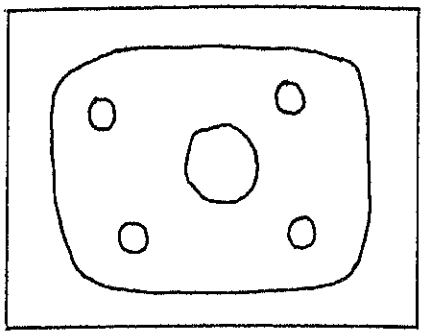


Fig. III.6.i Sketch of a 'sand' anchor, after McCaslin 1980: 20,fig.8.

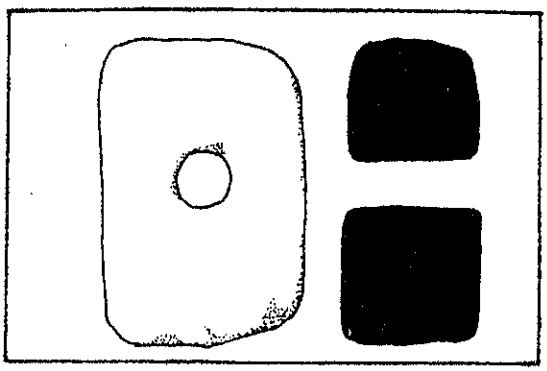


Fig. III.6.ii Sketch of a 'rock' or 'weight' anchor, after McCaslin 1980: 18,fig.6.

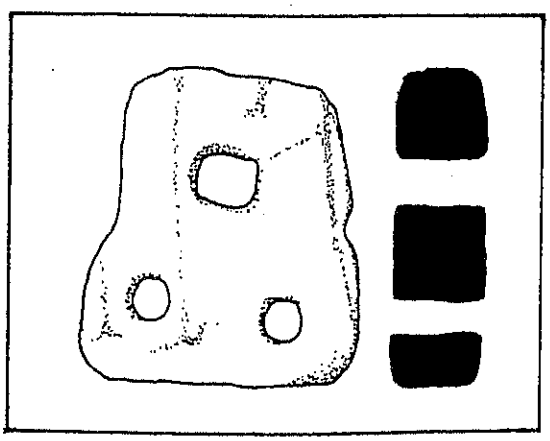


Fig. III.6.iii Sketch of a 'composite' anchor, after McCaslin 1980: 18,fig.5.

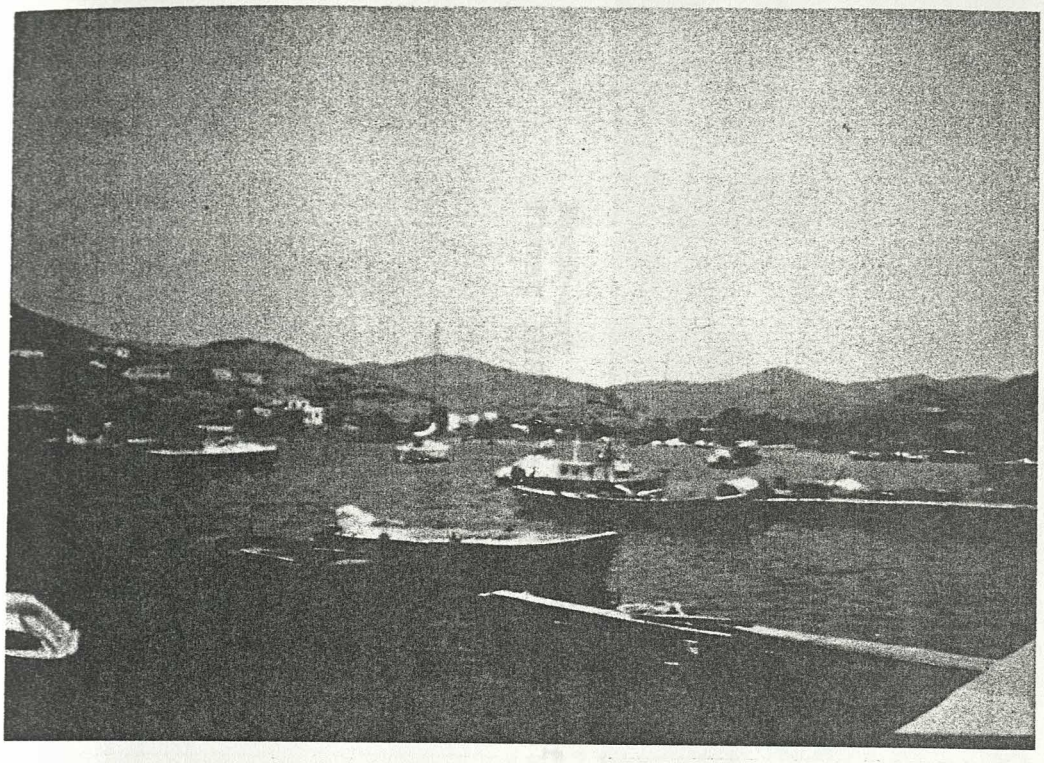


Fig. III.7 Vessels moored to wooden jetties, Kea, Greece. (Photo L. Blue 1991).

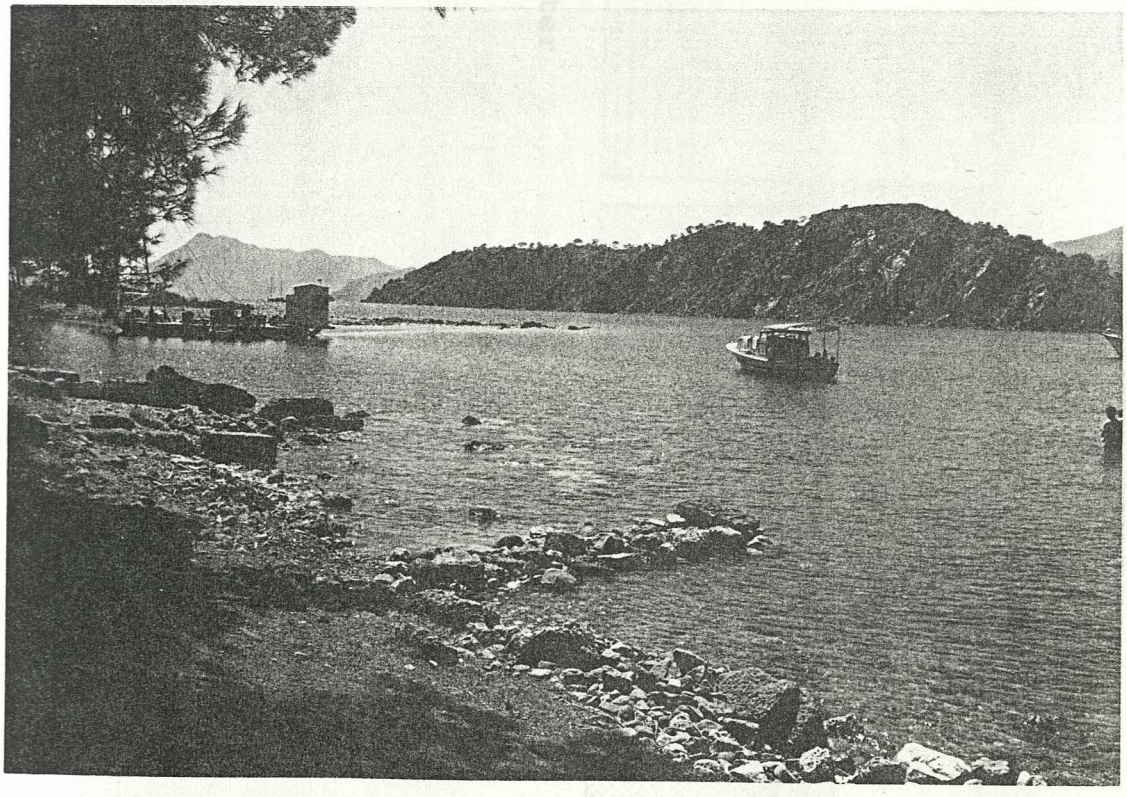


Fig. III.8 Rough stone jetties, South Harbour, Phaselis, southern Turkey (Photo L. Blue 1989).

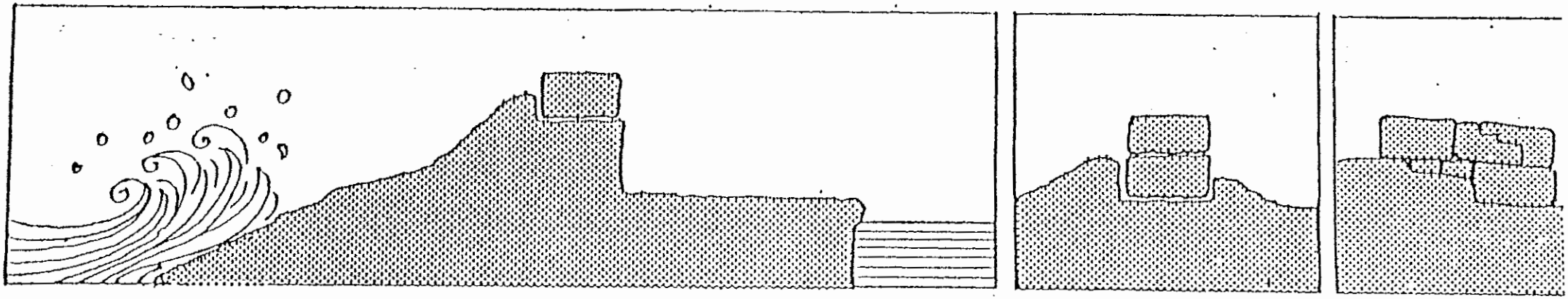


Fig. III.9 Rock-cut adaptation of an offshore reef, after Frost 1980: Fig. 1.



Fig. III.10 A stone quay in the harbour basin at the western entrance to the Temple of Karnak, Thebes, after Lauffray et al. 1970: 59,fig.2.

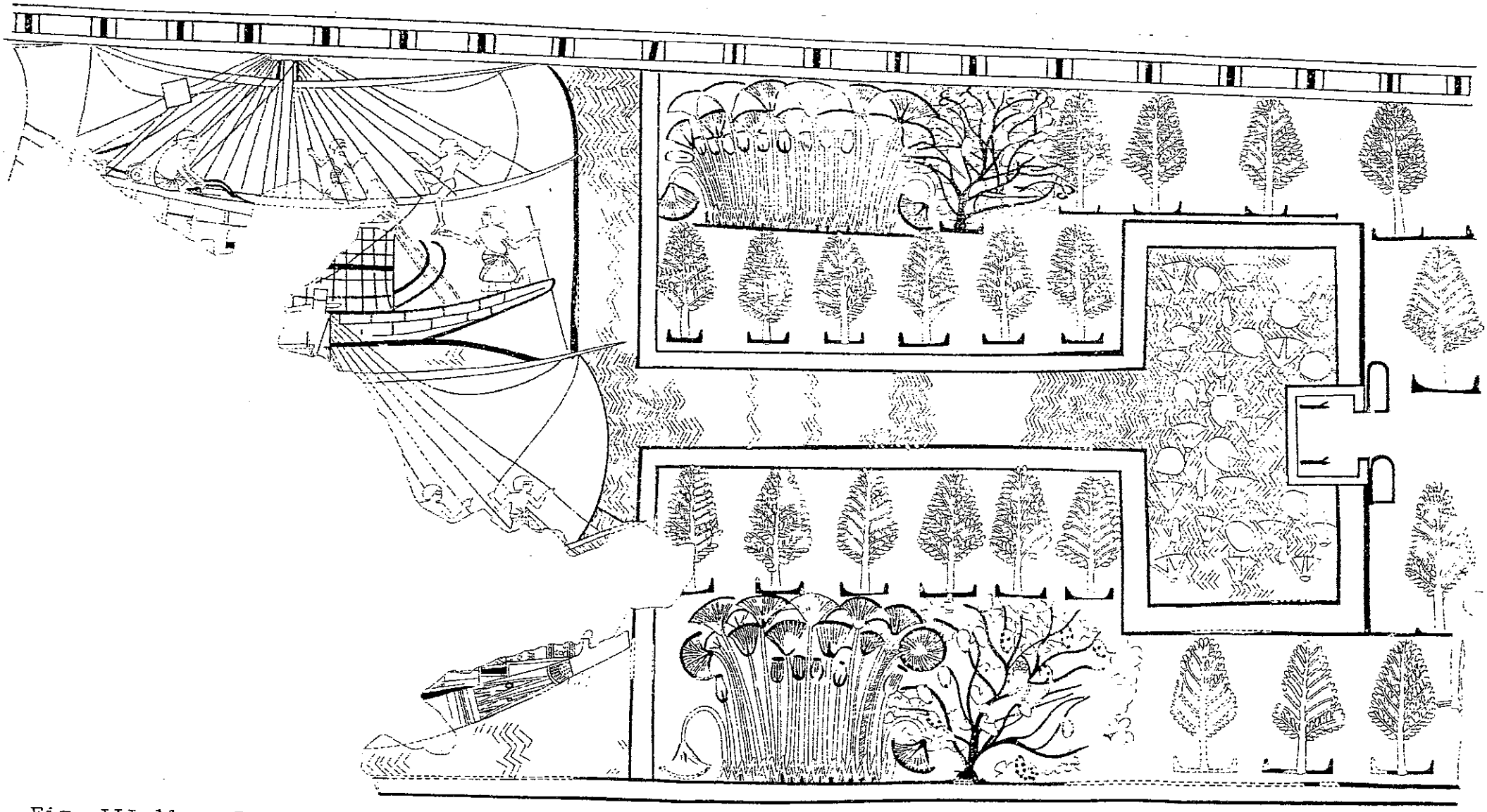


Fig. III.11 Depiction of a T-shaped harbour basin, from the tomb of Nefer-Hotep, Karnak, Thebes, after Davies 1933: Pl.XLII.

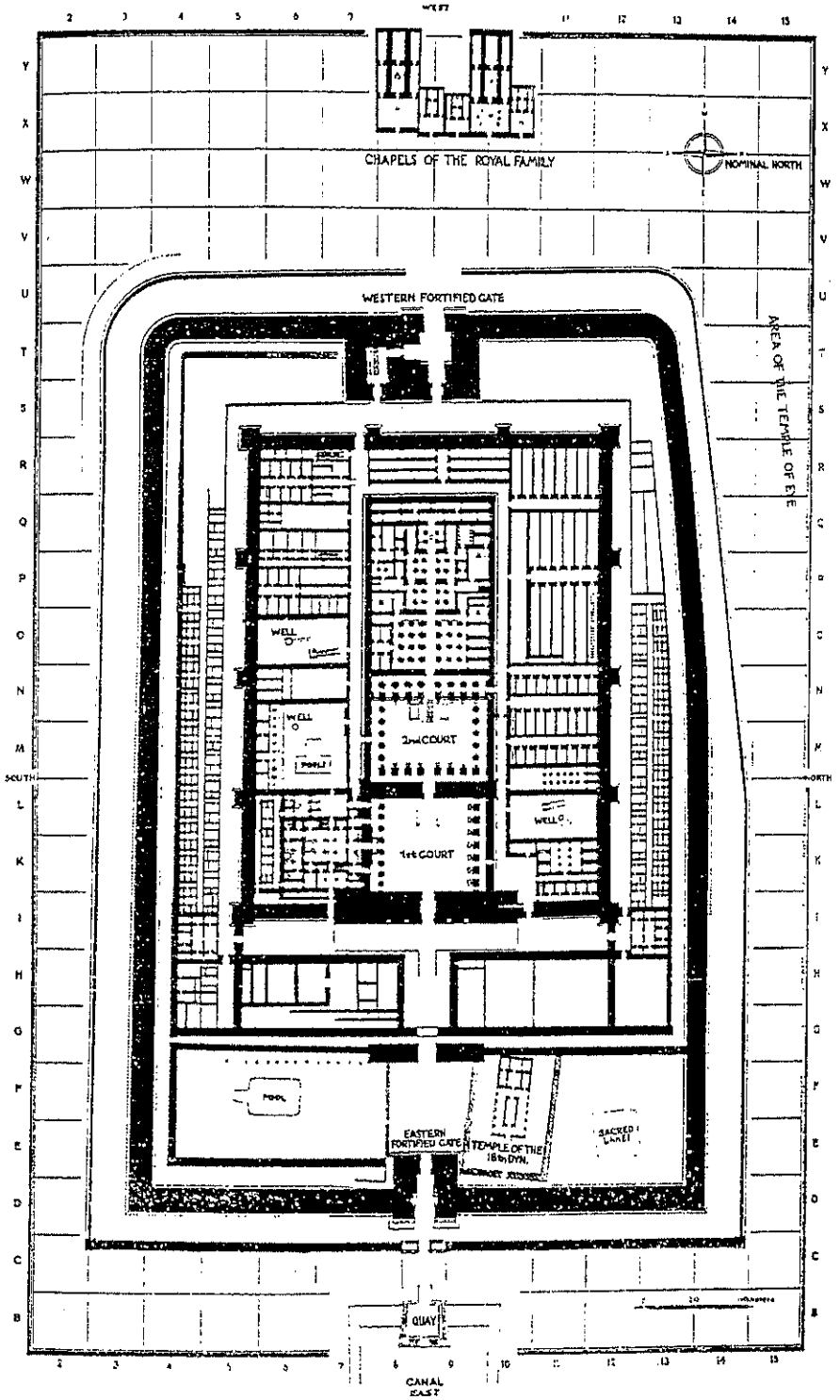



Fig. III.12 Ground plan of the temple area of Ramesses III at Medinet Habu, Thebes. The East Canal and the quay to the south, after Nelson & Hölscher 1934: Fig.47.

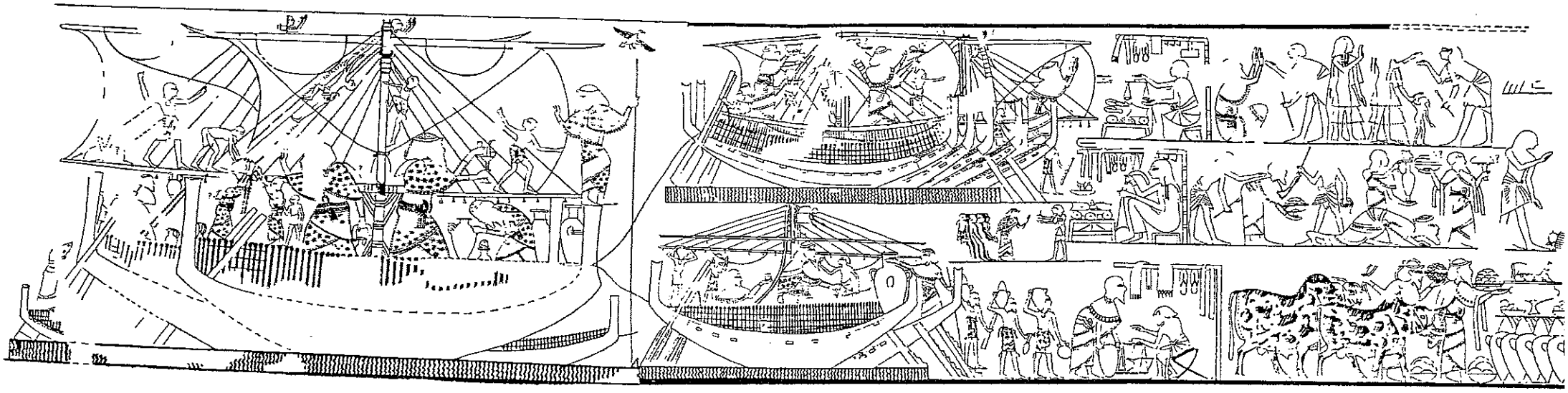


Fig. III.13 Tomb painting (162) in the tomb of Kenamun, Thebes, depicting foreign ships off-loading at quays, after Davies & Faulkner 1947: Pl.VIII.

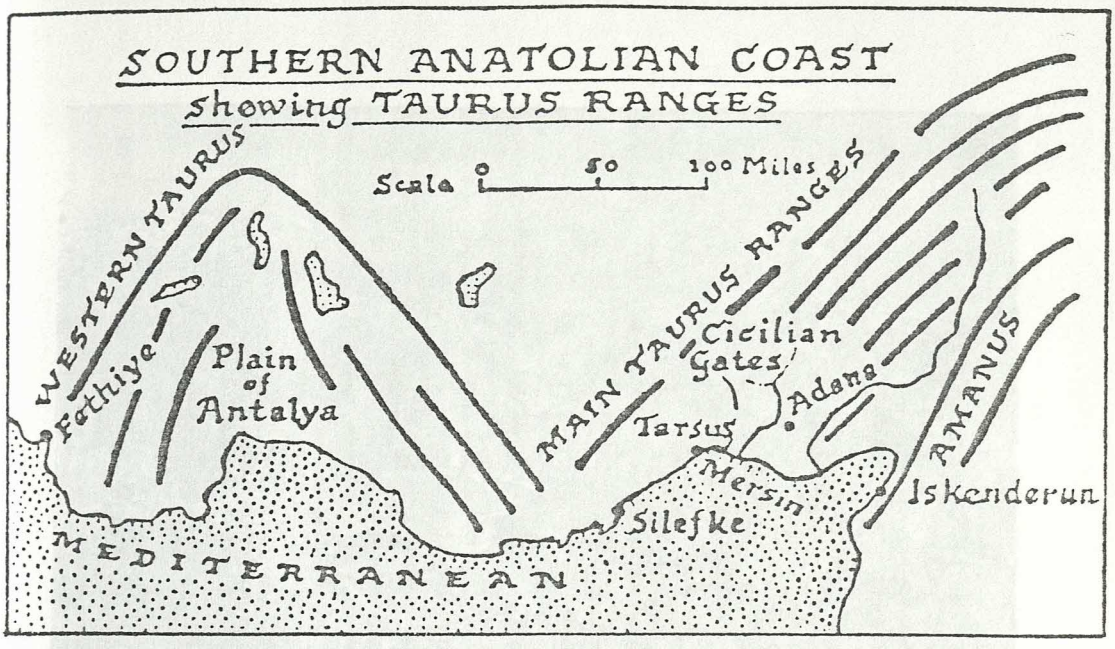



Fig. IV.1 Southern coast of Turkey showing Taurus Mountain Range, after Denham 1964: 89.

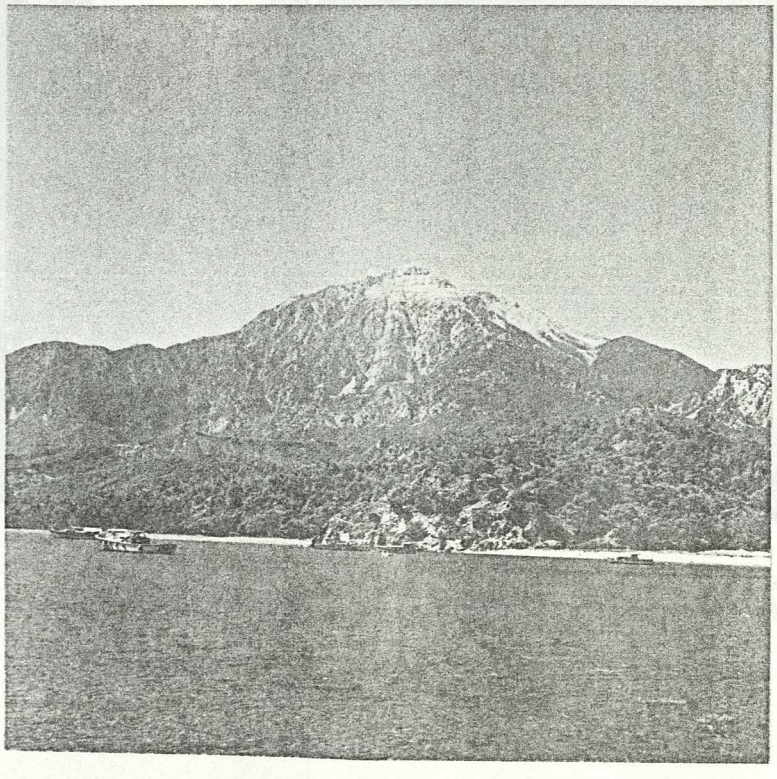


Fig. IV.2 General view of the steep coastline of Rough Cilicia (Photo L. Blue).

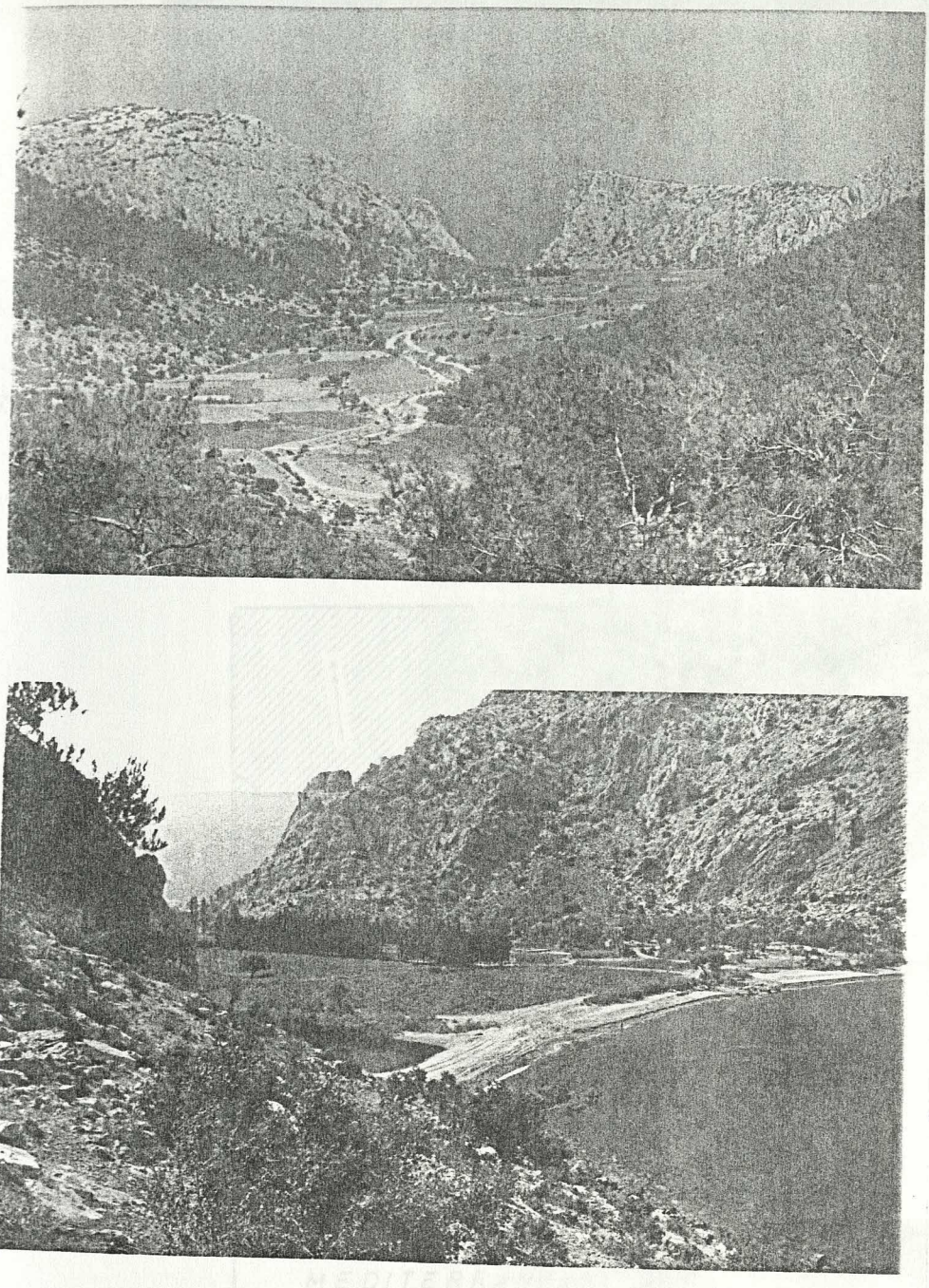


Fig. IV.3 View of alluviated river valley basins fronted by broad beaches (Photos L. Blue 1991).



Fig. IV.4 General view of the deltaic lagoonal environment of the Silifke and Cilician deltas (Photo L. Blue 1991).

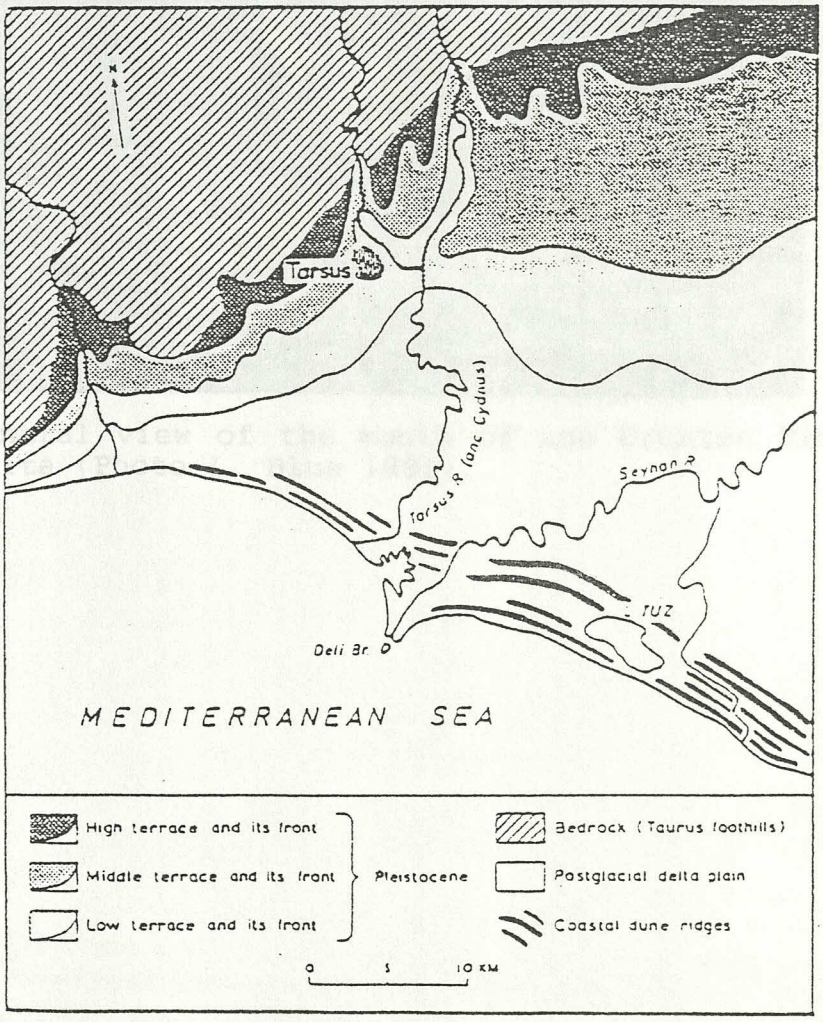



Fig. IV.5 The deltaic plain of Çukurova (Cilicia), after Erinç 1978: 101,fig.3.

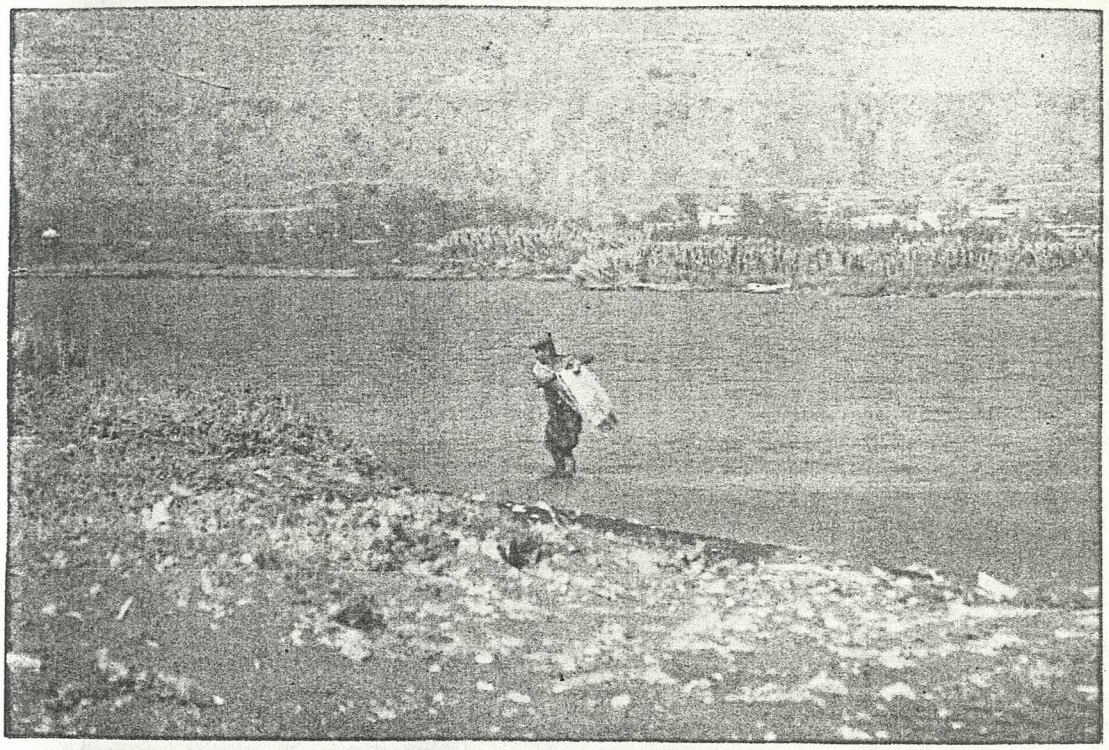


Fig. IV.6 General view of the mouth of the Orontes River Delta (Photo L. Blue 1991).

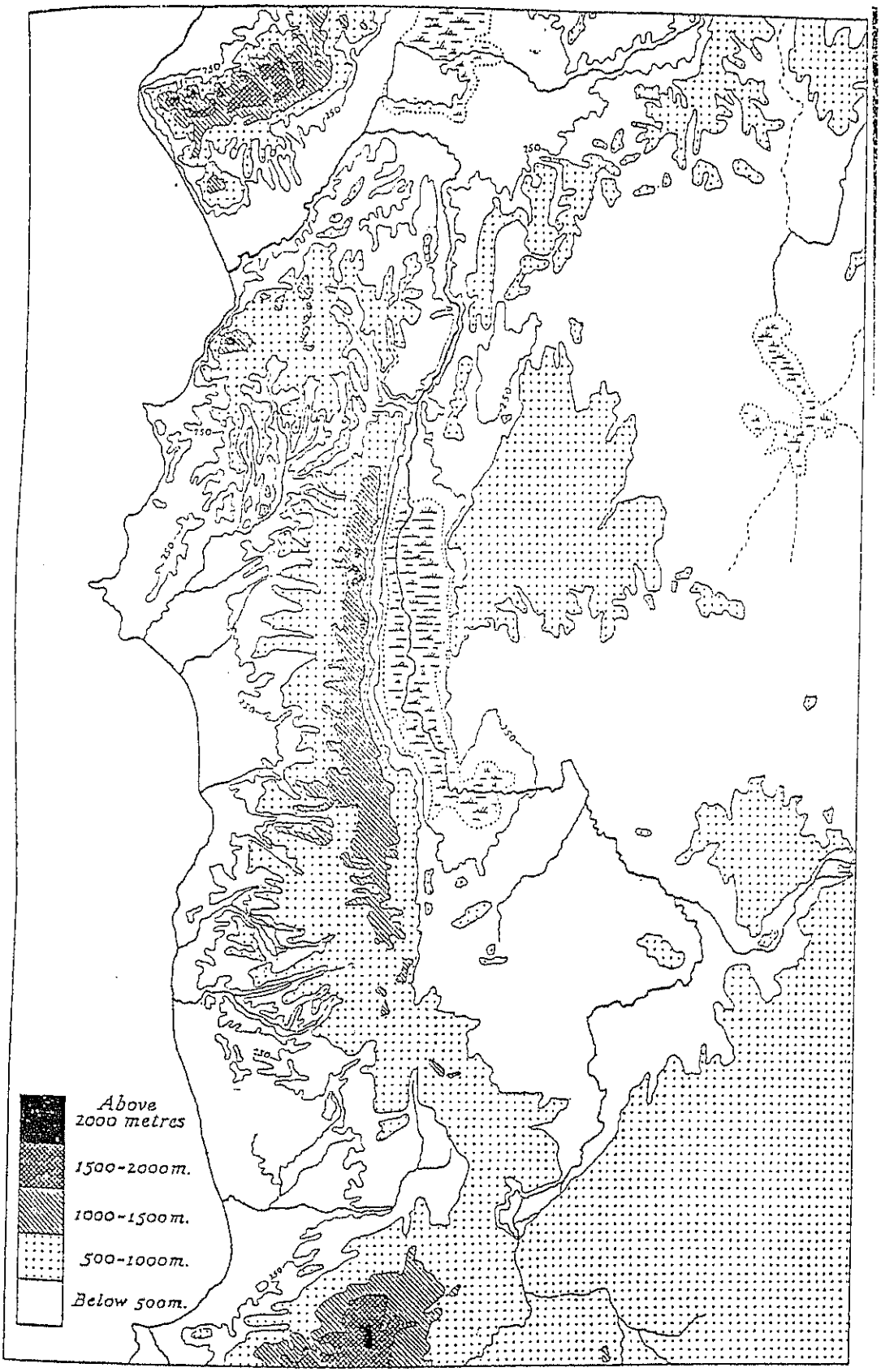



Fig. IV.7 The coastal plain of the Northern Levant. The Ansariyeh Mountains and the central depression, after Geo. Handbook 1943: Fig.4.a.

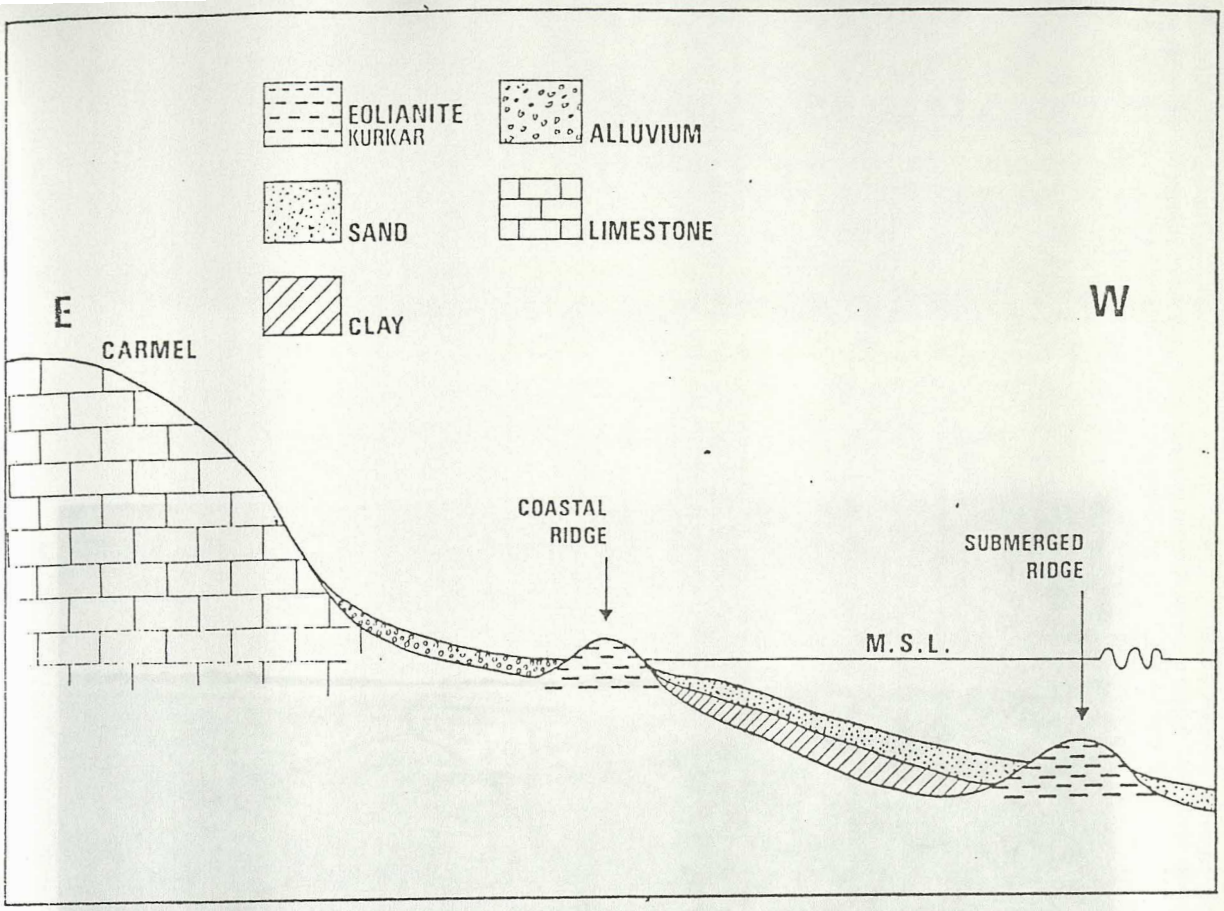



Fig. IV.8.i Generalised schematic section of the Carmel coast, after Galili & Weinstein-Evron 1985: 37,fig.1

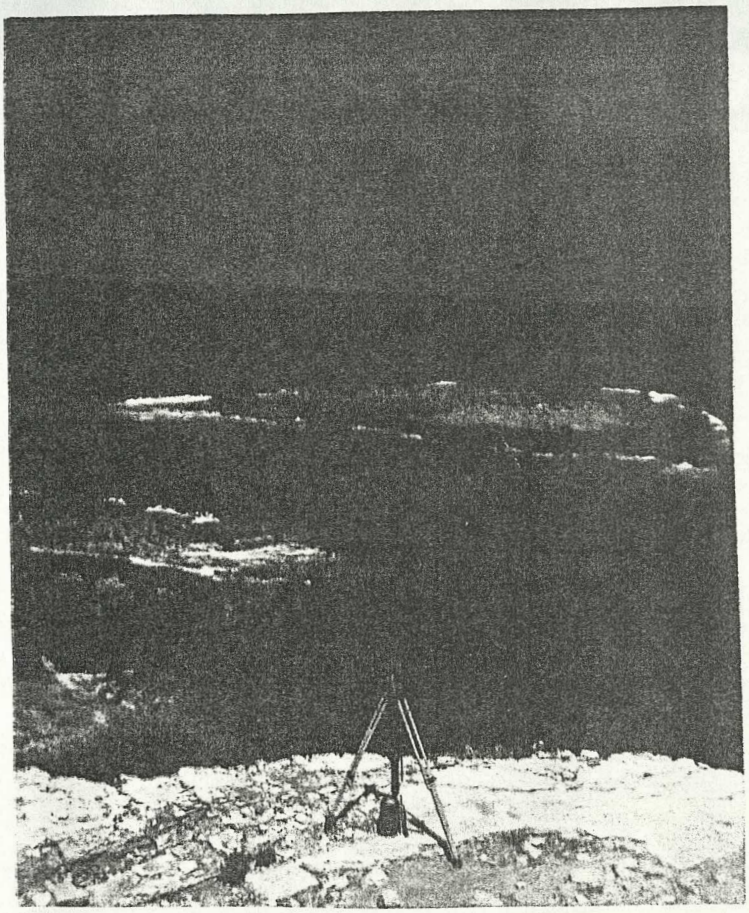


Fig. IV.8.ii View of an offshore coastal (kurkar) ridge (Photo L. Blue 1989).

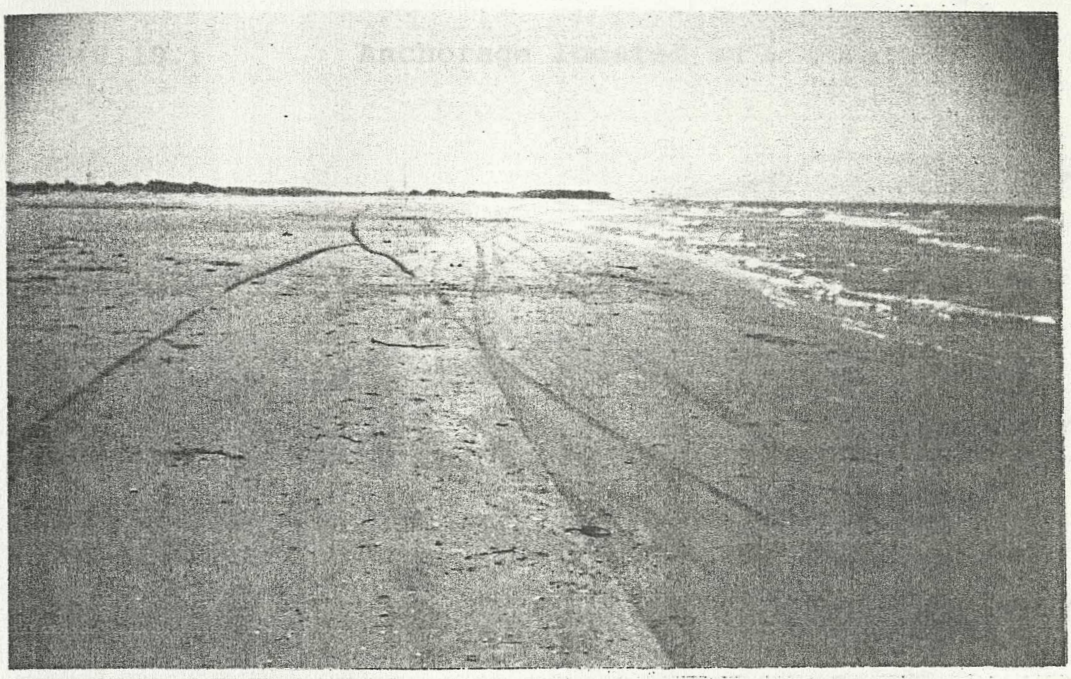


Fig. IV.9 View of the low-lying, sandy coast of the southern Levant (Photo L. Blue 1989).




Fig. IV.10.i Anchorage located on a straight-line coast.

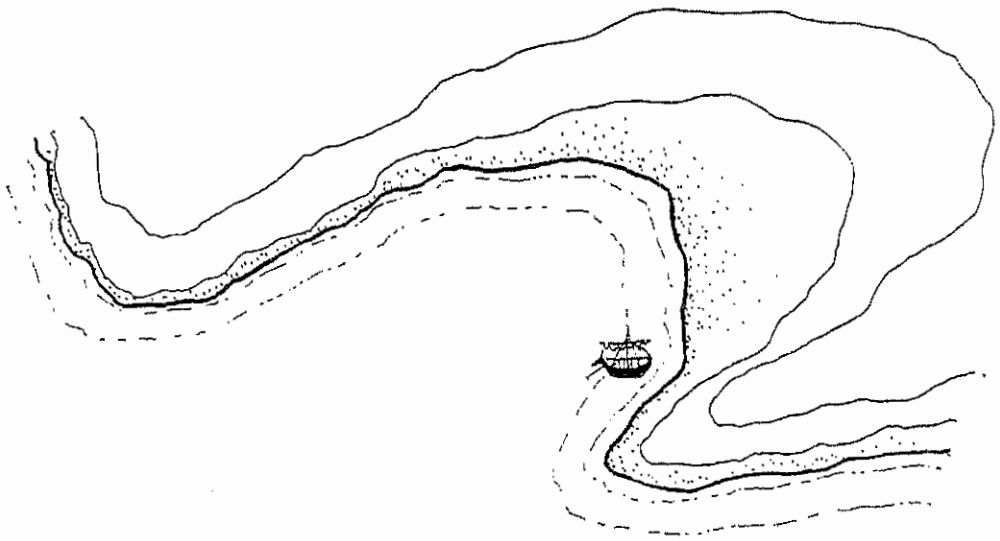
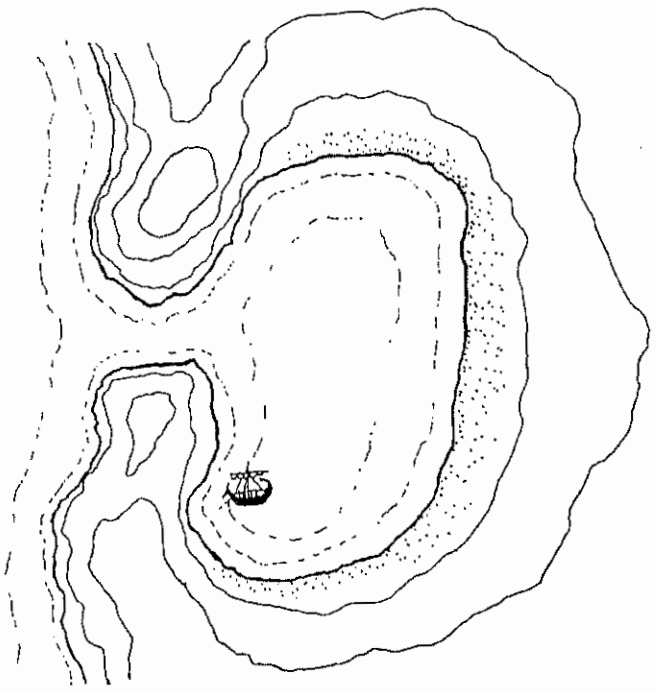



Fig. IV.10.ii Anchorage located in a natural bay.



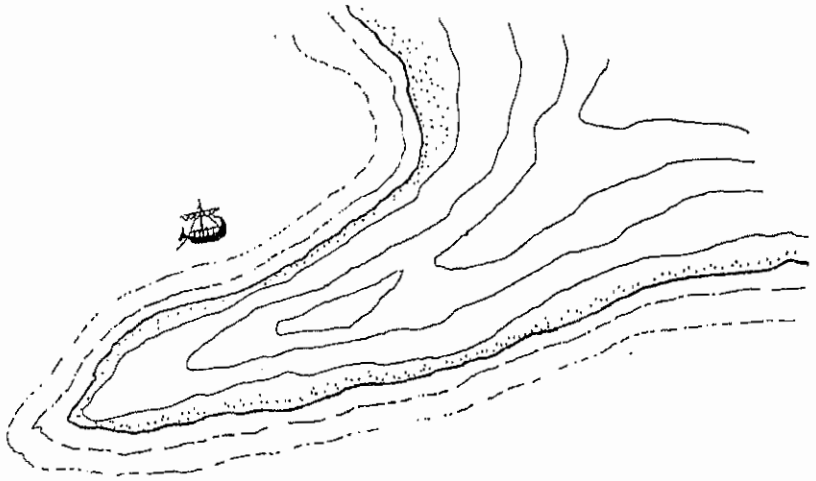



Fig. IV.10.iii Anchorage located in the lee of a promontory.

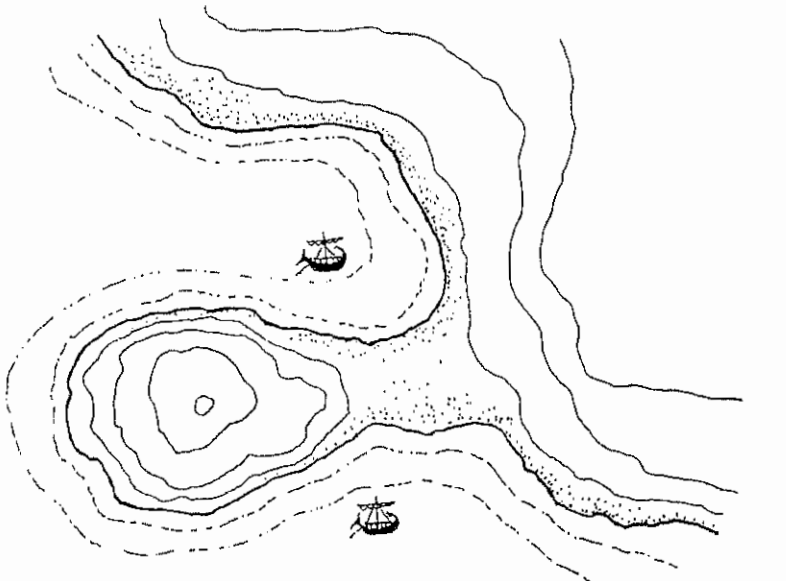



Fig. IV.10.iv Anchorage located on an anvil-shaped headland.

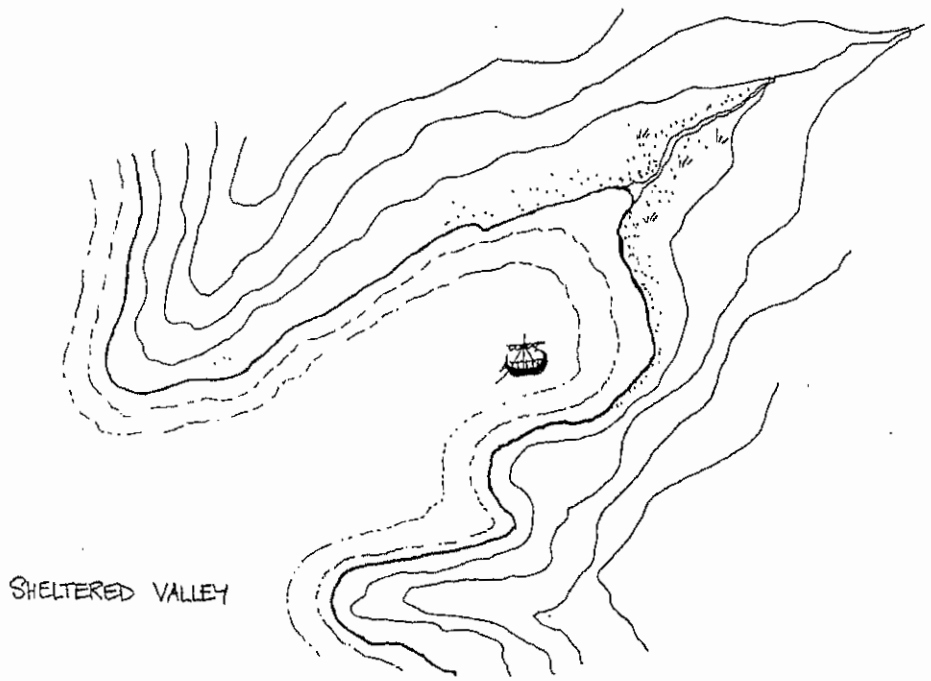



Fig. IV.10.v Anchorage located in a sheltered valley or inlet.

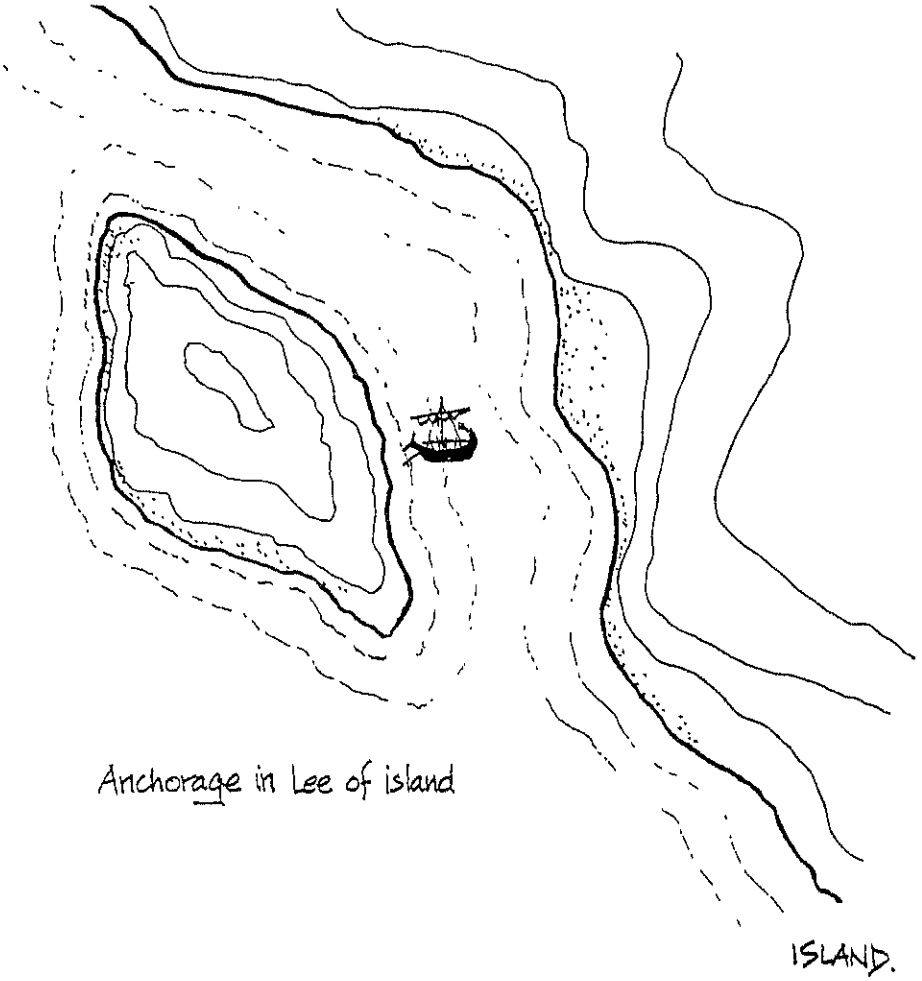



Fig. IV.10.vi Island anchorage.

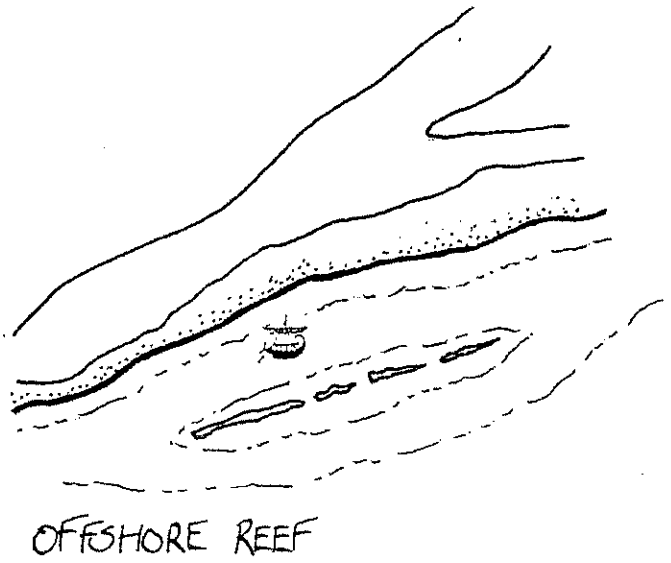



Fig. IV.10.vii Anchorage sheltered by offshore island or reef.

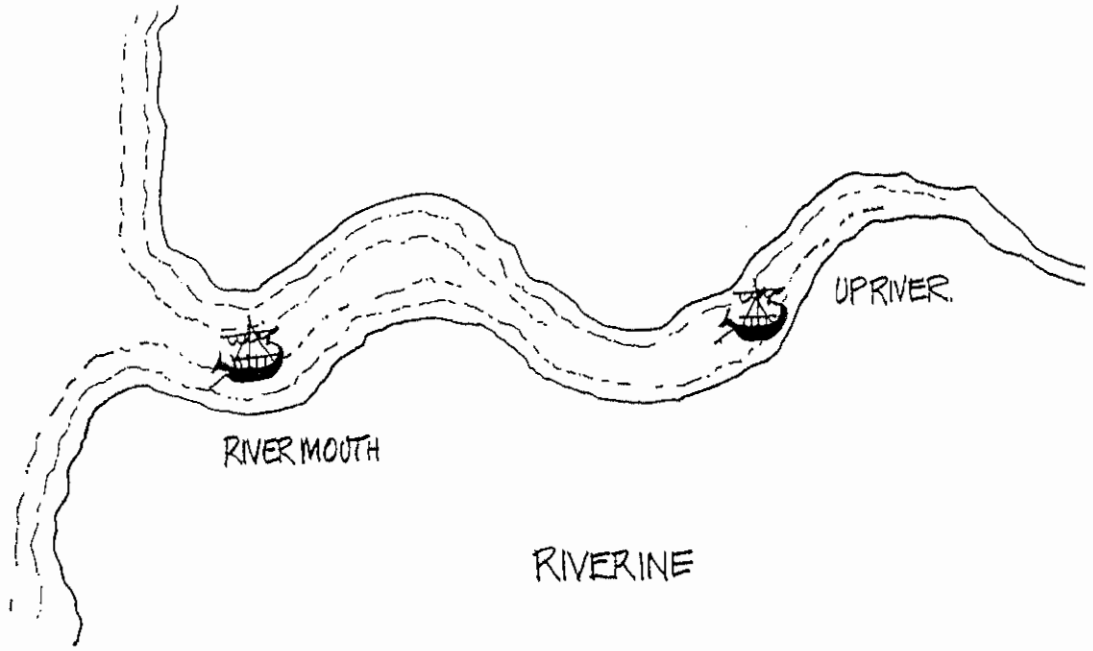



Fig. IV.10.viii Anchorage located in a river mouth or river embayment.

Fig. IV.10.ix Riverine anchorage.

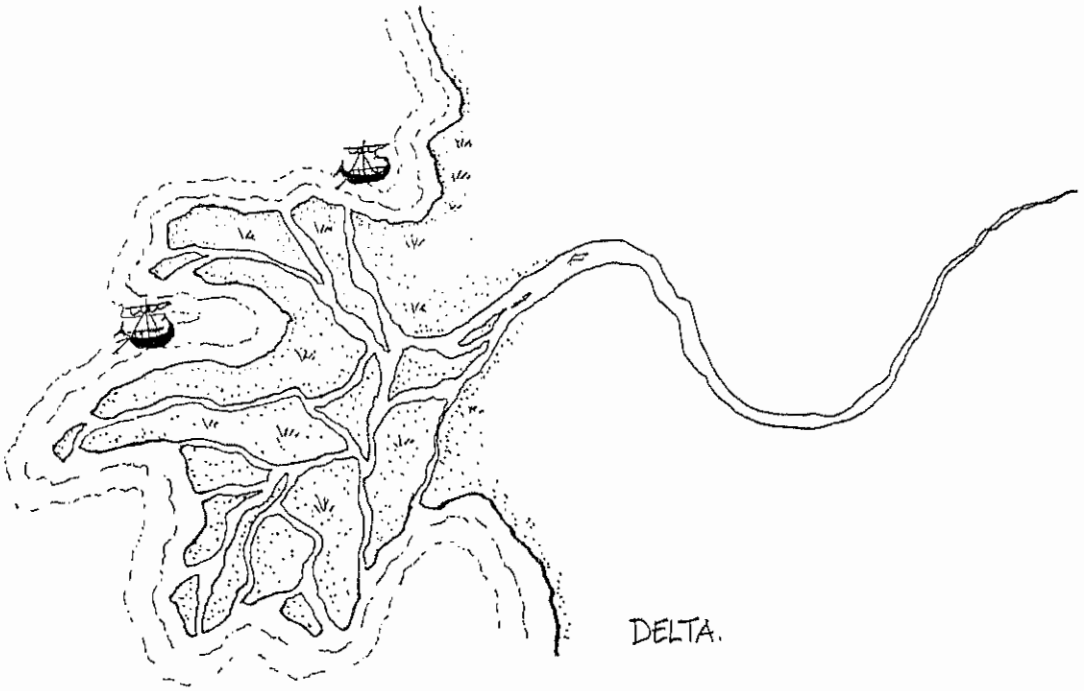



Fig. IV.10.x Deltaic anchorage.

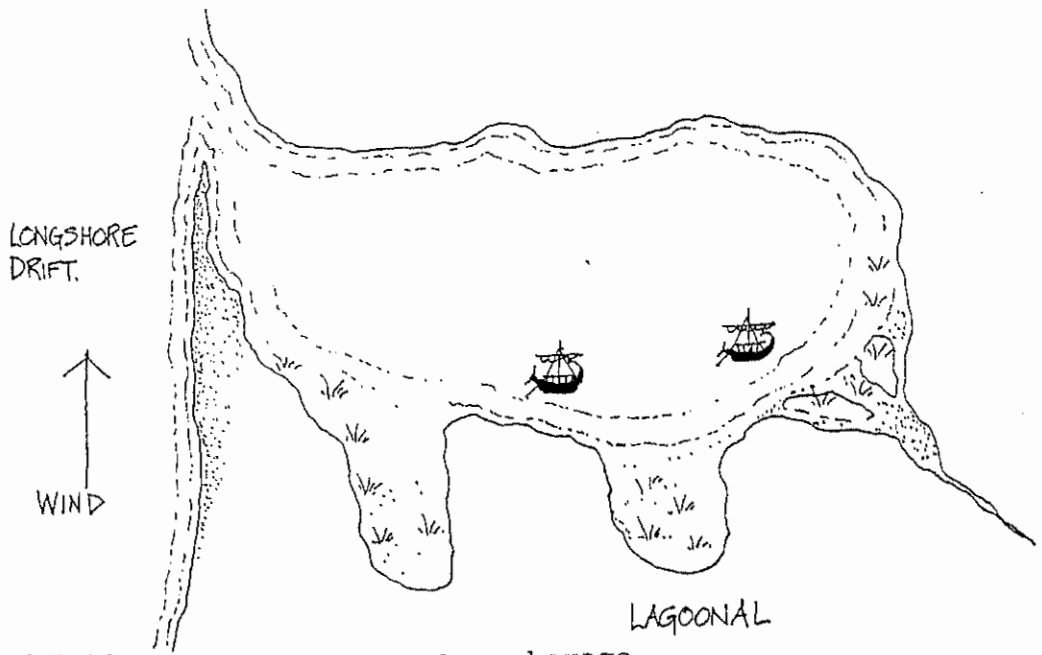



Fig. IV.10.xi Lagoonal anchorage.

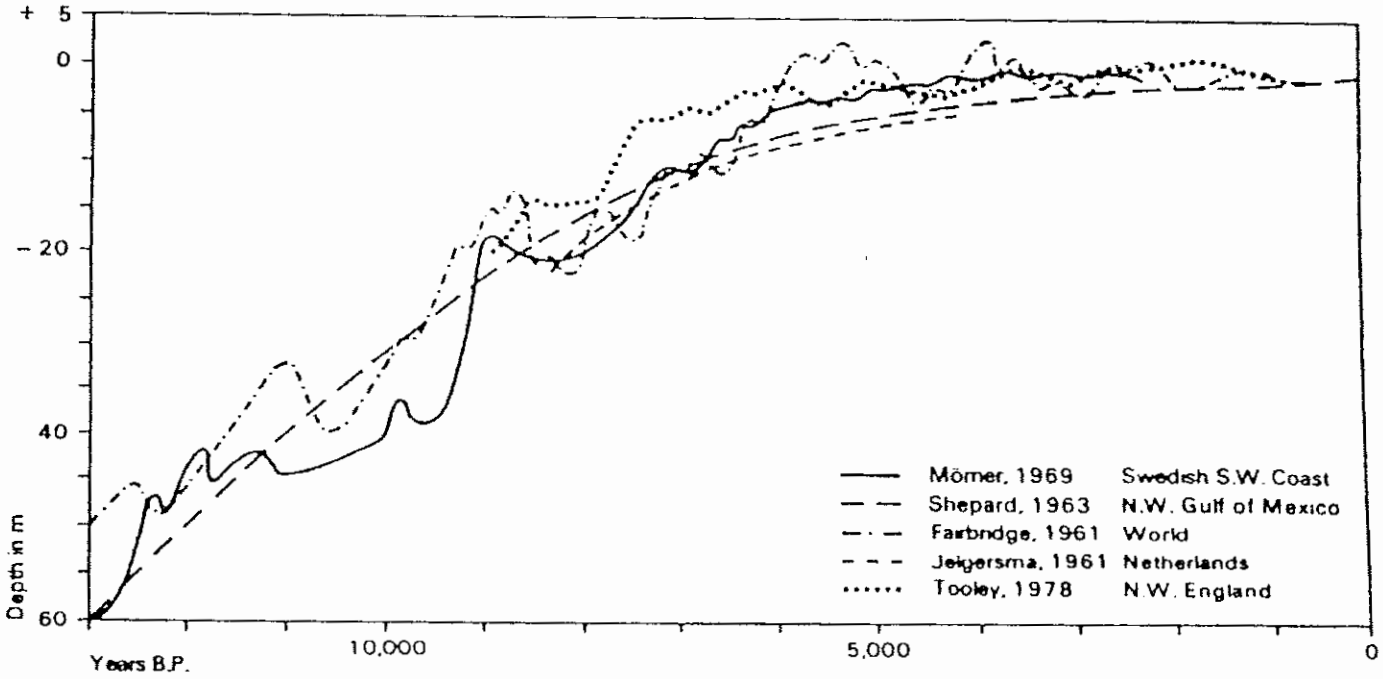



Fig. IV.11 Sea-level curves for the Holocene, after Goudie 1983: 192, fig.6.8.

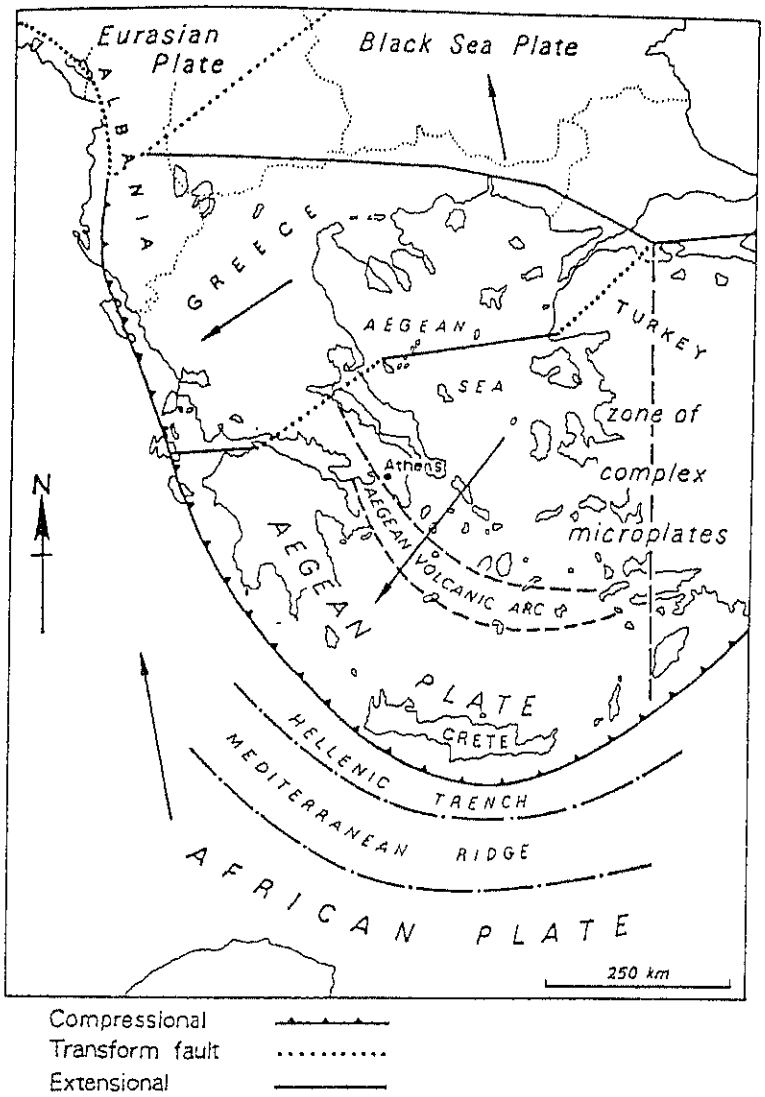



Fig. IV.12 Map showing the relationship of Crete to the tectonic elements of the Hellenic arc. Arrows indicate relative motion of different plates, after Lagios & Hipkin 1986: 166,fig.1.

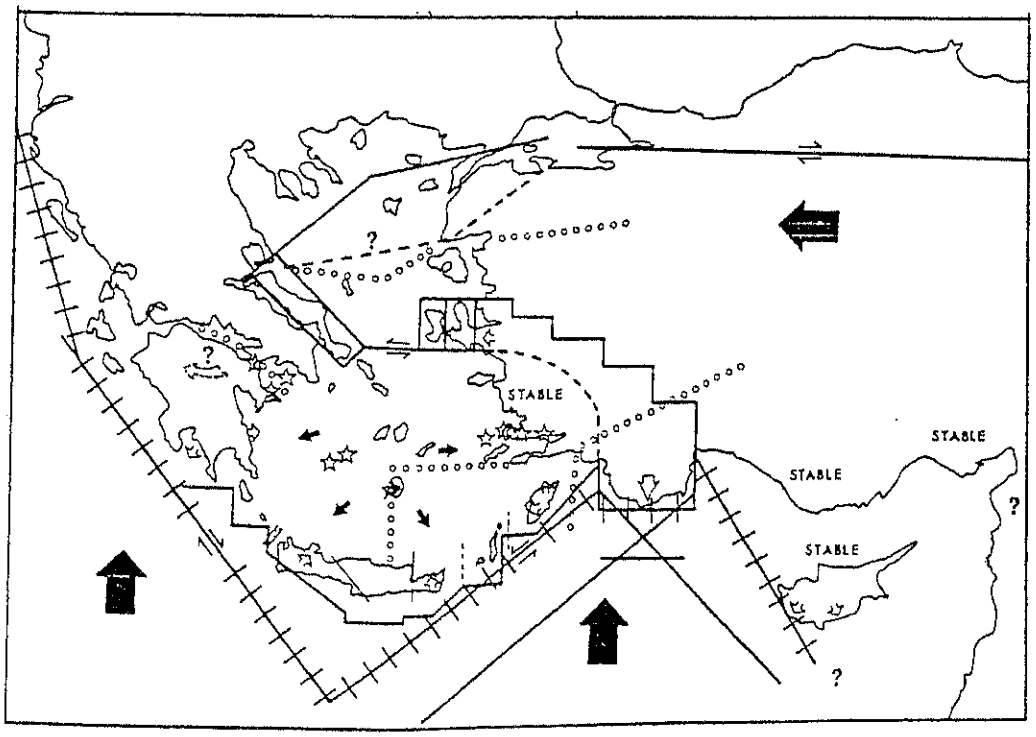



Fig. IV.13 Proposed plate boundaries, after Flemming 1978: 451,fig.19/c.

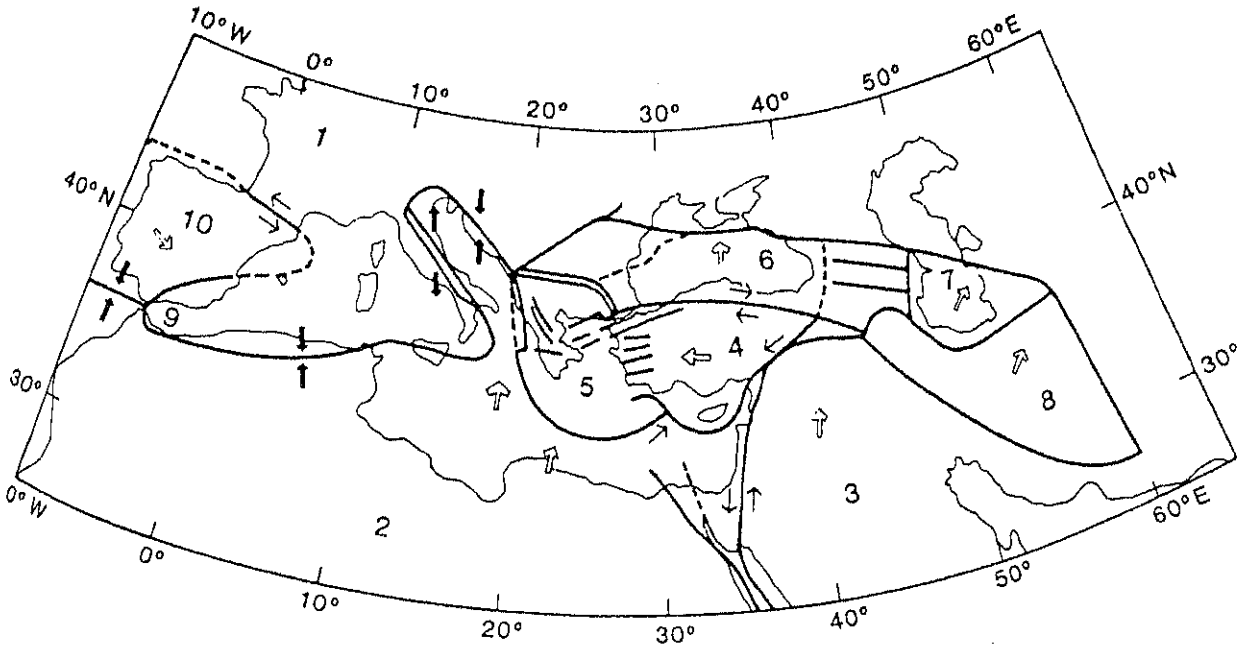



Fig. IV.14 Plate boundaries of the Mediterranean, after Flemming & Webb 1986: 25,fig.13.

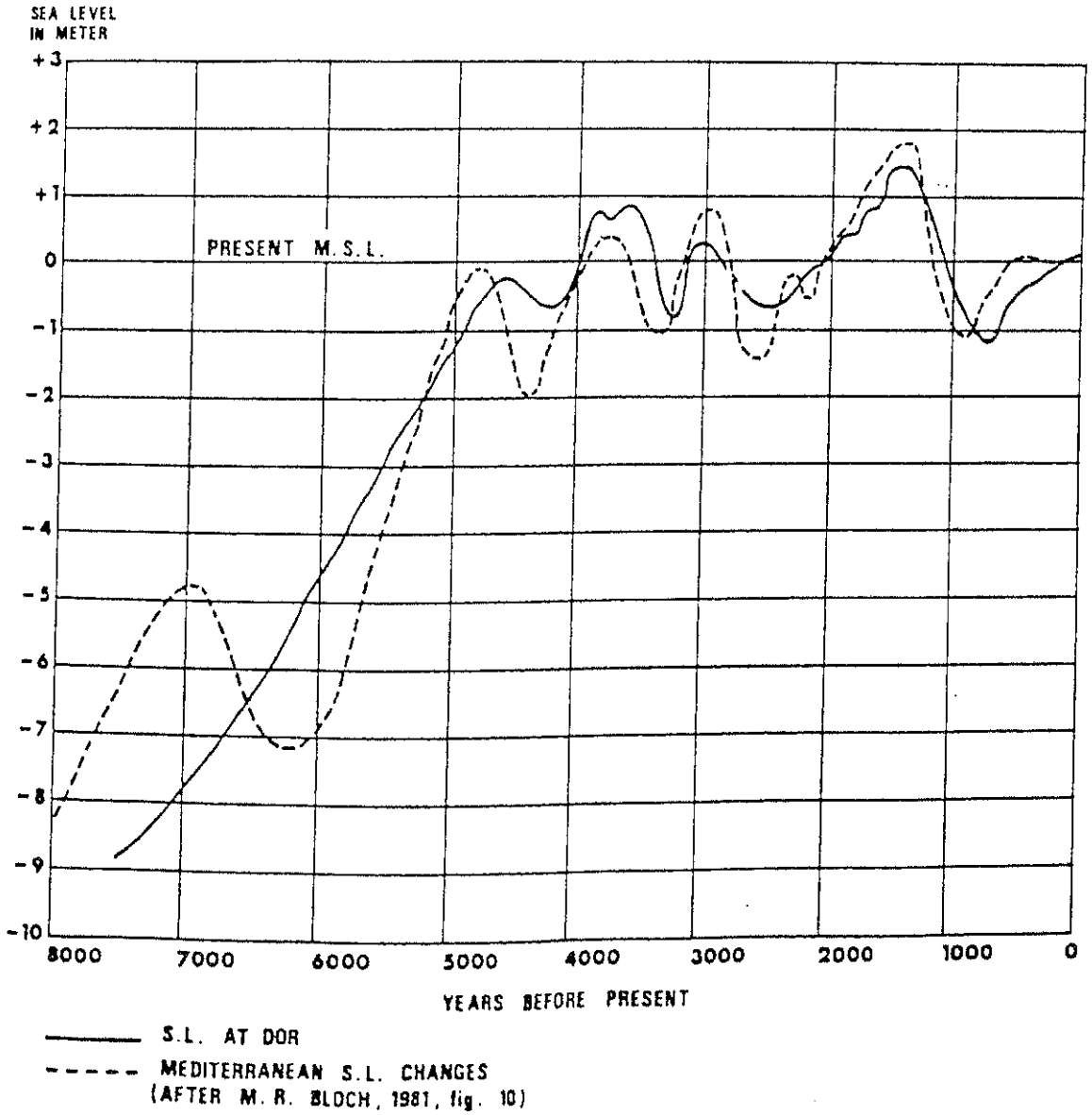



Fig. IV.15 Comparable eustatic sea-level changes at Dor based on archaeological data, after Raban &

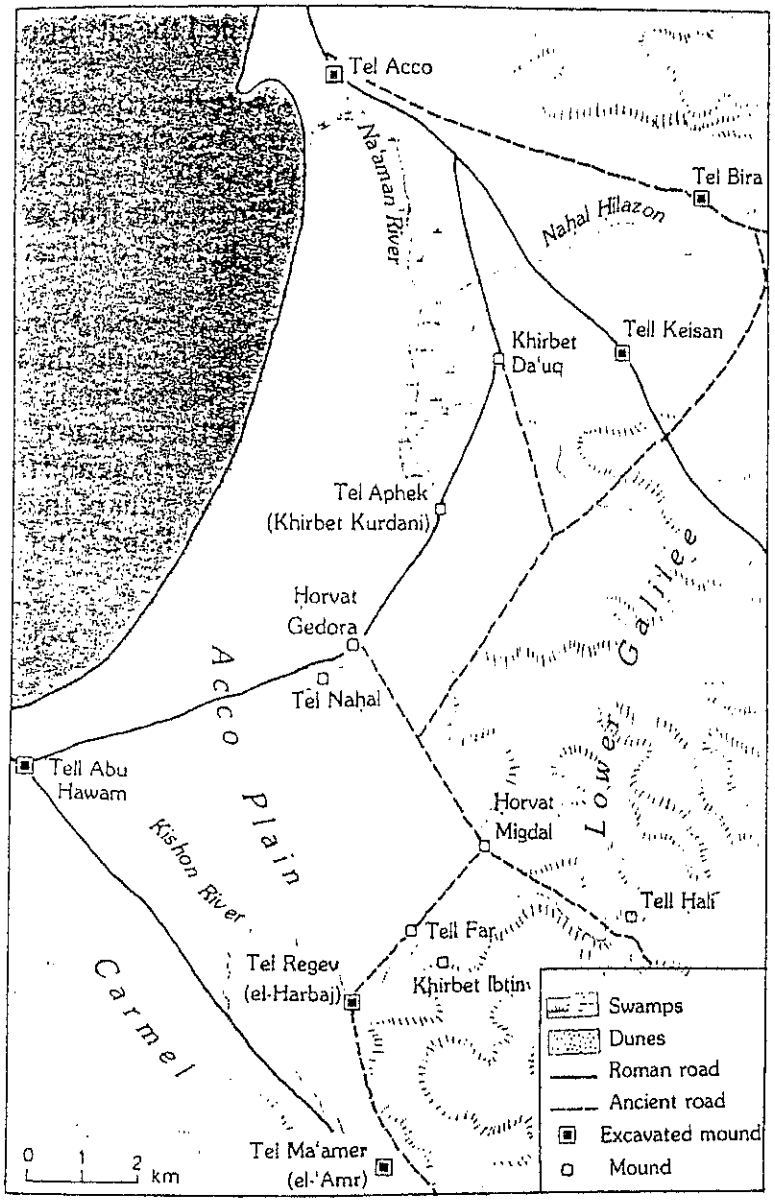
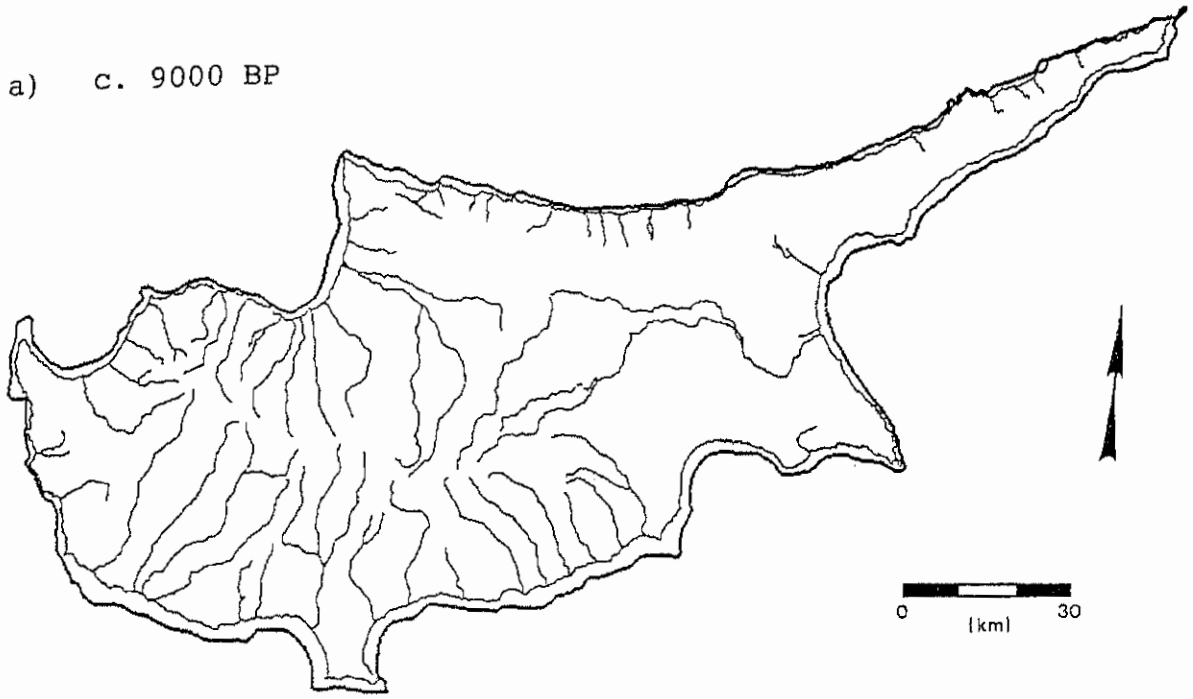
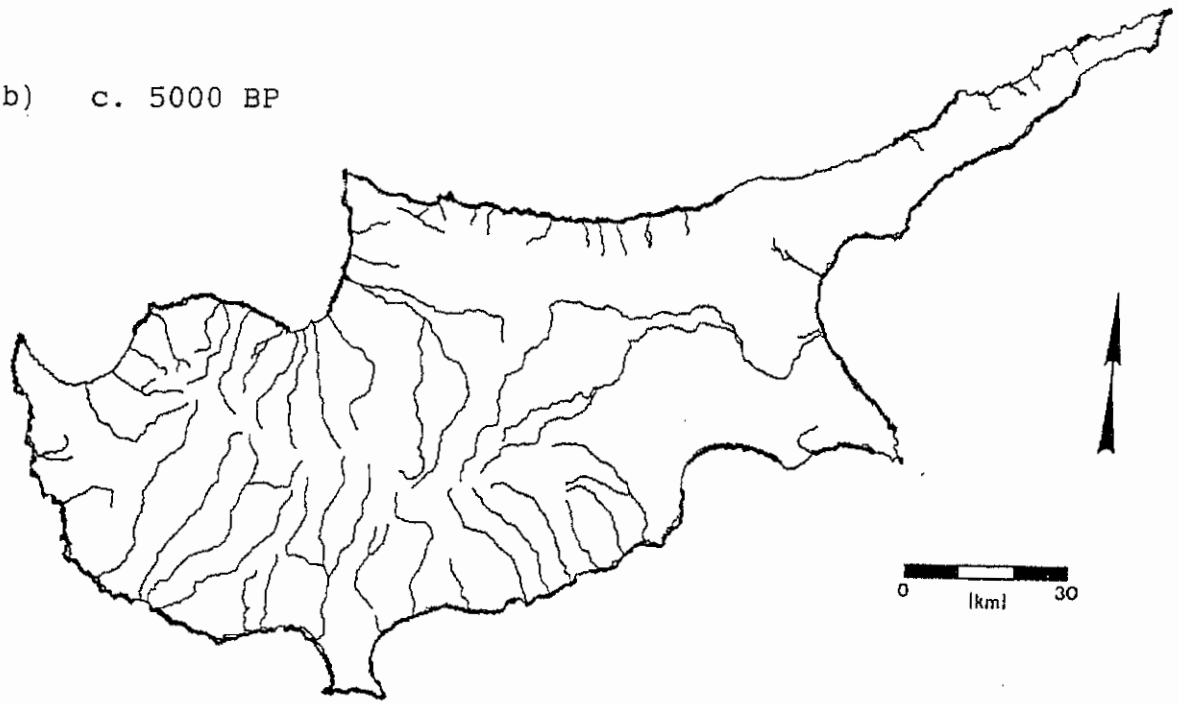



Fig. IV.16 Map of the Plain of Acco, after Prausnitz 1993: 31.

a) c. 9000 BP




b) c. 5000 BP




ig. IV.17 Palaeogeographic reconstruction of the Cypriot coastline (heavy line),after Gomez & Pease 1992: 3,figs.2&3.

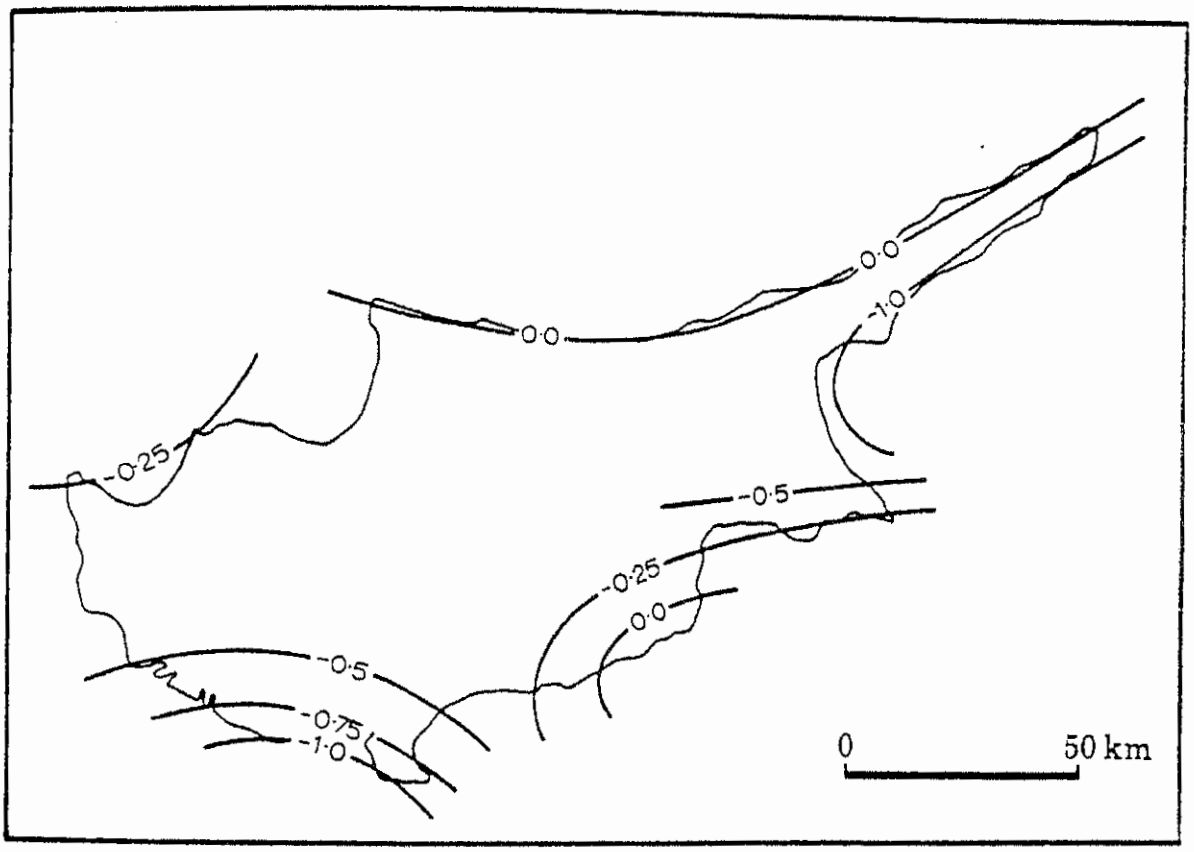



Fig. IV.18 Contours of rate of vertical displacement of the coast of Cyprus in meters per millennium, after Flemming 1978: 435,fig.12.

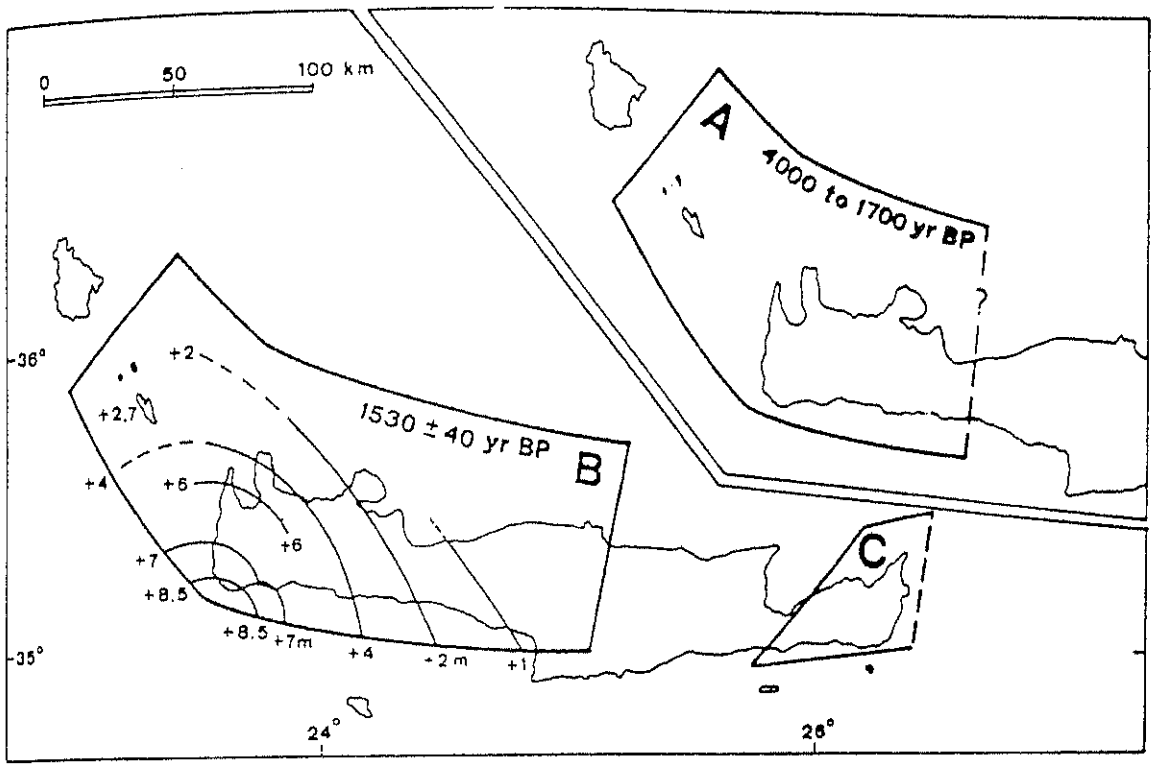



Fig. IV.19 Proposed boundaries of blocks of lithosphere affected by independent tectonic movements during Late Holocene. Block A underwent a series of rapid sudsidences (from 10 to 25 cm each time) without noticeable tilting. Block B was uplifted and tilted c. AD 500 (contours of elevation of the upheaval are indicated). Block C is affected by a long-term northeast tilting, after Pirazzoli et al. 1982: 39,fig.10.

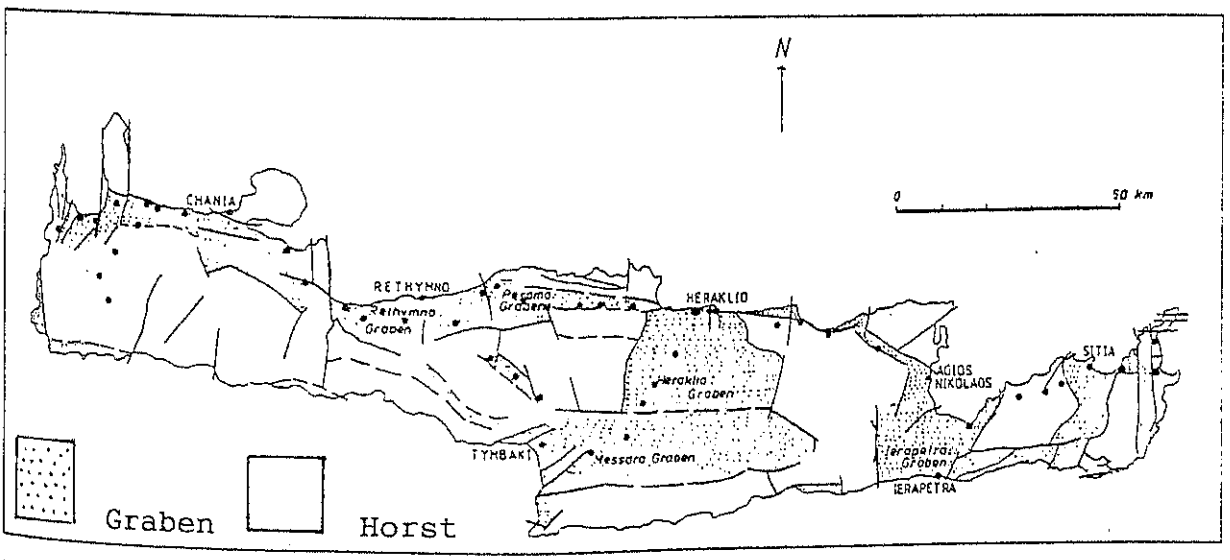



Fig. IV.20 Simplified map showing the principal tectonic horsts and grabens in Crete, after Lagios & Hipkin 1986: 167,fig.2.

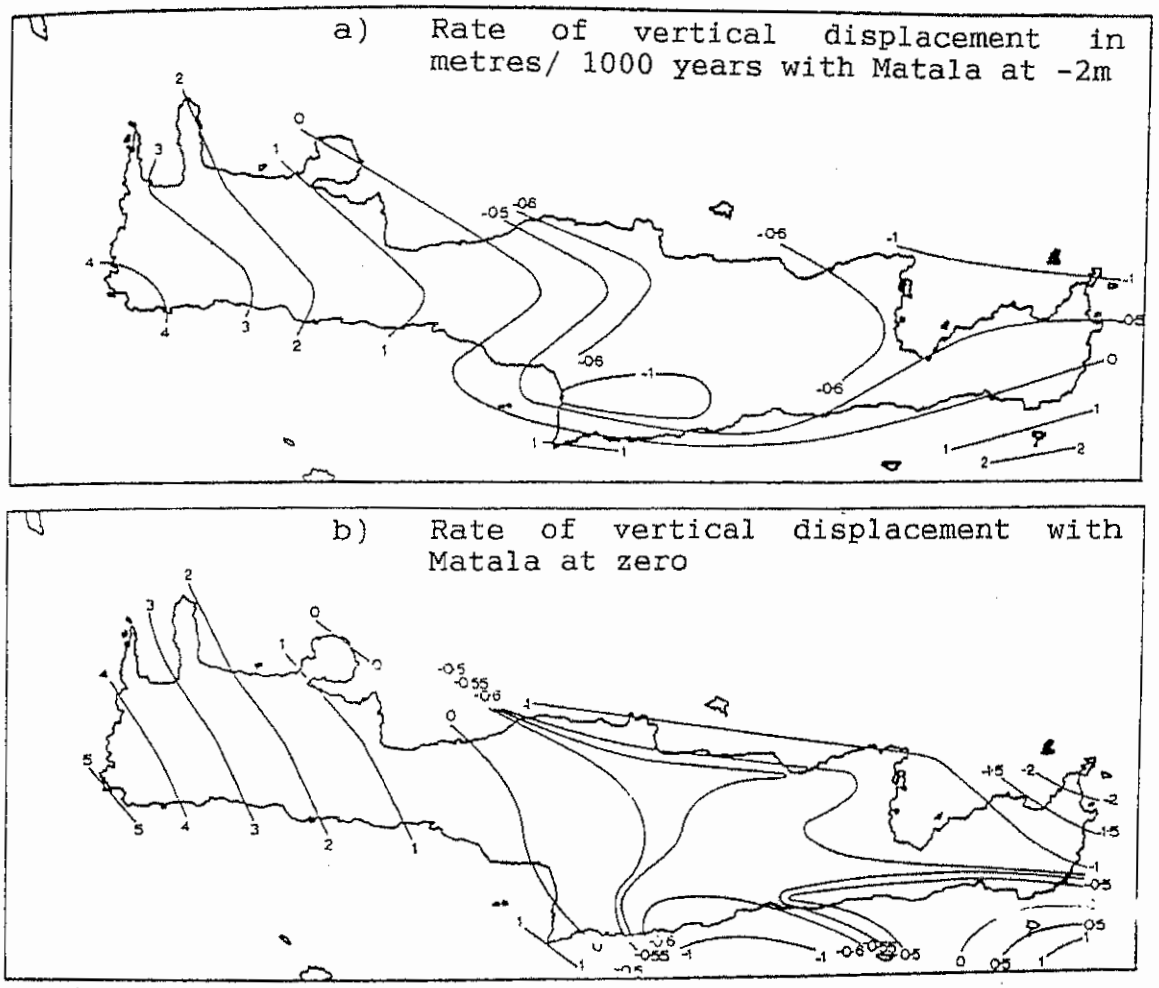



Fig. IV.21 Contours of displacement of the Cretan coast, after Flemming 1978: 430,fig.9/c-d.

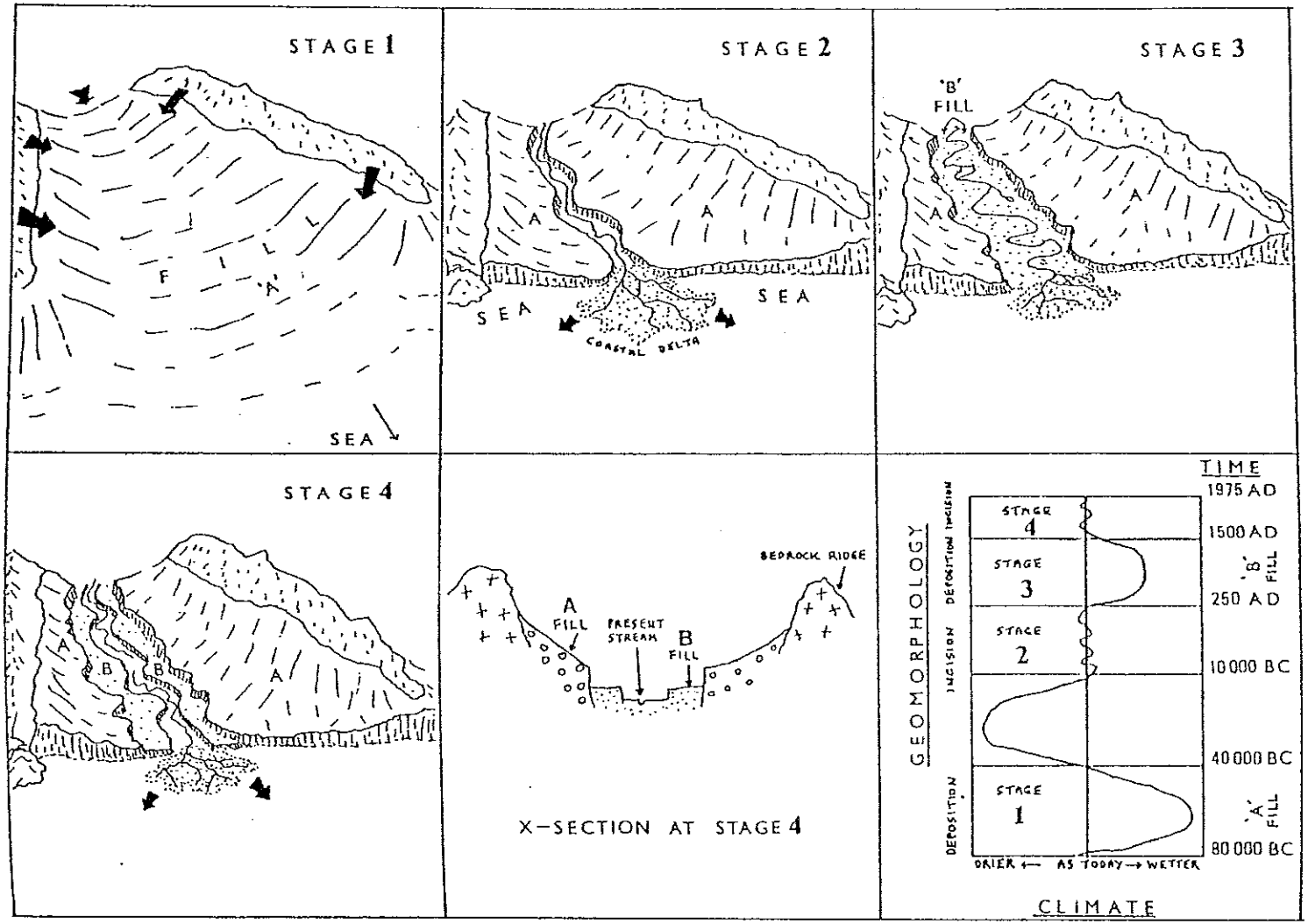



Fig. IV.22 The Late Quaternary development of the Mediterranean valleys, based on the studies of Bintliff 1977: 56-7,map 1.

Fill A = Older Fill
Fill B = Younger Fill
(after Vita Finzi 1969)

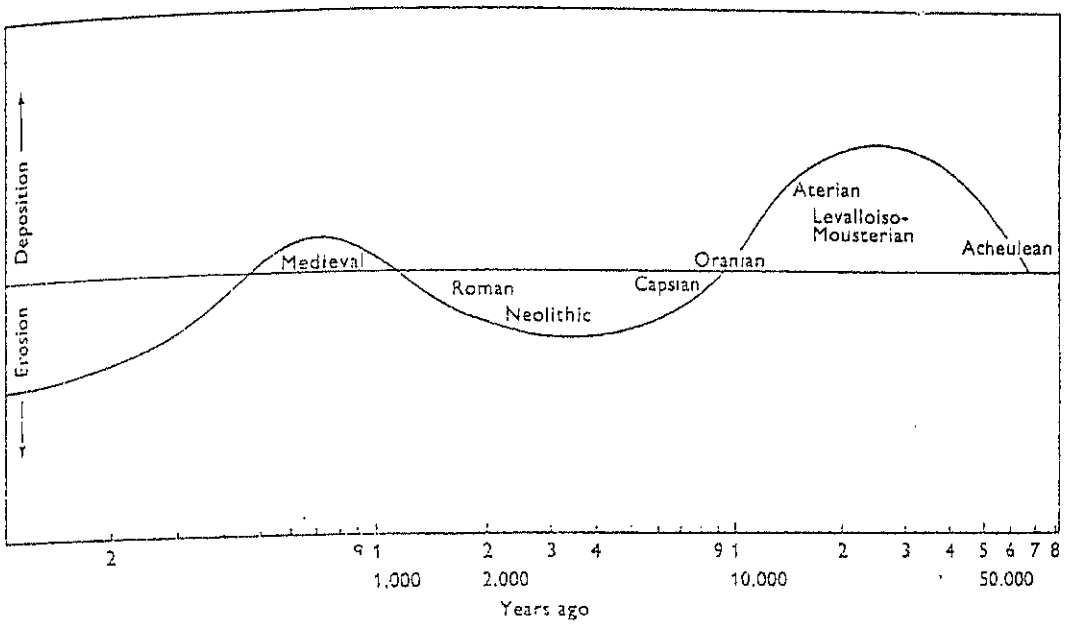



Fig. IV.23 Phases of erosion and alluviation in the Mediterranean valleys over the last 50,000 years, after Vita-Finzi 1969: 92.

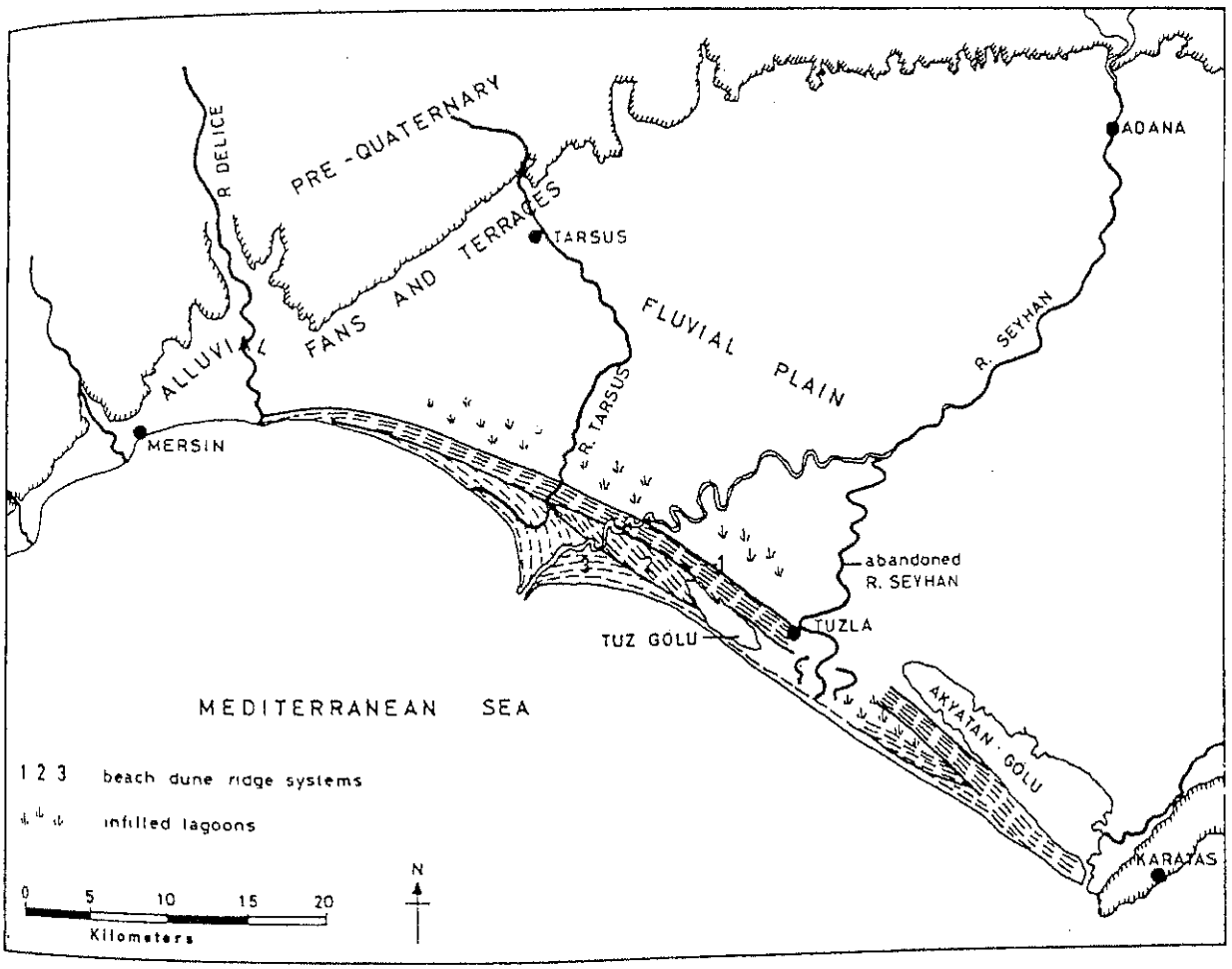



Fig. IV.24 Map of the coastal complex of the Seyhan delta, after Evans 1971: 391,fig.2.

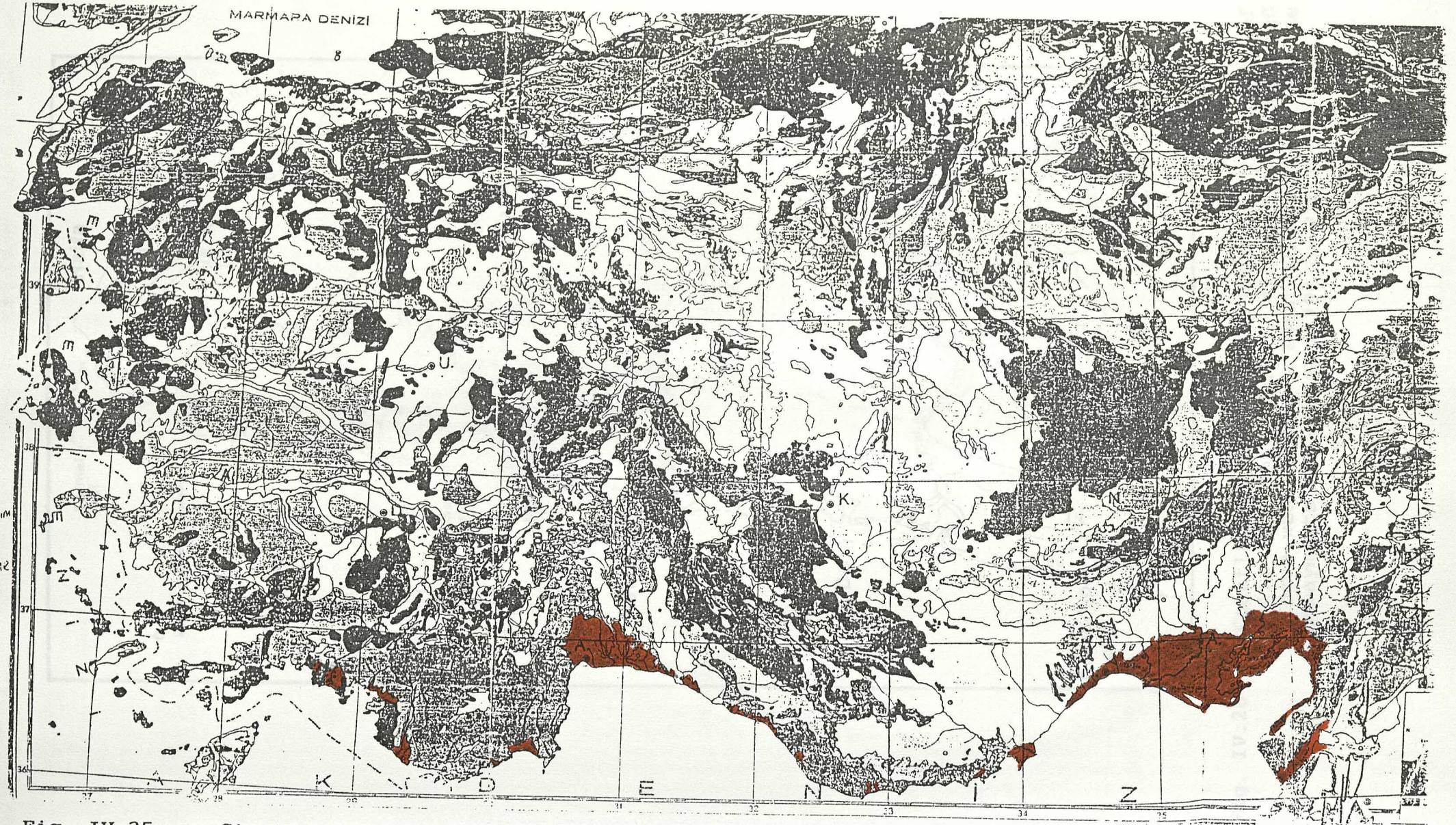



Fig. IV.25 Stretches of the south Turkish coast that have been subject to sedimentary alluviation.

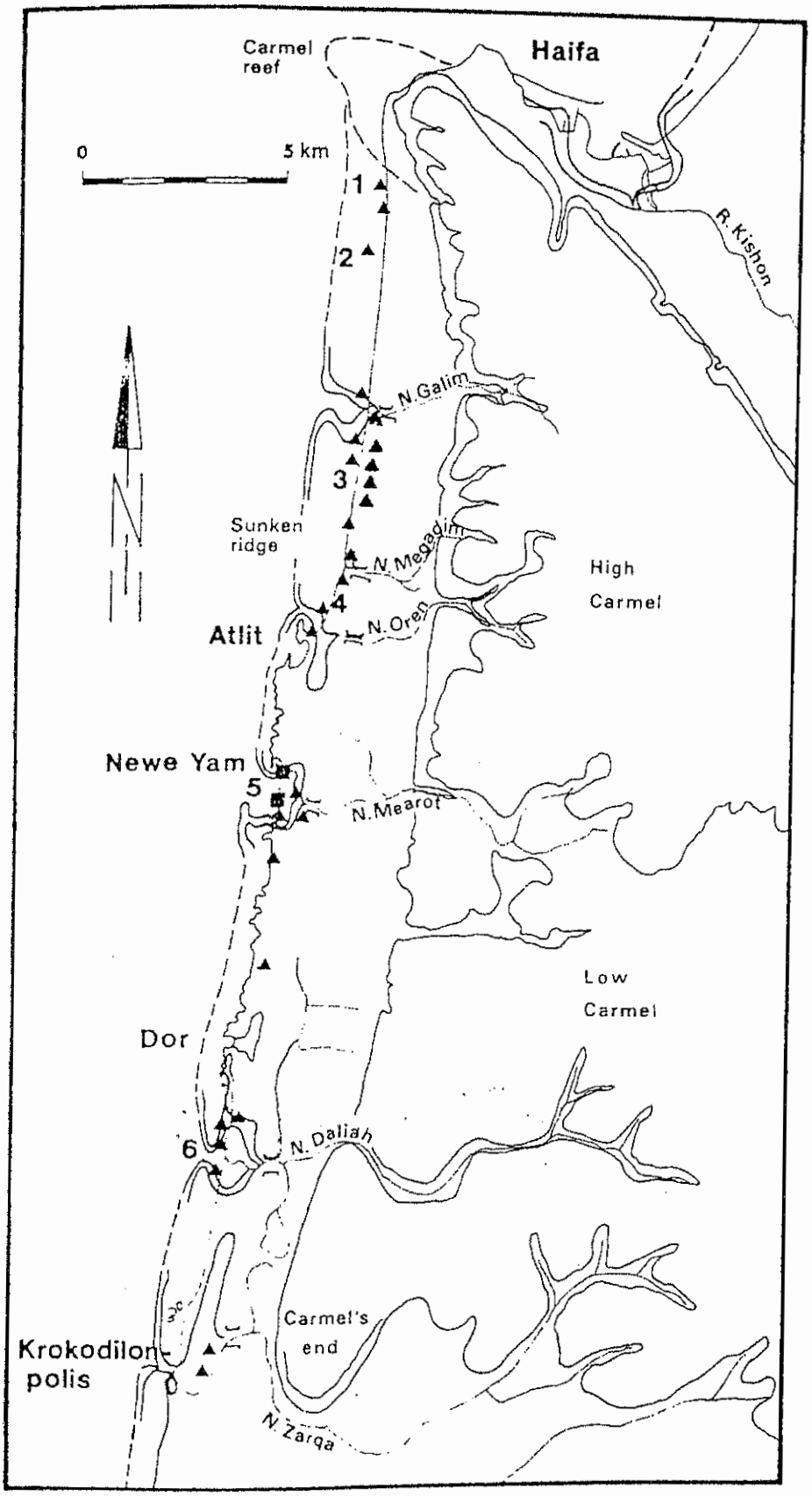



Fig. IV.26 Coastline of the southern Levant in the region of Haifa and Mount Carmel, illustrating submerged ridges west of the present shoreline and marine embayments, after Raban 1983b: 220,fig.2.

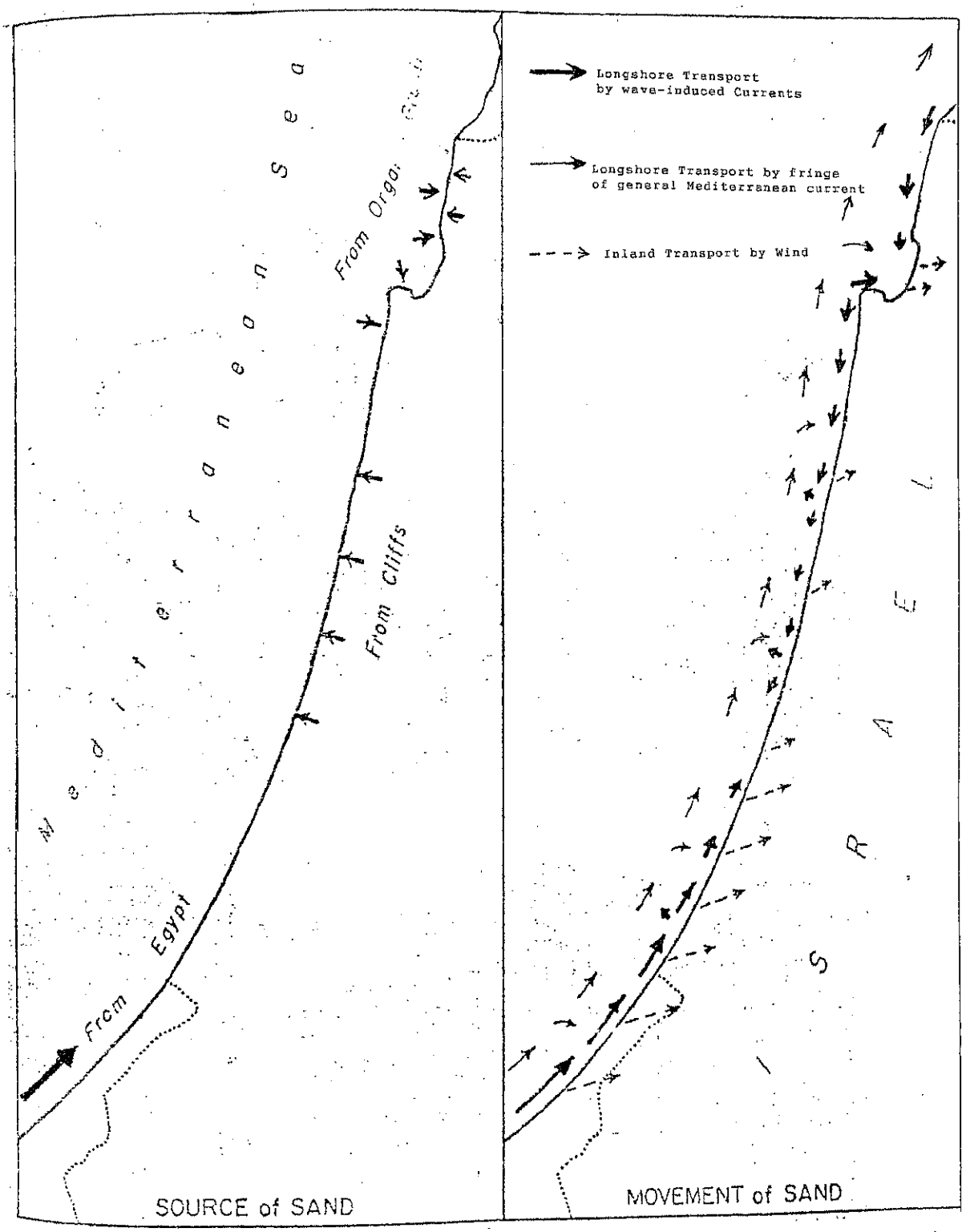



Fig. IV.27 Source and movement of sediment along the coast of the southern Levant, after Emery & Neev 1960: Fig.4.

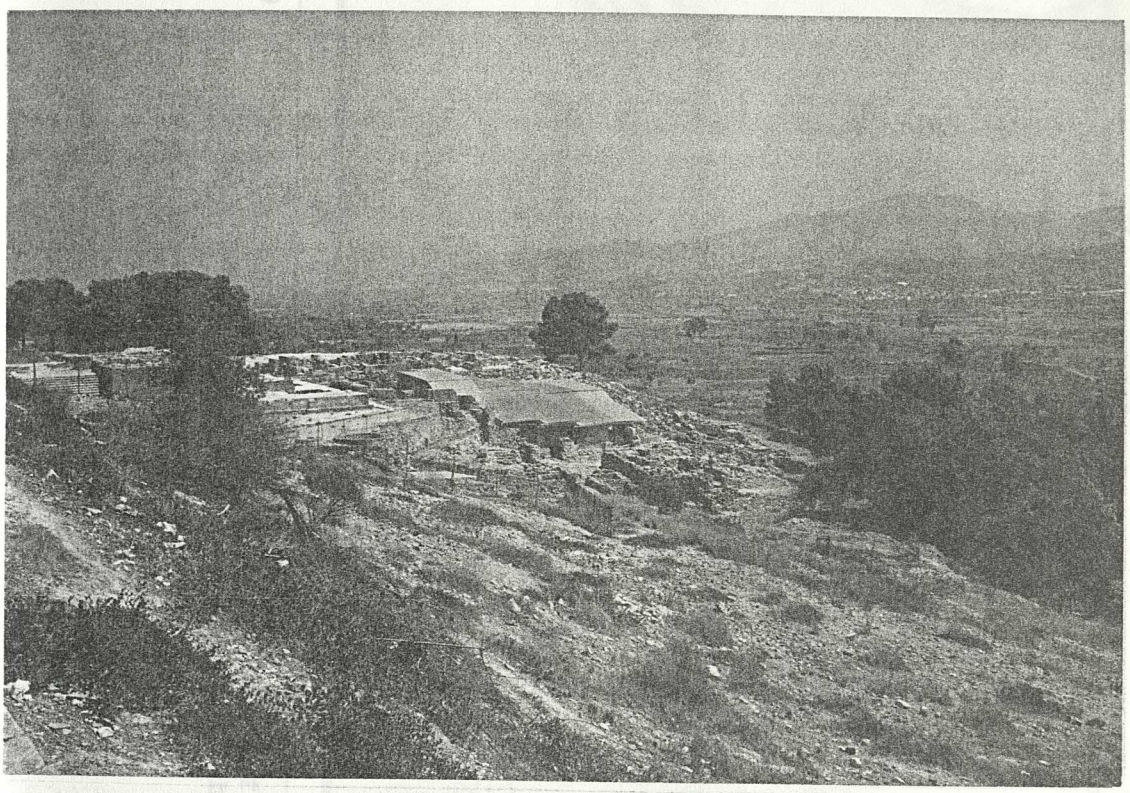


Fig. IV.28 View of the Minoan palace of Phaistos looking to the east across the alluvial plain of Messara (Photo L. Blue).

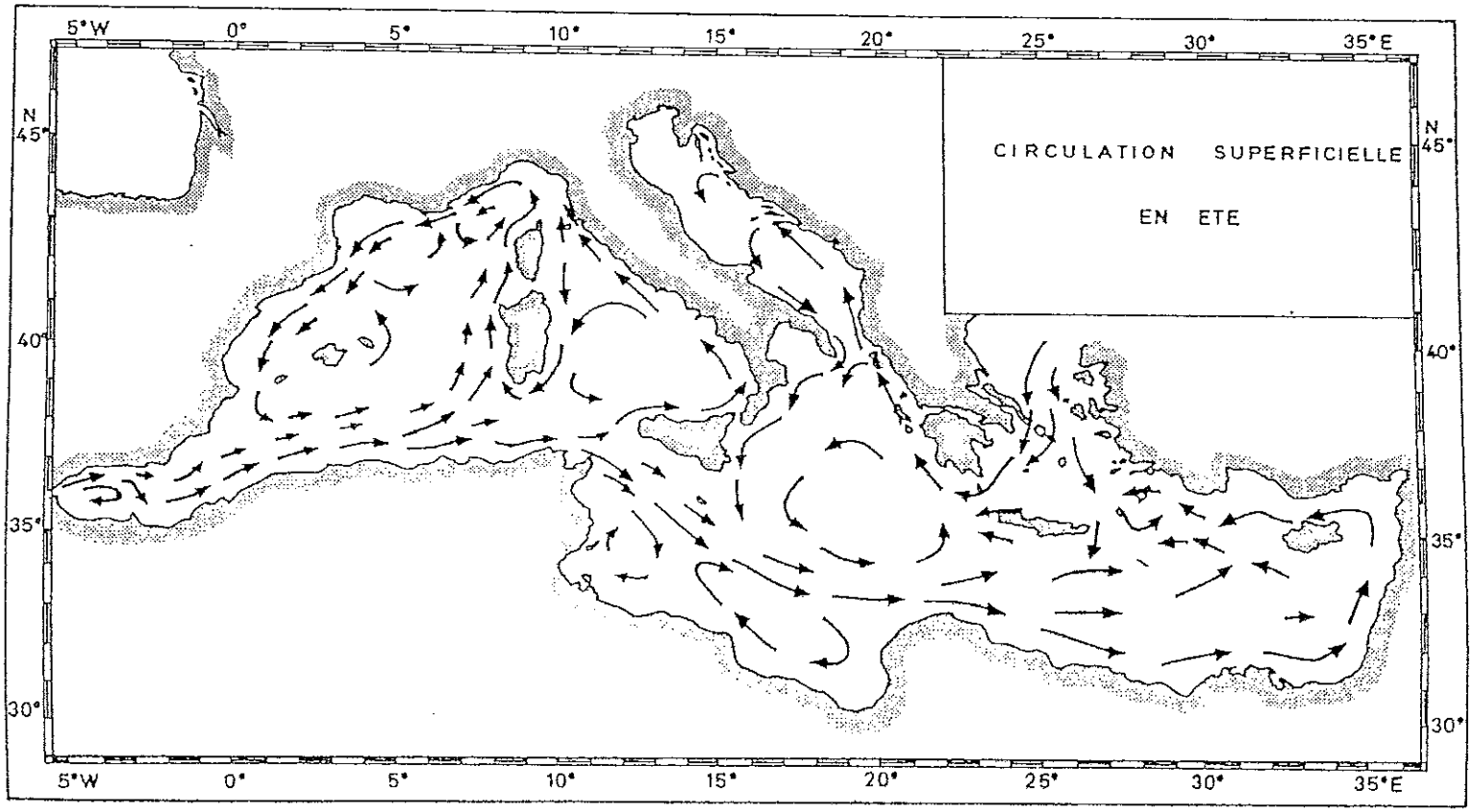



Fig. IV.29 Counter-clockwise surface current of the eastern Mediterranean, after Lacombe & Tchernia 1972: Fig.3.

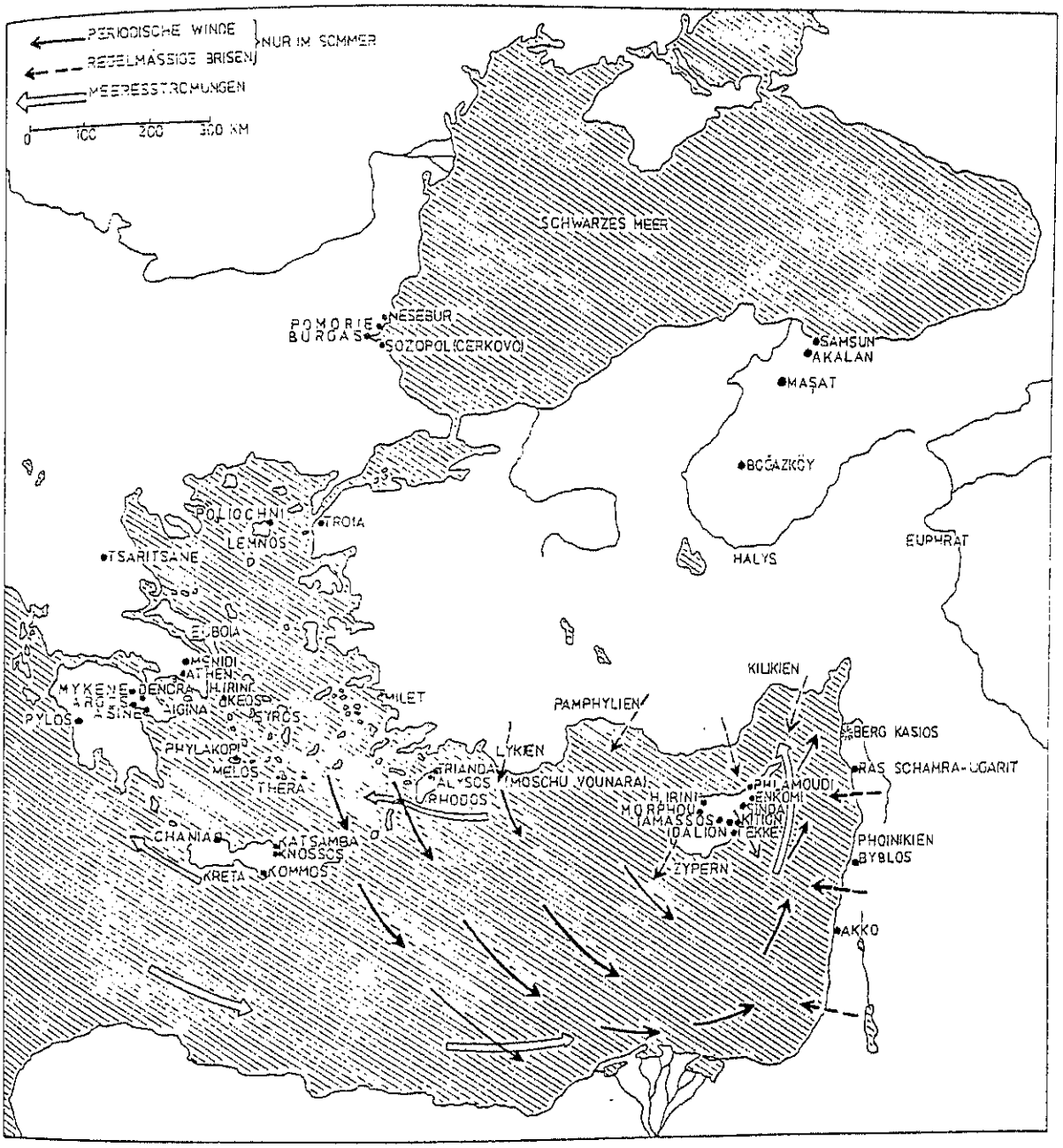
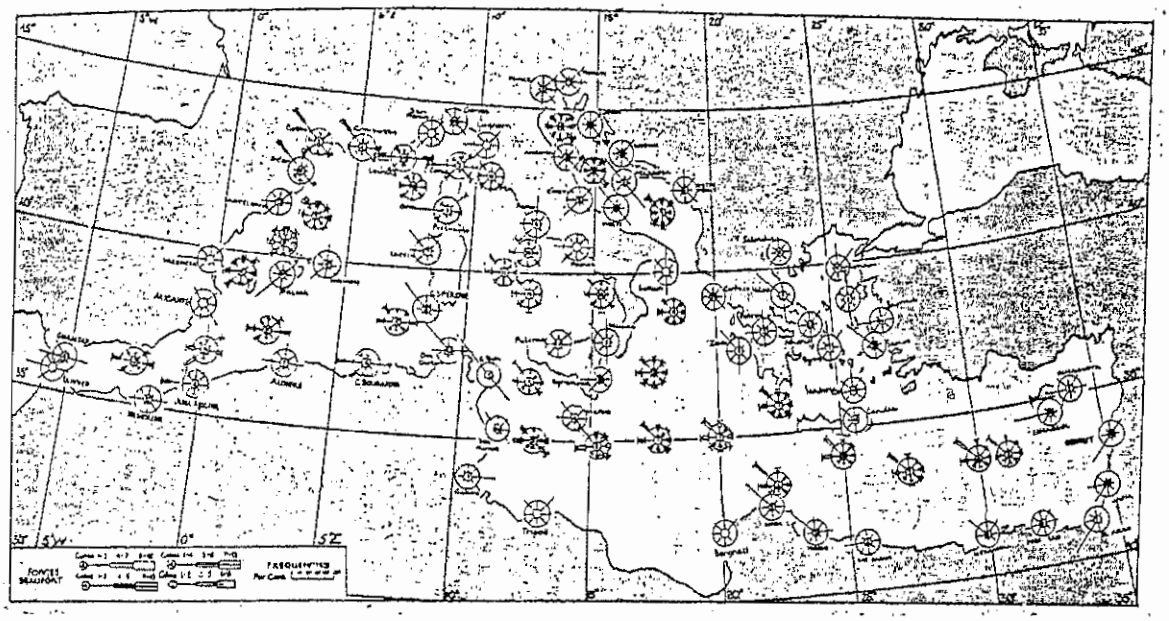



Fig. IV.30 Prevailing winds in the eastern Mediterranean during the summer season. Solid black arrows indicate prevailing offshore winds, particularly the NW meltemi wind. Broken black arrows indicate offshore land breezes. Solid white arrows indicate predominant surface current, after Buchholz 1987: 163,fig.42.

a) Spring, after Weather in the Mediterranean 1937: 18,fig.4



b) July, after MP V 1976: 1.151.3

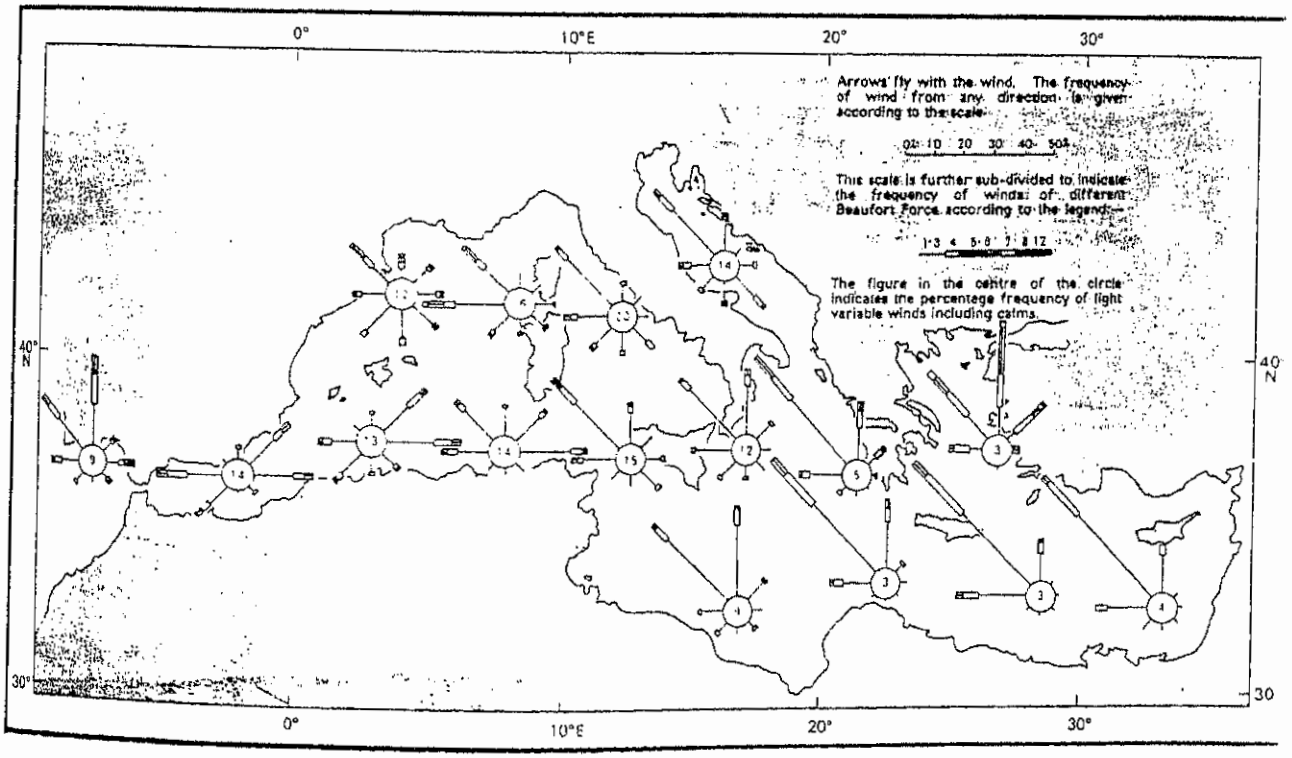



Fig. IV.31 Wind direction in the eastern Mediterranean during the summer season

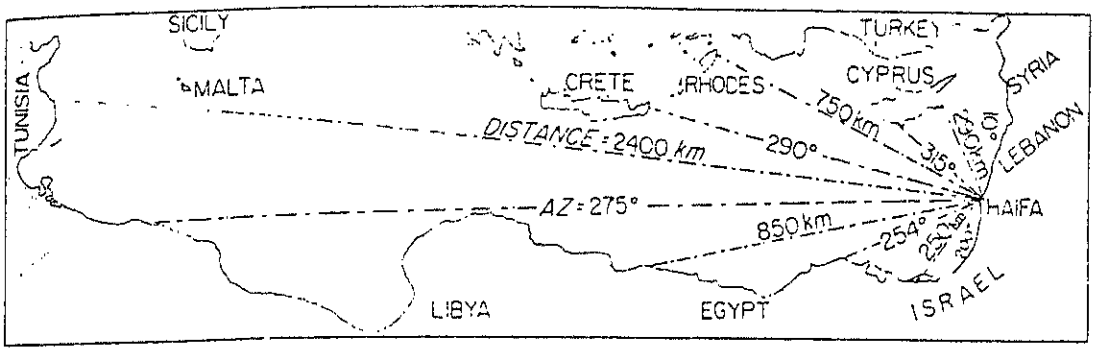
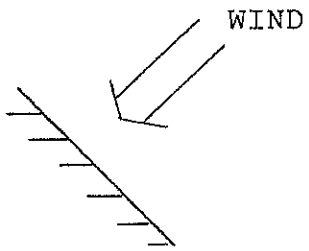
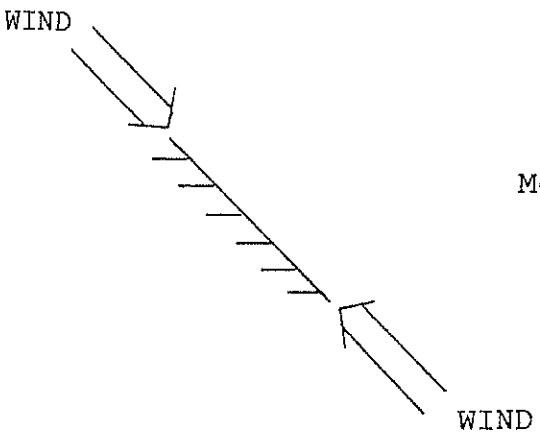


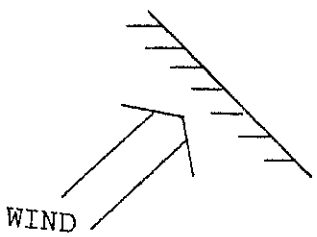

Fig. IV.32 Fetch conditions at Haifa on the coast of the southern Levant. The maximum fetch is restricted to the angle between 275-285 degrees, after Flemming 1983: 147,fig.4.




McKee Type (1)

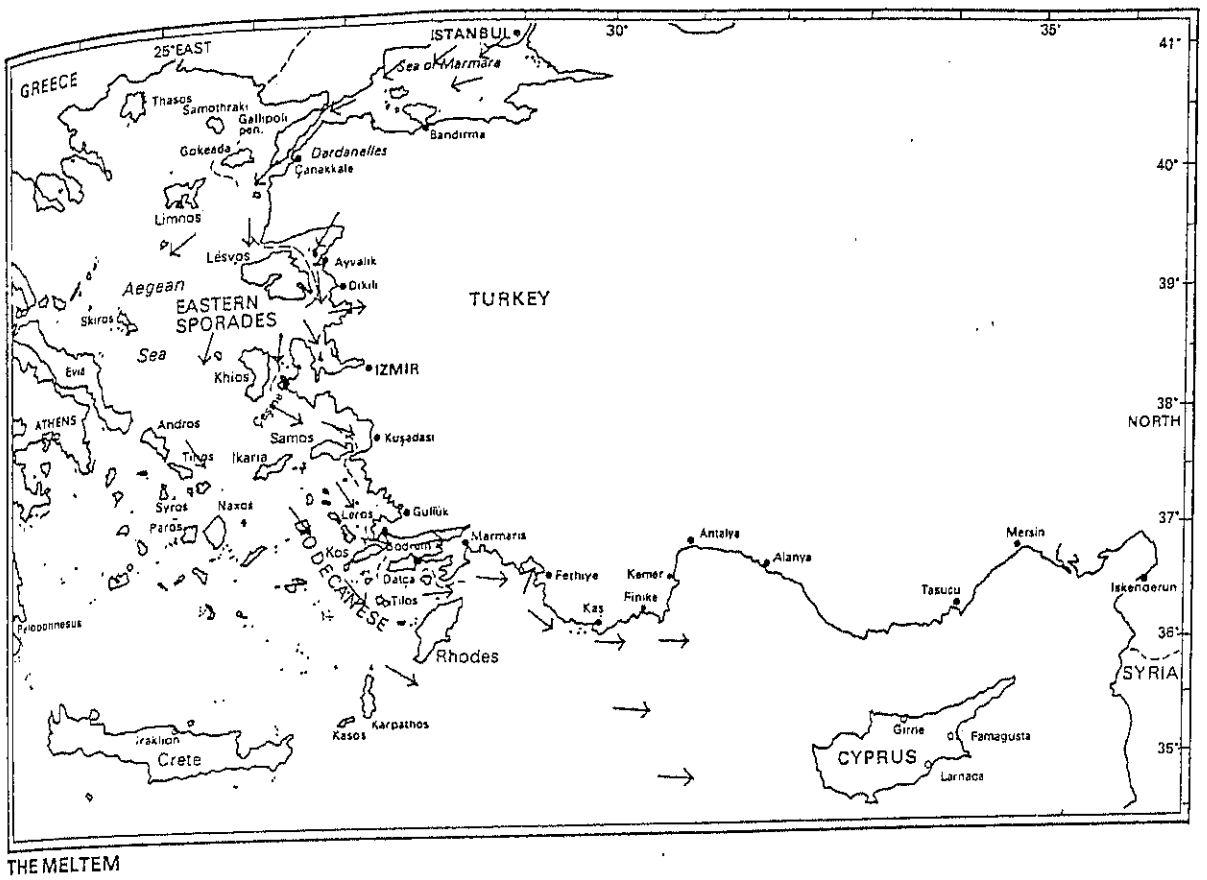



McKee Type (2)/(3)

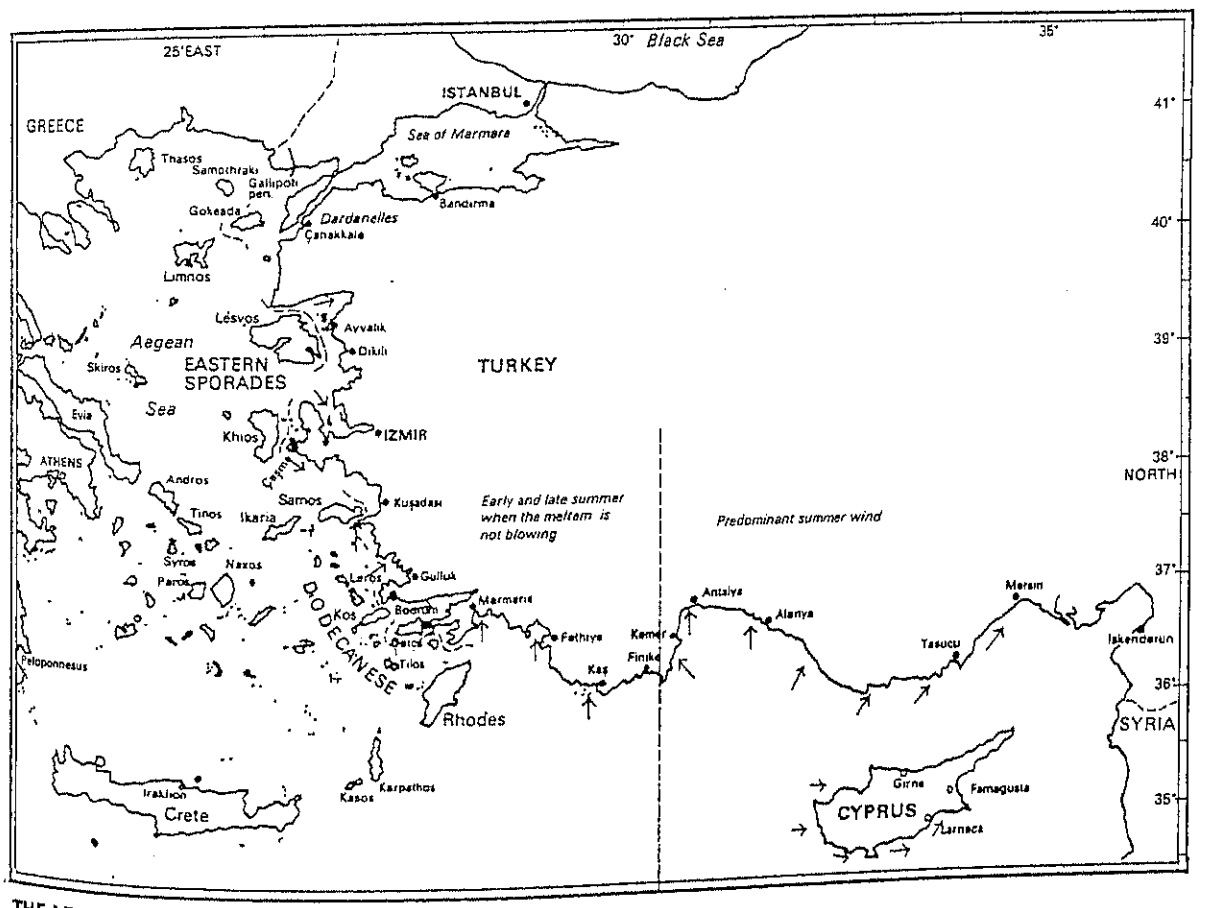



McKee Type (4)

Fig. IV.33 Diagrams of McKee Type shores (1), (2)/(3), (4).




THE MELTEM




THE AFTERNOON SUMMER BREEZE

Fig. IV.34 Meltemi and summer breezes along the coast of southern Turkey, after Heikell 1989: 21.

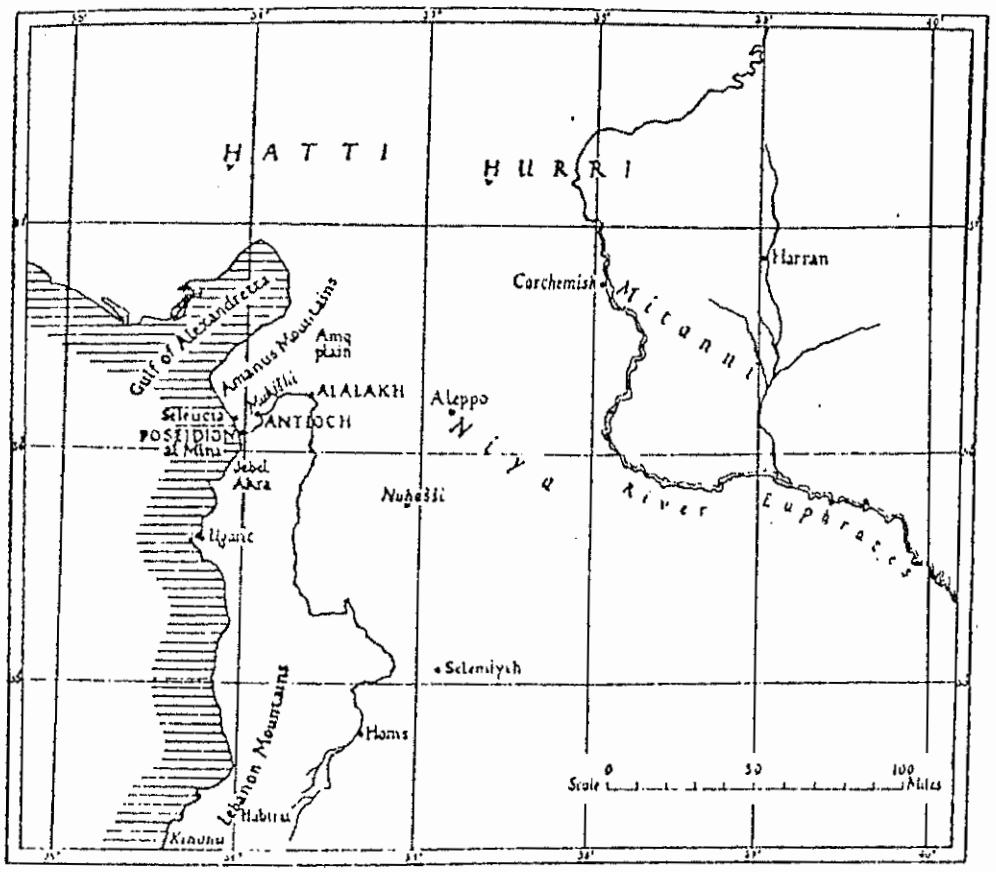



Fig. VI.1.a Locations outlined in Route 'a' - Orontes River Delta to Northern Syria, after Woolley 1953: 21,fig.2.

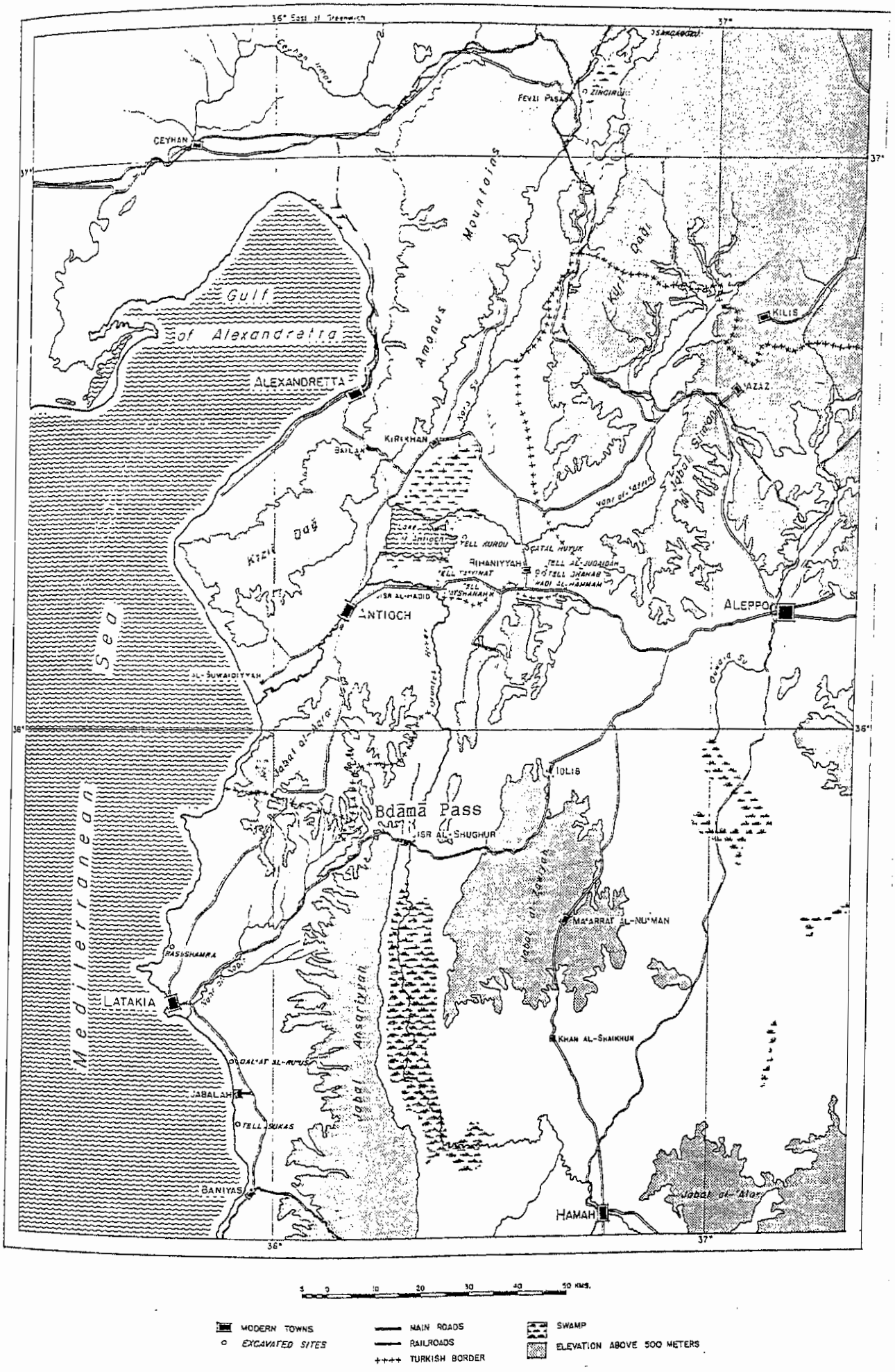



Fig. VI.1.b Locations outlined in Route 'b' - Northern Levantine coast to Mesopotamia, after Braidwood 1960.

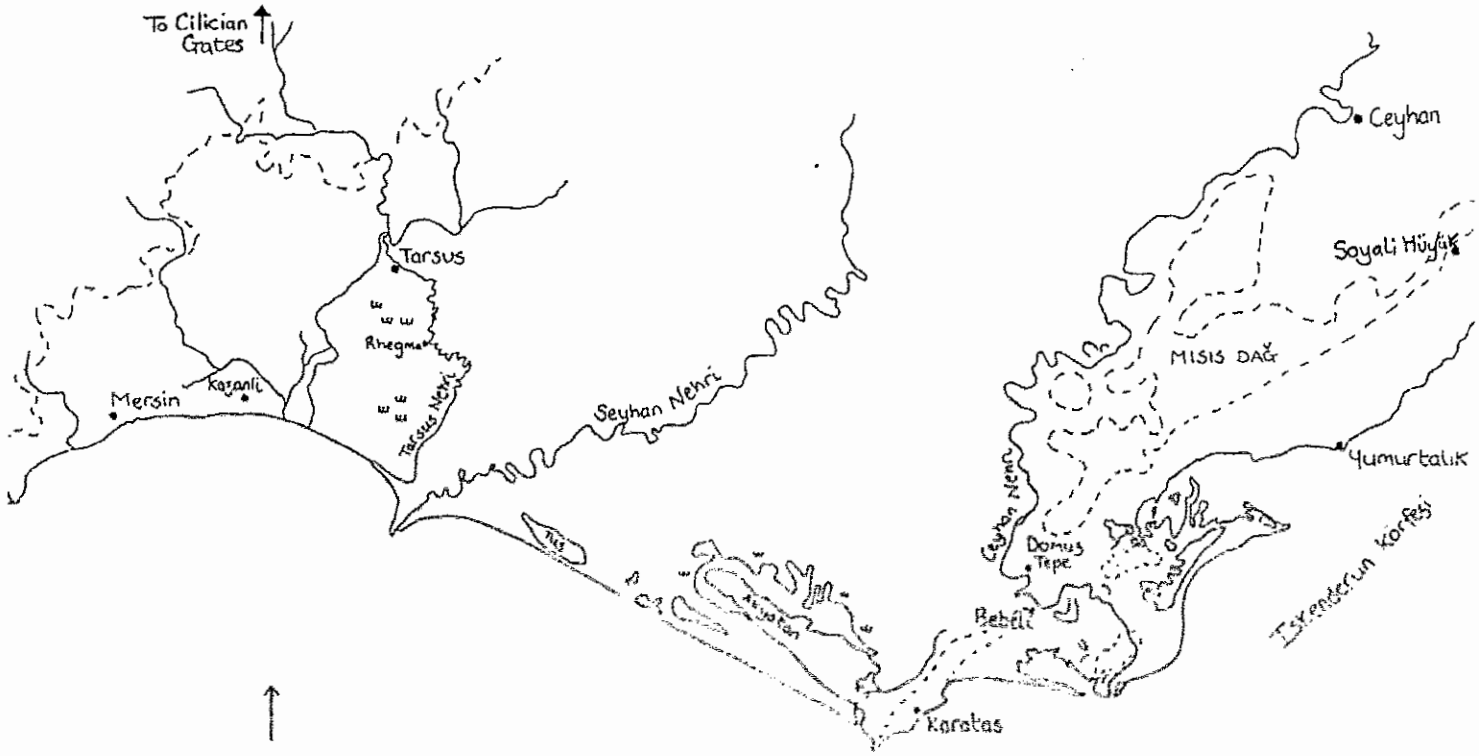



Fig. VI.1.c Locations outlined in Route 'c' - Cilician Delta to Hittite Empire.

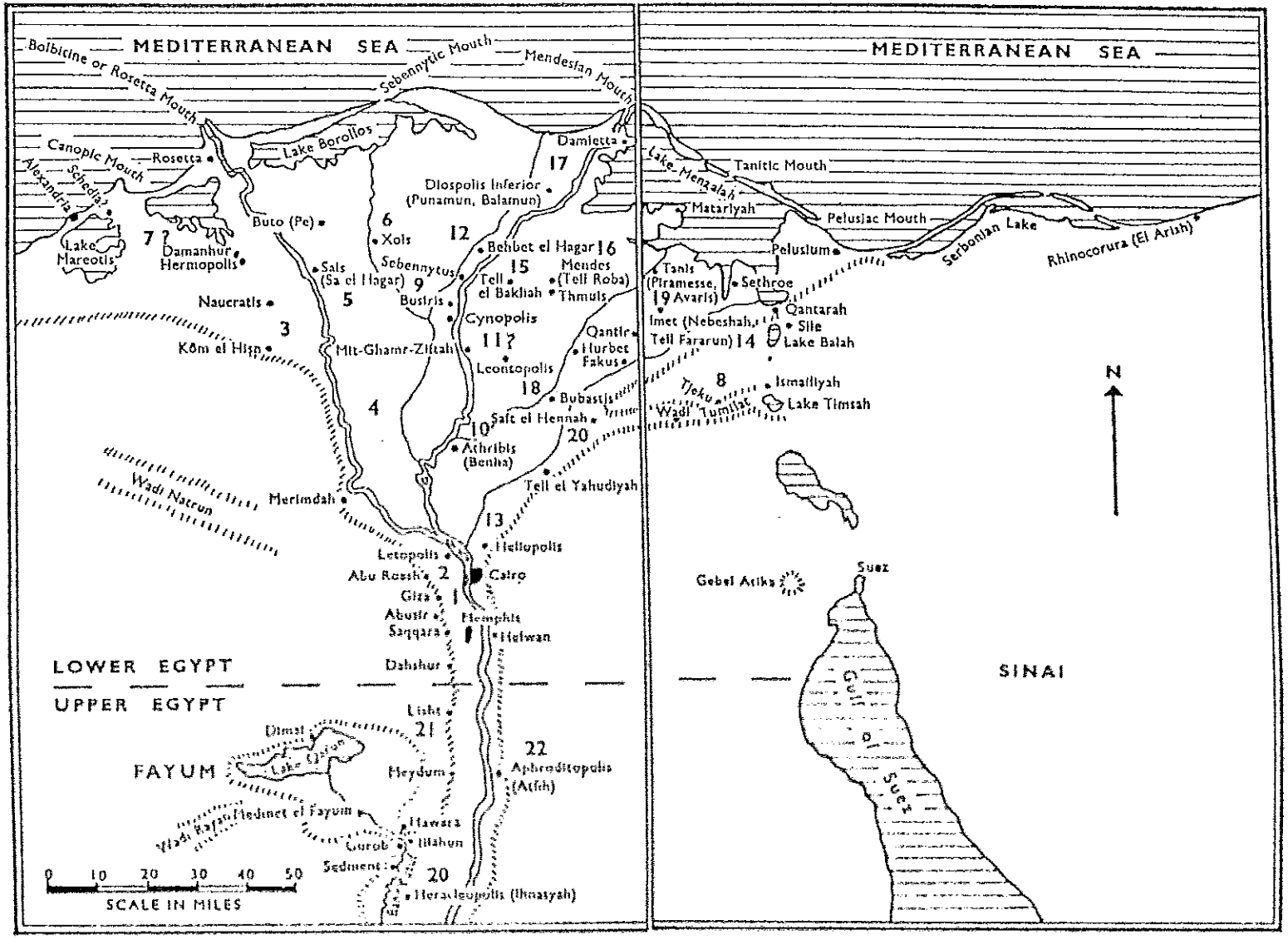



Fig. VI.1.d Locations outlined in Route 'd' - Nile Delta to Lower and Upper Egypt, after Kees 1961: 186-87, fig.5.

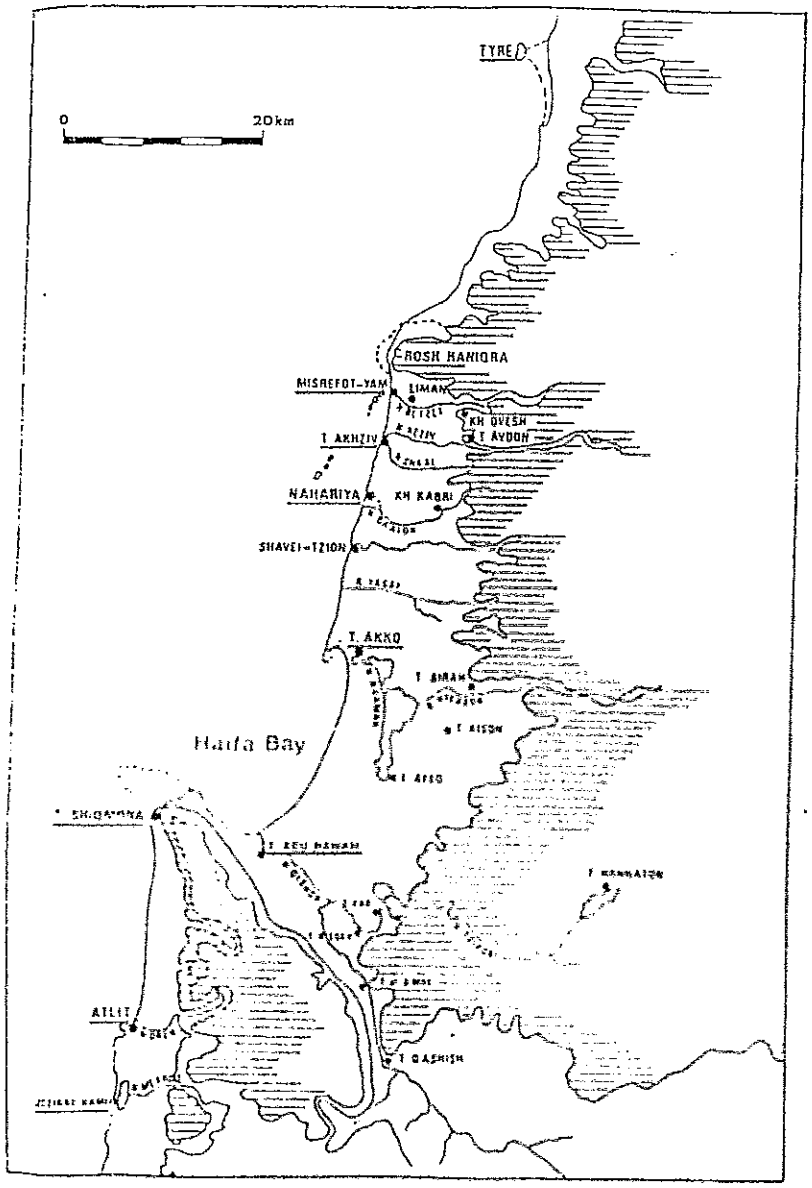



Fig. VI.1.e.i

River mouth and inland upriver Middle Bronze II sites along the north coast of Israel, after Raban 1987: 175,fig.1.

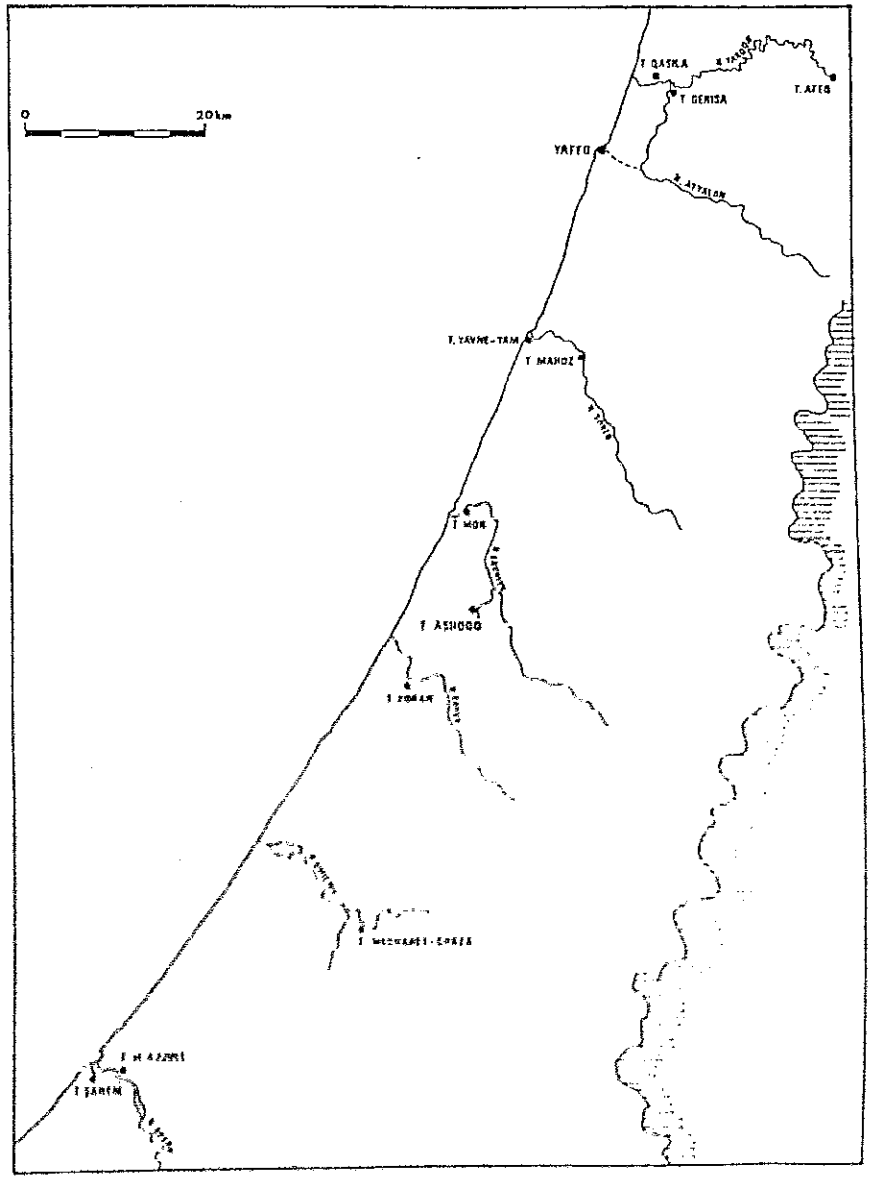



Fig. VI.1.e.ii

River mouth and inland upriver Middle Bronze II sites along the south coast of Israel, after Raban 1987: 179,fig.3.

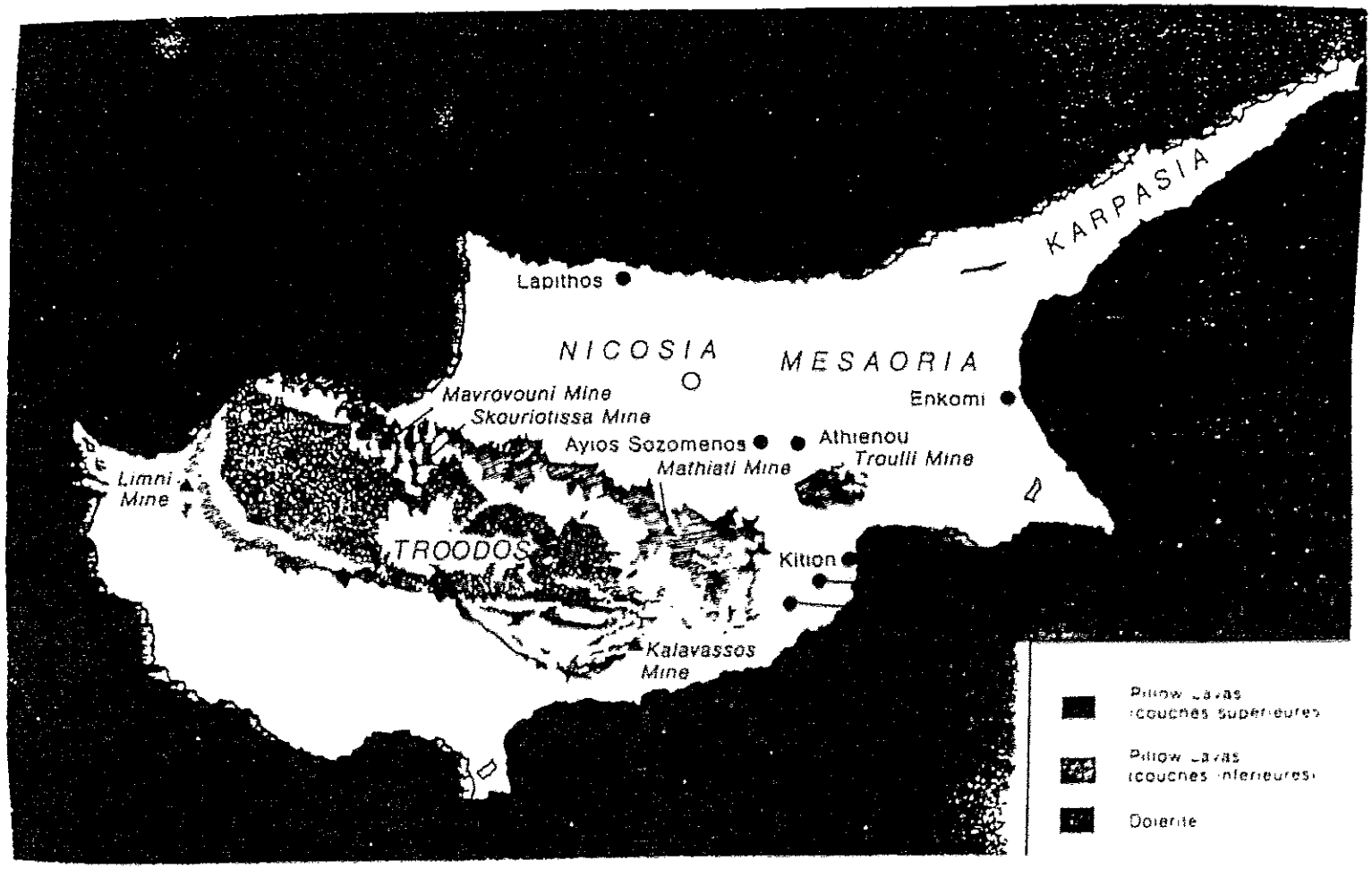



Fig. VI.1.e.iii Location of Bronze Age copper mines in Cyprus, after Sibella 1993: 55,fig.127.

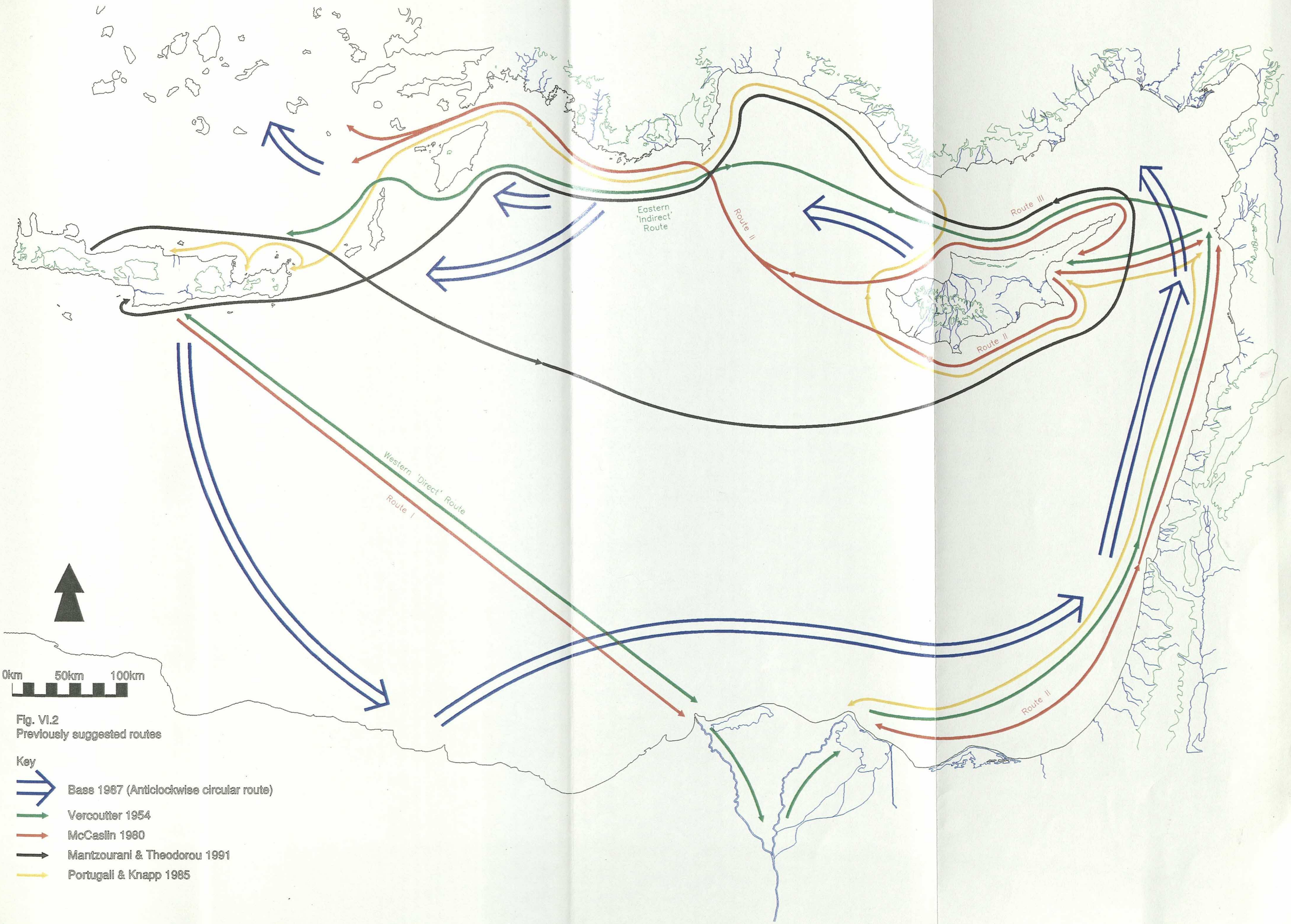



Fig. VI.2
Previously suggested routes

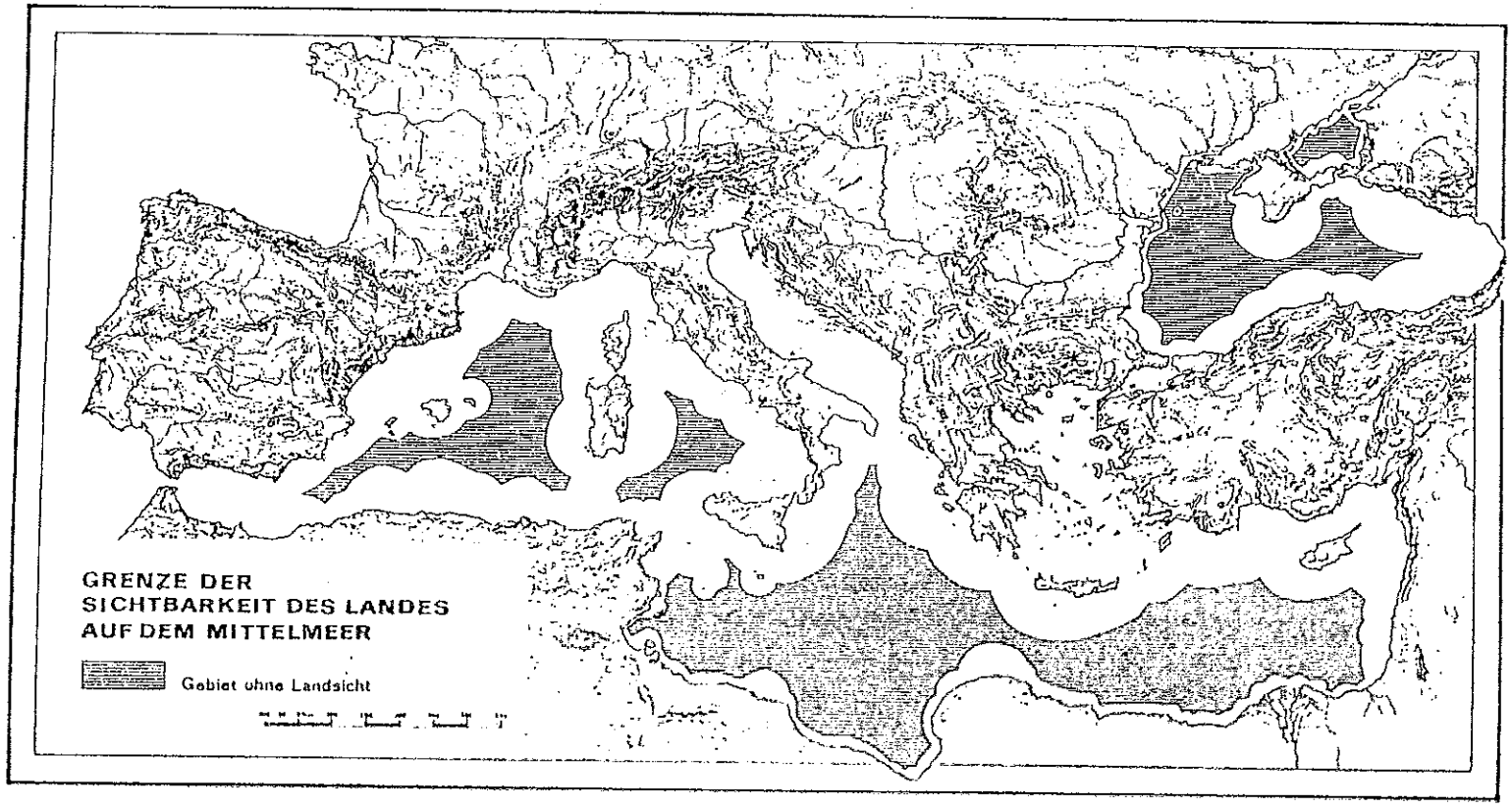



Fig. VI.2b Limits of inter-visibility between land and sea in the Mediterranean, after Congresso Nacional de Arquelogia 1968: 450,fig.1.



Fig VI.2.1
Route 'A' - Crete to Egypt

0km 50km 100km

Fig. VI.2.2
Route 'B' - Crete to Cyprus

Key

Route 'B'

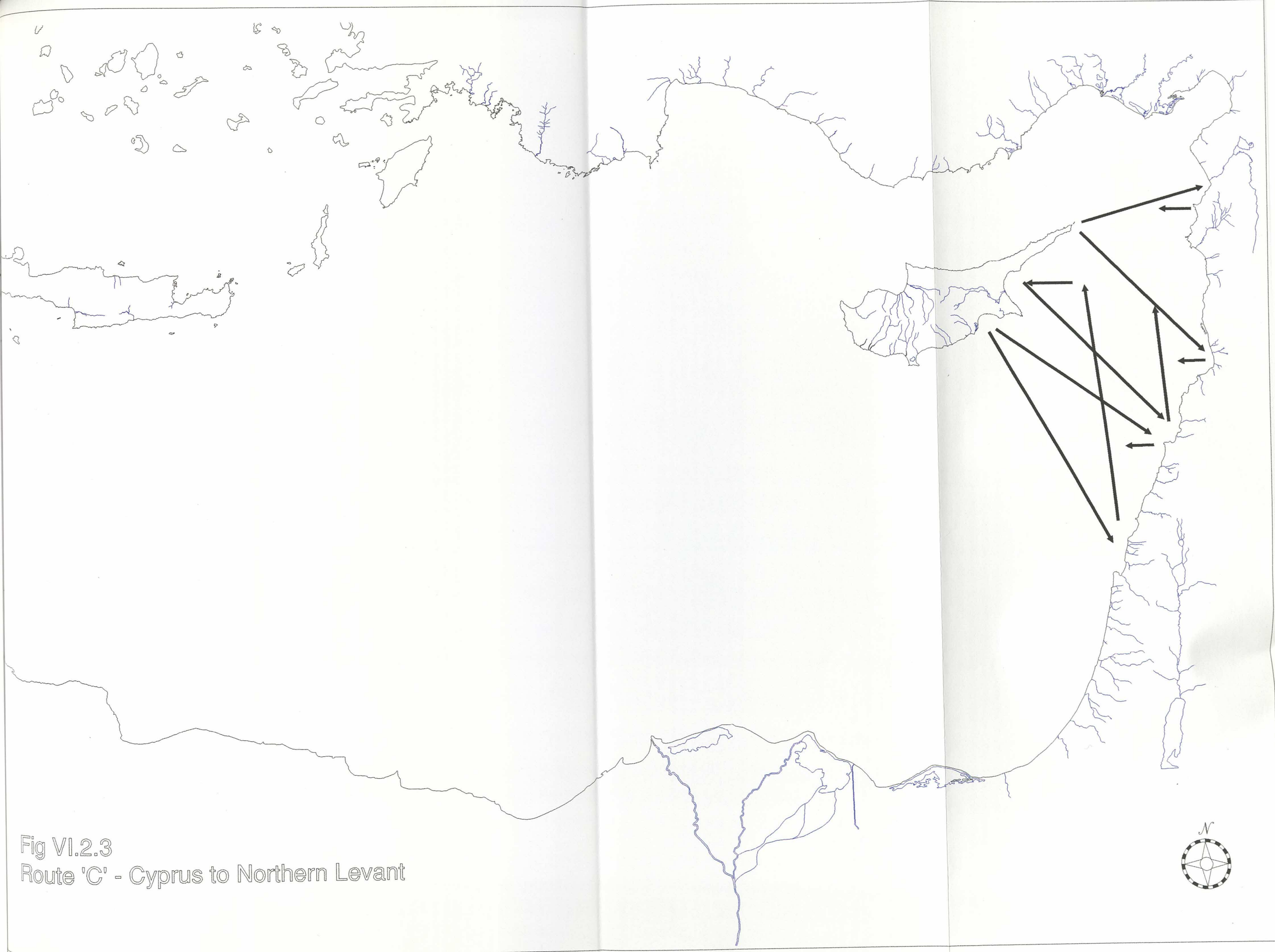



Fig VI.2.3
Route 'C' - Cyprus to Northern Levant

0km 50km 100km

Fig. VI.2.4
Route 'D' - Cyprus to Southern Levant

Key

Route 'D'

0km 50km 100km

Fig. VI.2.5
Route 'E' - Cyprus to Cilicia

Key

Route 'E'

0km 50km 100km

Fig. VI.2.6
Route 'F' - Northern Levant to Cilicia

Key

Route 'F'

0km 50km 100km

Fig. VI.2.7
Route 'G' - Egypt to Southern Levant

Key

Route 'G'

0km 50km 100km

Fig.VI.2.8
Route 'H' - Cyprus to Egypt

Key

Route 'H'

N

Fig VI.2.9
Route I- Cilicia, the south Turkish coast to Rhodes

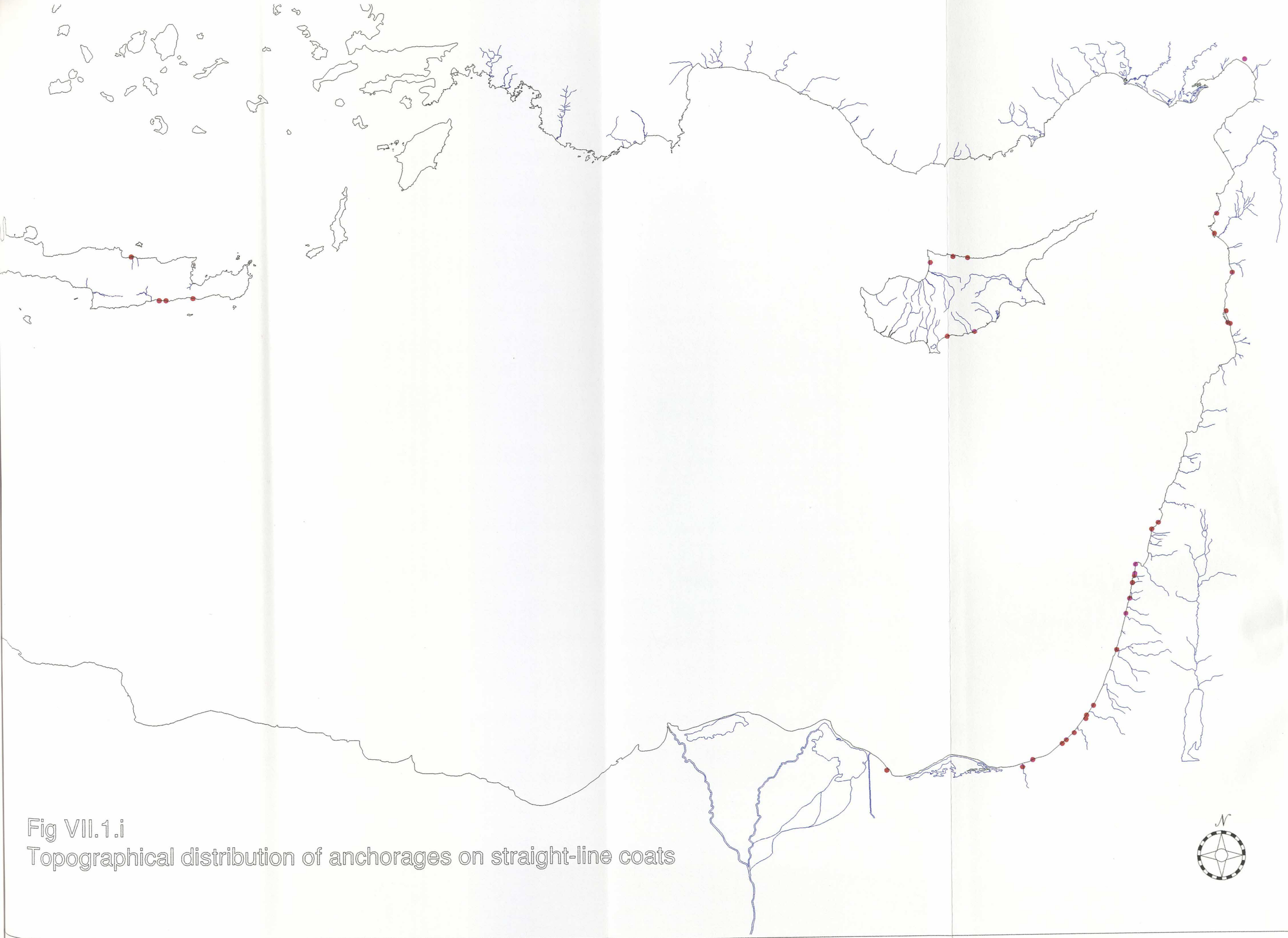


Fig VII.1.i
Topographical distribution of anchorages on straight-line coats

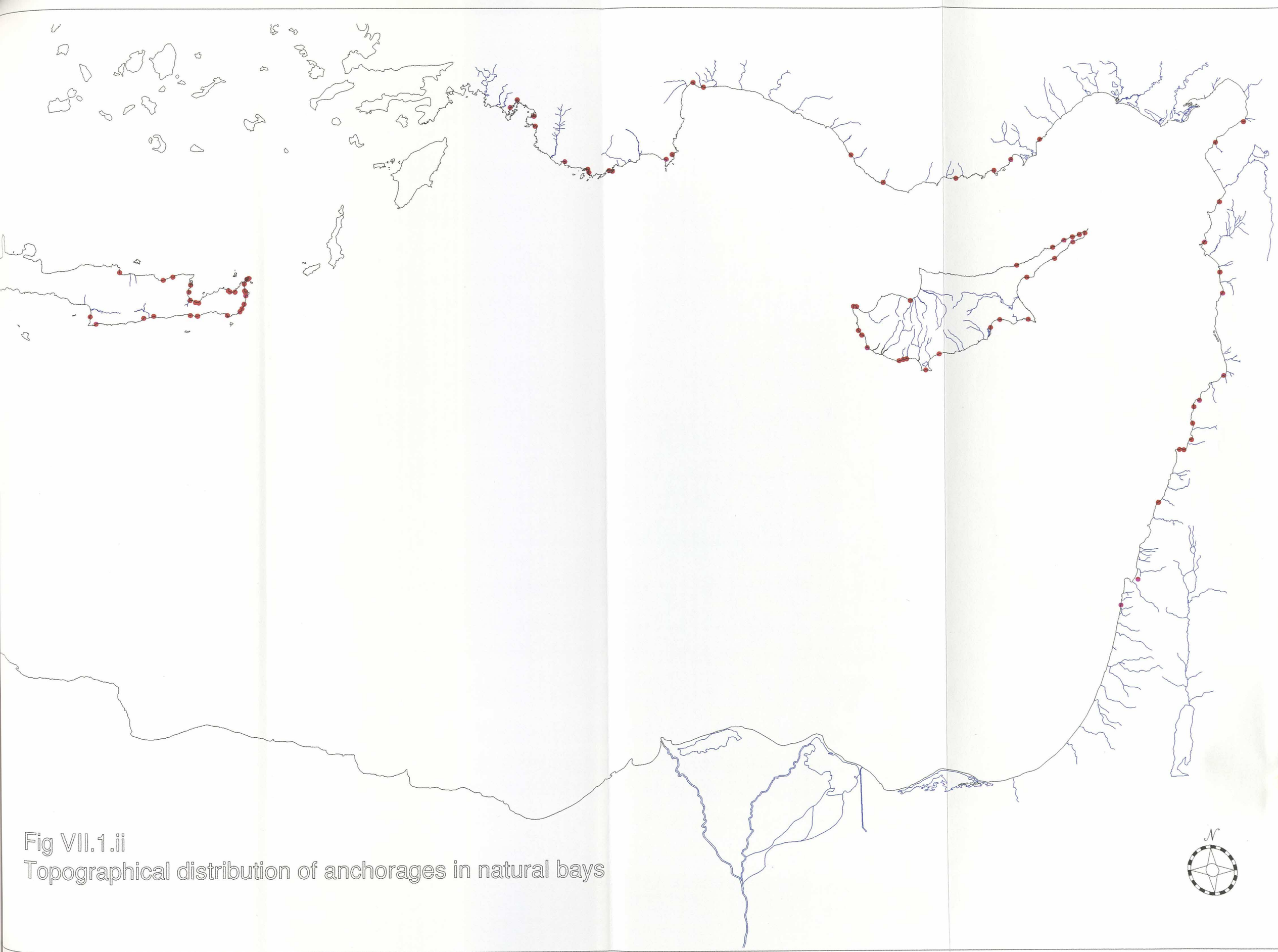


Fig VII.1.ii
Topographical distribution of anchorages in natural bays

Fig VII.1.iii
Topographical distribution of anchorages in lee of promontories

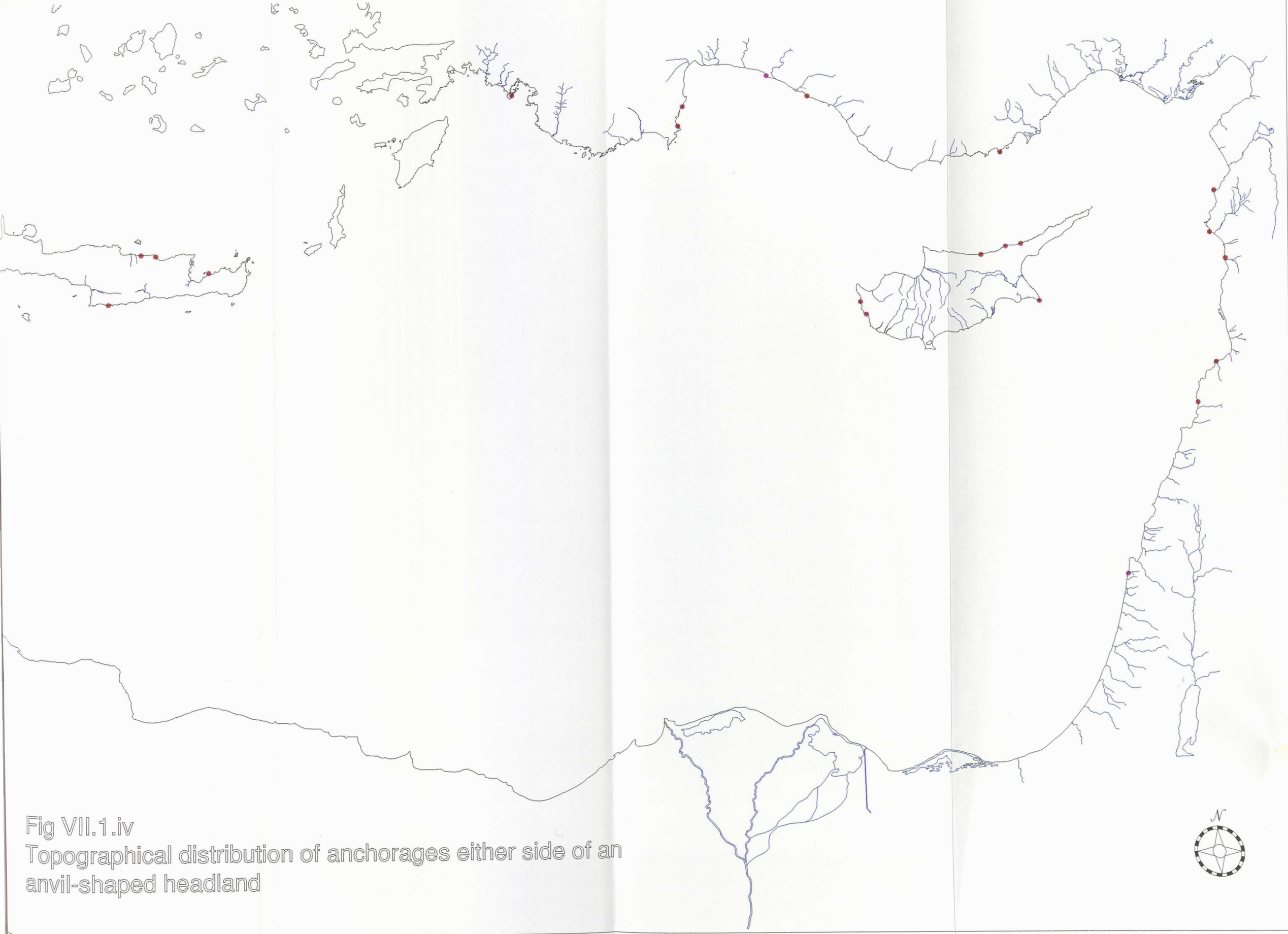



Fig VII.1.iv
Topographical distribution of anchorages either side of an anvil-shaped headland

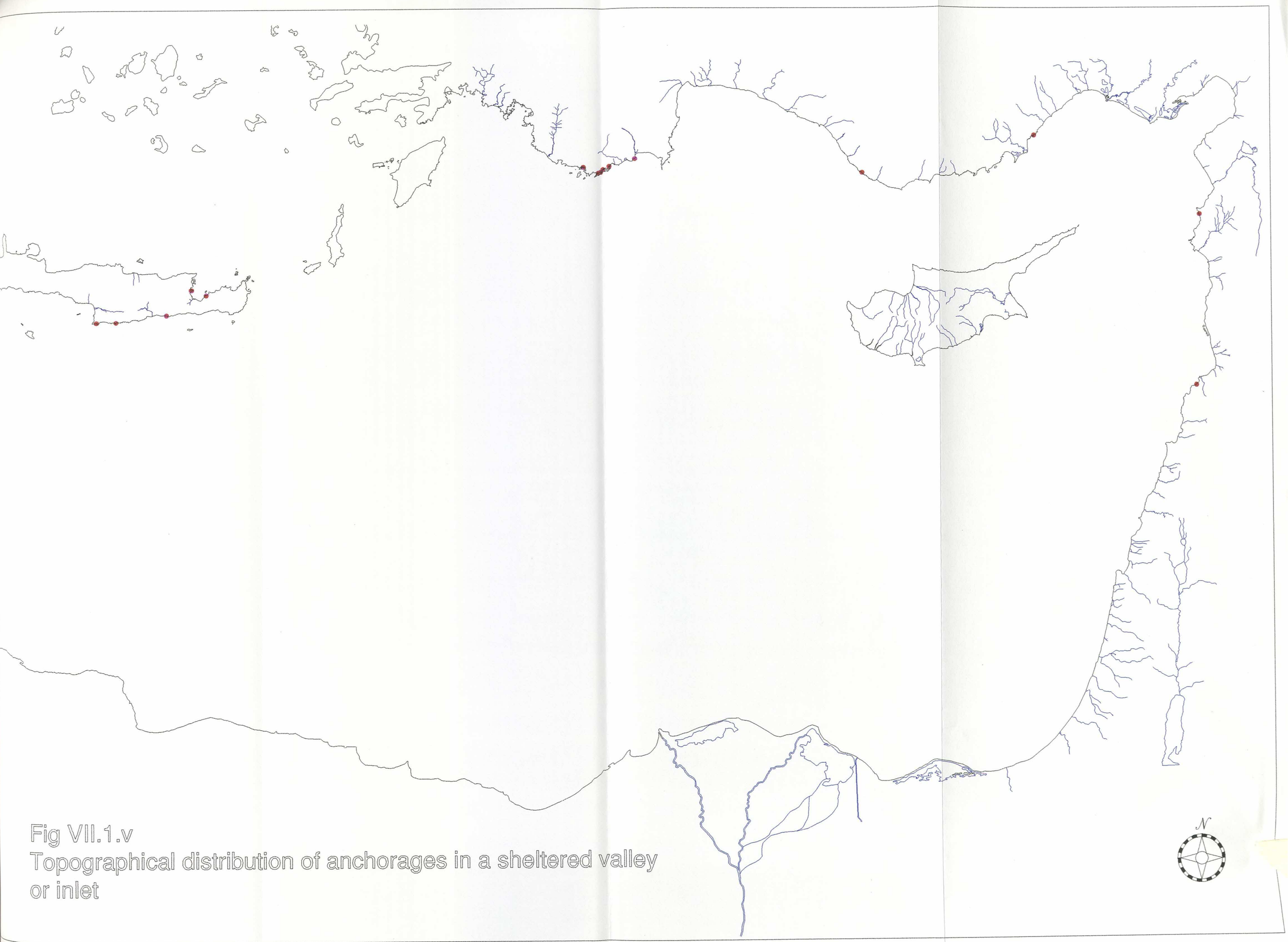


Fig VII.1.v
Topographical distribution of anchorages in a sheltered valley or inlet

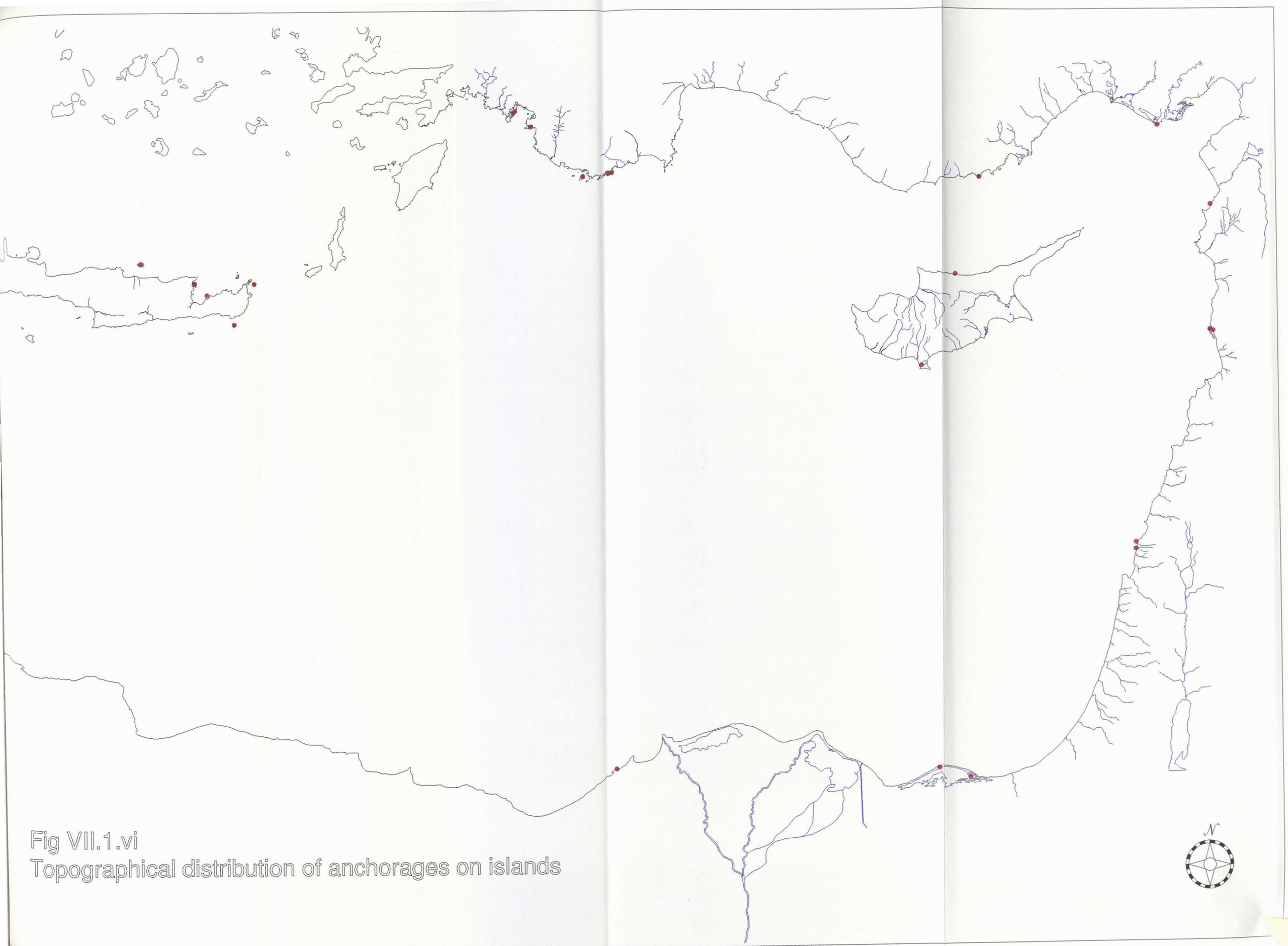



Fig VII.1.vi
Topographical distribution of anchorages on islands

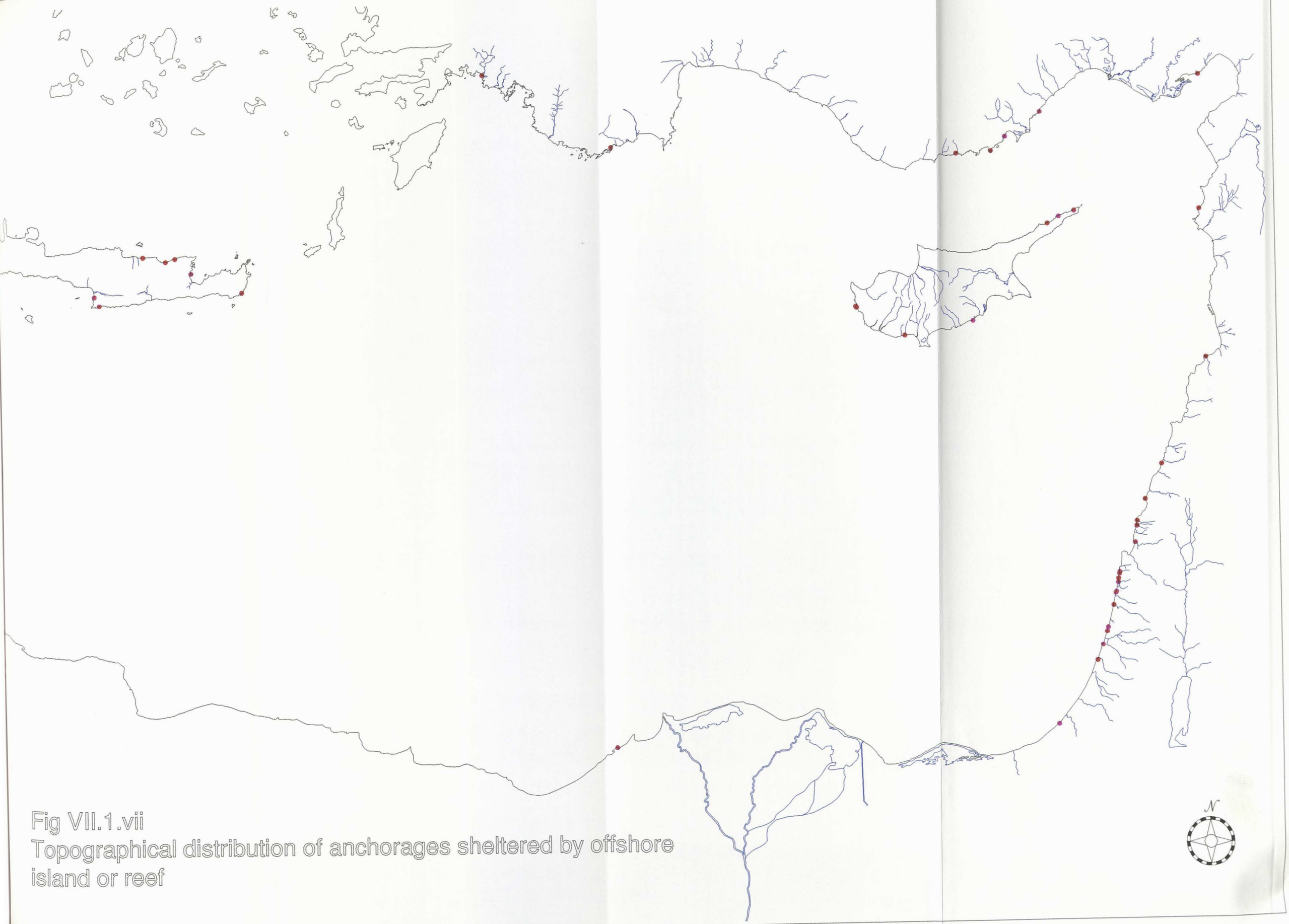


Fig VII.1.vii
Topographical distribution of anchorages sheltered by offshore island or reef

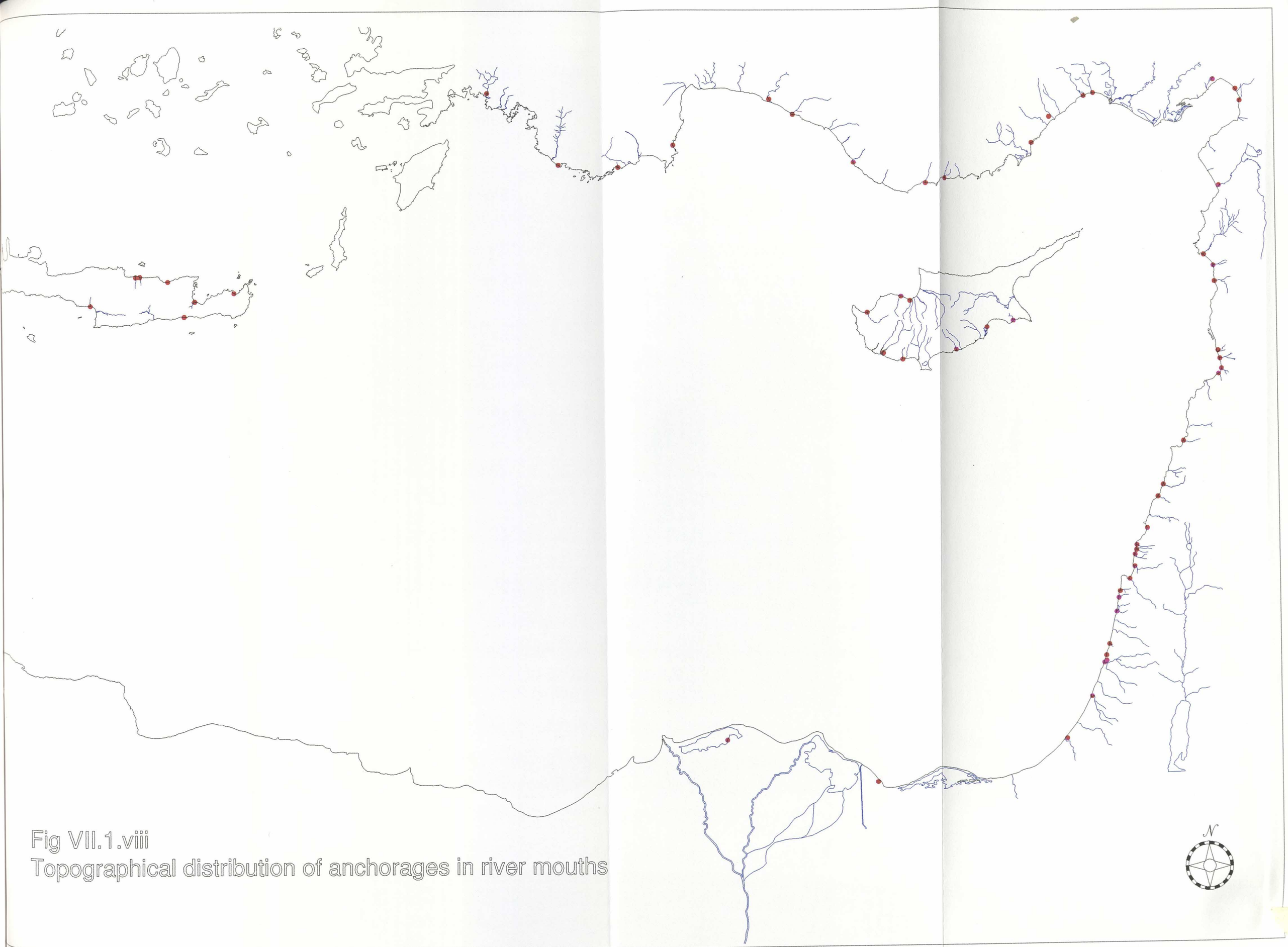



Fig VII.1.viii
Topographical distribution of anchorages in river mouths

Fig VII.1.ix
Topographical distribution of riverine anchorages



Fig VII.1.x
Topographical distribution of deltaic anchorages

Fig VII.1.xi
Topographical distribution of lagoonal anchorages



Fig VII.2.i
Distribution of Mckee type (1) anchorages.

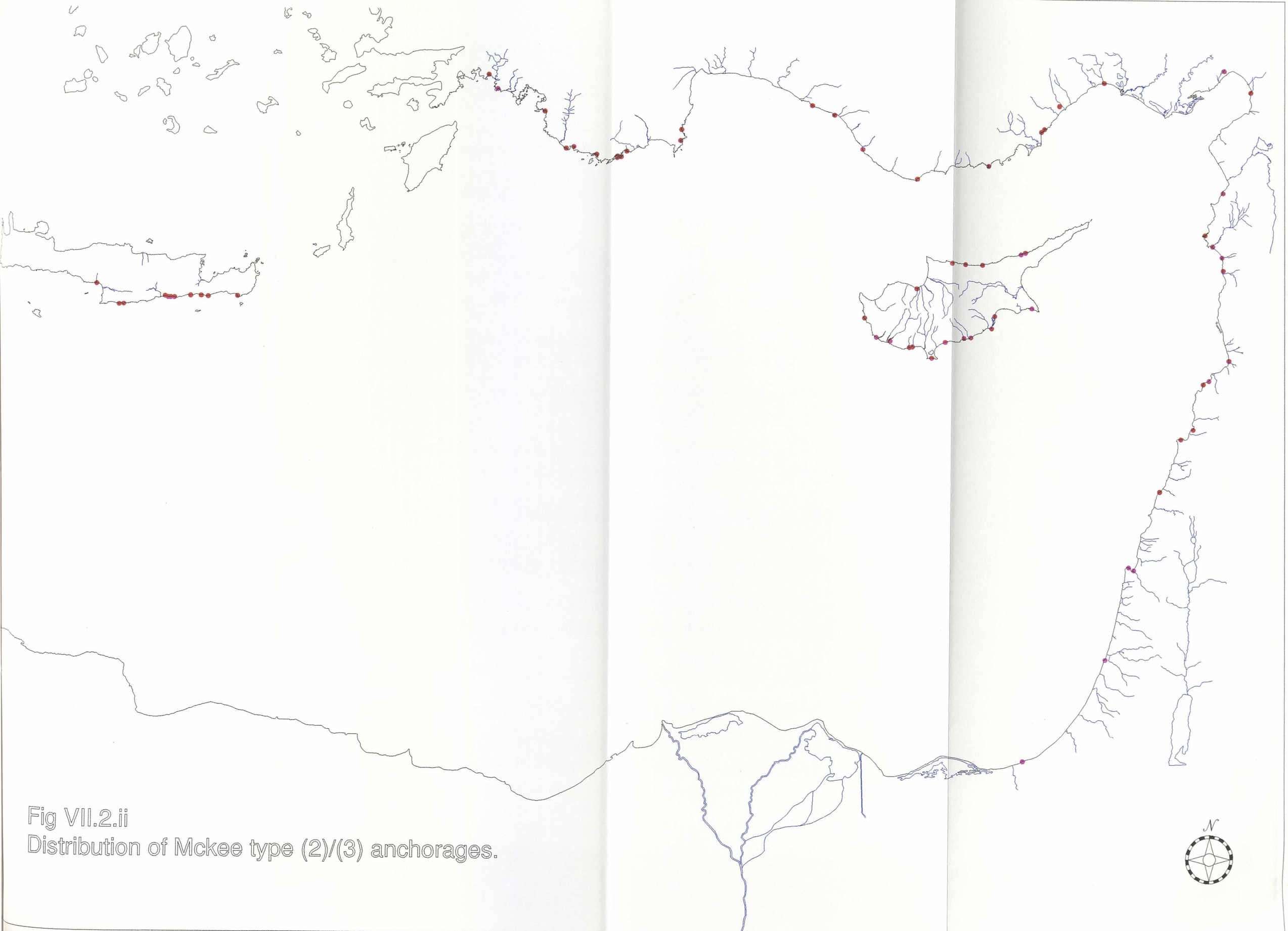



Fig VII.2.ii
Distribution of Mckee type (2)/(3) anchorages.




Fig VII.2.iii
Distribution of Mckee type (4) anchorages.

0km 50km 100km

Fig.VII.3.I
Distribution of McKee type (4) anchorages in Middle Bronze Age

N

0km 50km 100km

Fig.VII.3.ii
Distribution of McKee type (4) anchorages in the Late Bronze Age

N

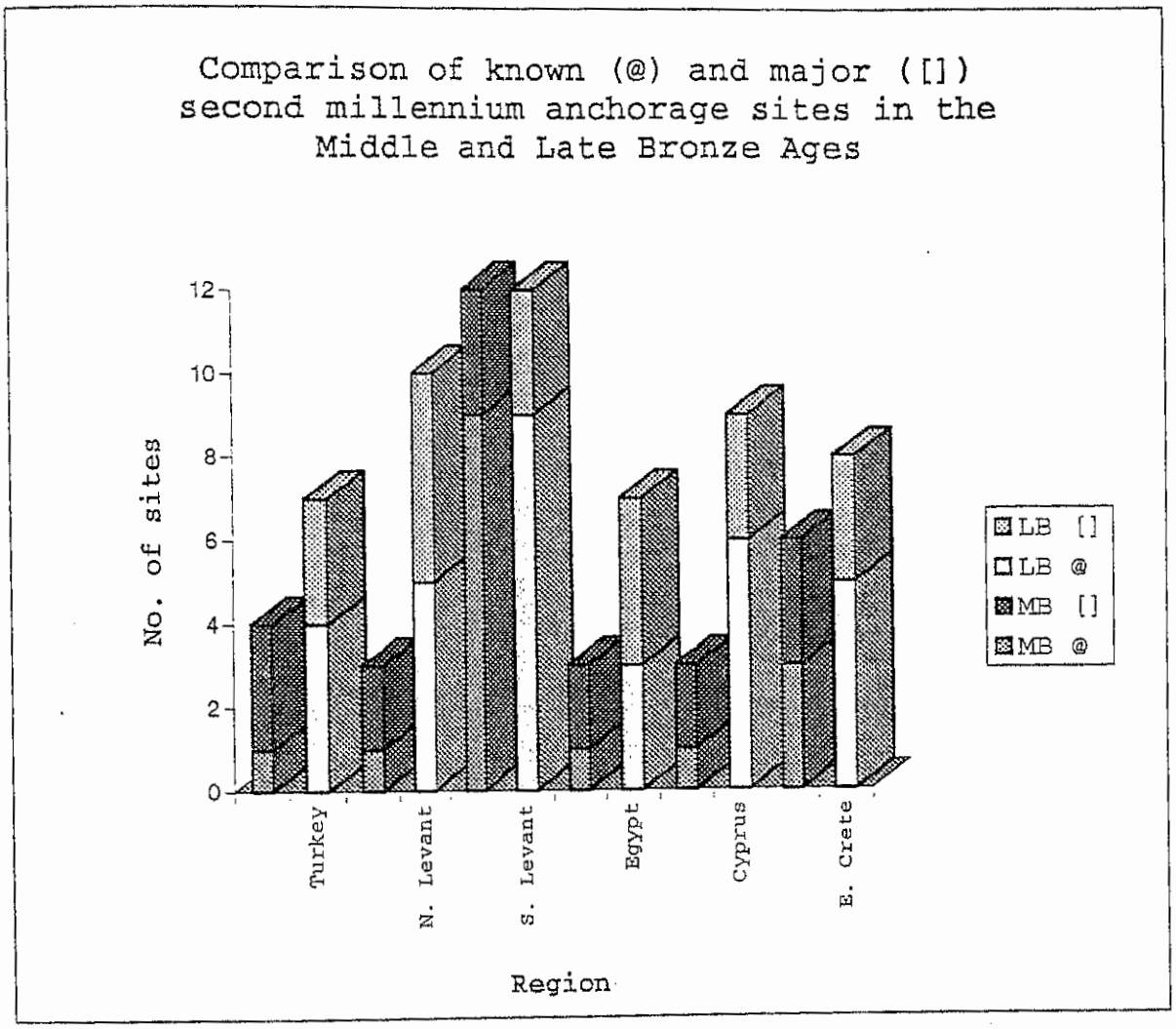

Comparison of known (@) and major ([]) second millennium anchorage sites in the Middle and Late Bronze Ages
No. of sites
0
2
4
6
8
10
12
Turkey
N. Levant
S. Levant
Egypt
Cyprus
E. Crete
Region
LB []
LB @
MB []
MB @

Fig. VII.4