Sub-Marine Exploration in Crete, 1955

Author(s): John Leatham and Sinclair Hood

Source: *The Annual of the British School at Athens*, 1958/1959, Vol. 53/54 (1958/1959), pp. 263-280

Published by: British School at Athens

Stable URL: https://www.jstor.org/stable/30104465

SUB-MARINE EXPLORATION IN CRETE, 1955

(PLATES 63–65)

IN 1955 it was decided to transfer the School's undersea activity from Chios to Crete during the time that excavations on land were being continued at Knossos. The Greek Ministry of Education most generously granted permission for the School to carry on diving operations at selected points off the coast of Crete in co-operation with the Ephor of Antiquities, Dr. Nicolas Platon.

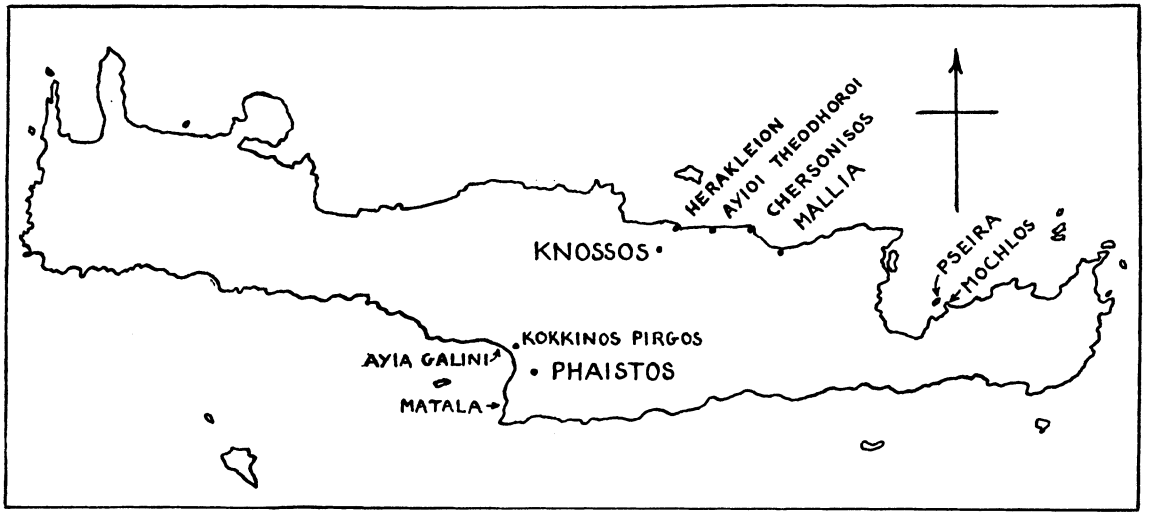


FIG. 1. CRETE, SHOWING AREA IN WHICH WORK WAS DONE

The campaign lasted three weeks, from August 9th to 30th, with a party of ten volunteers under the leadership of John Leatham. The sites explored were chosen by Dr. Platon, who gave the party much of his time and interest, and made repeated visits to the places where they were working. The party had its headquarters in an empty house which belonged to the School's foreman, Manoli Markoyiannakis, conveniently situated upon the main road in the suburb of Poros (Katsamba) just east of Herakleion. This was used as a central depot, and the compressor

Acknowledgements

The School is very much indebted to Professor Sp. Marinatos, then Head of the Department of Antiquities, and to the Greek Ministry of Education, which generously granted permission for the diving; also to the Ephor of Antiquities for Crete, Dr. Nicolas Platon, for his able guidance and help in connexion with it.

The School would like once again to express its gratitude to the *Sunday Times* for the gift of £1,000 by means of which the basic equipment of compressor and aqualungs was bought in 1954; and to the British Academy and to the Royal Geographical Society for grants which made it possible to continue the work this season.

Those who took part in the expedition were: Ley Kenyon, Richard Mitchell, Igor Pavloff-Melanophides, Raef Payne, Susan Chomley, Honor Frost, Regine Lugo (now Mrs. Pavloff-Melanophides), Alison Marsh (now Mrs. Myles Stoney), Ann Pearce (now Mrs. Joseph Natanson). To all of them we should like to express our gratitude for their help and co-operation throughout the work. The plans, notably that of Chersonisos harbour, are basically the work of Mr. John Carswell; the drawings of the pottery are by Mrs. Myles Stoney.

The observations at Chersonisos were checked and revised in some details by Sinclair Hood with the help of George Huxley and Davina Best (now Mrs. Huxley) under exceptionally favourable conditions of calm weather in the autumn of 1956.

for filling the aqualungs was established here. The work was unfortunately hampered throughout the three weeks by high seas owing to the prevailing north winds (Meltemia). It was difficult therefore to make great use of the aqualungs.

A day or two was first spent examining the waters of Herakleion harbour itself, in the hope of finding some trace of boats sunk there during the great siege by the Turks in the late seventeenth century. Two bronze cannon and charred timbers from a galley of the period were dredged from a depth of 4 metres in the harbour just before the war.[1] But the water was excessively cloudy, making it difficult to see, and no results were obtained. The sea around the mouth of the Kairatos stream and off Katsamba point, the area of the Minoan harbour town of Knossos just east of Herakleion, was also investigated, but without result.

The party then, at Dr. Platon's suggestion, moved to Chersonisos, where the main effort of the season was made. The traces of Roman and possibly earlier harbour works there were planned and studied. At the same time an examination was made of the waters around the Minoan settlements on the islands of Mochlos and Pseira in the Gulf of Mirabello; and several vases of Early and Middle Minoan types were recovered from the depths of the sea in that area. Then, once more at Dr. Platon's invitation, the party made an attempt to locate the wreck of the Classical Period noted before the war in the bay of Ayia Galini on the north edge of the Mesara plain in south Crete. The neighbouring ancient harbours of Komo and Metalla on the south coast were also visited.

Professor Marinatos most kindly gave permission for us to examine the interesting traces of possible Minoan harbour works to which he has drawn attention at Ayioi Theodhoroi[2] just west of Nirou Khani between Herakleion and Mallia on the north coast. But rough weather and high winds severely curtailed investigations here.

Fish-tanks (see pp. 270 and 275)

A curious discovery at Chersonisos and Mochlos was that of rock-cut compartments, which appear to be tanks for conserving sea-fish according to the description of these given by the Roman agricultural writers, Columella and Varro.[3]

The ancient Greeks evidently had artificial tanks for keeping freshwater fish. In the fifth century B.C. the people of Agrigentum in Sicily constructed for the tyrant Gelo a huge tank (κολυμβήθρα), nearly 1,300 metres round and over 9 metres deep.[4] Plato also talks of a man falling into a little κολυμβήθρα or into the sea;[5] but this κολυμβήθρα is not necessarily a fish-tank.

The Romans seem to have followed the Greeks in making tanks for conserving freshwater fish. But during the last phase of the Roman Republic in the first century B.C. a rage developed for sea-fish, and many anecdotes are told of the lengths to which people went to indulge their passion for this form of food. At first at any rate some attempts appear to have been made to establish sea-fish in fresh water; but tanks built by the sea allowing a constant flow of sea-water through them eventually became the rule. An incidental reference in Pliny makes it clear that tanks for sea-fish existed by his time at the opposite ends of the Mediterranean, in Phoenicia and at Narbonne in south France.[6] There is therefore nothing improbable in the discovery of such tanks in Crete.

[1] Ἐπετήρις Ἑτ. Κρητικῶν Σπουδῶν 2 (1939) 536.
[2] See his account in *PAE* 1926, 141 f.
[3] Columella viii. 16–17; Varro iii. 17. See also other references in *DA*, s.v. Vivarium; *RE*, s.v. Piscina.
[4] Diodorus xi. 25, 4.
[5] *Republic* 453d.
[6] Pliny, *HN* ix. 59.

Columella recommends the construction of tanks for sea-fish to owners of islands or of poor estates by the sea.[7] But both the tanks at Chersonisos and those at Mochlos doubtless belonged to somebody living in the towns there.

The tanks are grouped in a pair at Mochlos, and there are three in a row at Chersonisos, evidently to keep different kinds of fish apart. 'Who, however, goes in for fish-ponds and does not have a row of them?' says Varro: 'for just as painters have large boxes with compartments for keeping their pigments of different colours, so they have ponds with compartments for keeping the varieties of fish separate' (iii. 17, 3). The tanks were fed by channels cut in the rock. One tank at Mochlos, and all those at Chersonisos, have at least two channels, or even three. This accords with the advice of the agricultural writers that the chief concern in building a tank for sea-fish must be to ensure a constant flow and circulation of fresh water.[8] The tank must imitate as far as possible the condition of the sea itself, says Columella (viii. 17, 1). There should therefore, if possible, be channels on every side, and (ideally) an outlet opposite the inlet channel to carry the water away as the wave forces itself into the tank through the inlet (ibid. 17, 3). This is precisely the arrangement visible in the tanks at Chersonisos.

The channels must obviously have had grills or gratings of some kind to prevent the fish escaping, while admitting a constant supply of fresh sea-water.[9] A fragment of a stone slab with regular perforations found in the eastern tank at Mochlos (p. 275, PLATE 63 *a*) must be part of such a grating from one of the channels.

The floors of the tanks at Mochlos are about 1·50, and at Chersonisos between 1·95 and 2·20, below the modern sea-level. It is clear that the sea-level has risen considerably in these parts of Crete since ancient times (see below). At Chersonisos, for instance, the original surface of the Roman mole (A) is flush with the sea-level today. If, therefore, the mole originally stood to a height of a metre above the level of the sea in Roman times, the fish-tanks at Chersonisos would have had a depth of about a metre of water in them.

In discussing various kinds of fish-tanks for different kinds of fish, Columella speaks of tanks with only about 2 Roman feet (say 0·60 m.) depth of water (viii. 17, 9); these, however, are not tanks cut in the rock, but ponds built in sandy shallows especially for flatfish like soles or turbots. Our tanks, it would appear, were rather intended for rock-fish, and tanks for these, according to Columella, should be some 7 feet, or over 2 metres, deep. The greater the depth the better, he says, as the water is then colder, and this is more healthy for the fish (viii. 17, 3–4). But it is not surprising to find ideal specifications ignored in practice, least of all in a provincial area like Crete.

Rise of Sea-level

All the evidence points to a slight general rise of sea-level throughout the Mediterranean since early historic times. But this rise may not have progressed at a uniform rate, and there may even have been periods of oscillation when the sea-level fell again to some extent.[10] In a region of great earthquake activity like Crete the picture is further complicated by the possibility of localized earth movements. The idea has indeed been advanced that the whole of Crete has

[7] Columella viii. 16, 6. But Varro strongly disapproves of sea-fish tanks as opposed to tanks for freshwater fish. They are only built at great cost, and stocked at great cost; and the upkeep is expensive (iii. 17, 2).

[8] Q. Hortensius used to criticize M. Lucullus because the fish-tanks at his villa near Naples did not have suitable tidal currents. Whereupon Lucullus spent a fortune digging a tunnel through a mountain to bring a stream of sea-water into his fish-ponds so that they should ebb and flow (Varro iii. 17, 8).

[9] Columella (viii. 17, 6) recommends bronze gratings with small holes.

[10] There is now evidence for the phenomena of a partial regression followed by renewed transgression of the sea in England in the Middle Ages (*The Times*, Apr. 14th, 1956, p. 11).

tilted along a north–south axis, so that the west end has risen, leaving the harbour of the Roman period at Phalasarna high and dry, while the eastern part of the island has been correspondingly depressed. Pendlebury suggested that such a tilting might have taken place owing to a single great catastrophe in the early Middle Ages.[11]

The evidence from Mochlos and Chersonisos, however, rather suggests that the rise of the sea-level at both places since Roman times has been about the same, a metre more or less.[12] Since the floors of the fish-tanks at Mochlos are rather less deep (1·50 as opposed to about 2·00 m.) below the modern surface than those at Chersonisos, it might even be deduced that the rise at Chersonisos had been somewhat more than at Mochlos. At all events, the evidence certainly does not support a theory that Crete has tilted along a north–south axis so that the west end has risen while the east has sunk, since, if the island had tilted in this way, the sea ought to have risen higher at Mochlos, which lies nearly 50 kilometres farther east, than at Chersonisos.

Chersonisos (see Plan, fig. 2, and Key below)[13]

Key to Plan of Harbour (fig. 2)

(1) Area of squared stone blocks. Possibly remains of Greek or Hellenistic harbour works (p. 269).
(2) Roman fountain with mosaics (p. 269).
(3) Roman apse exposed in road (p. 269).
(4) Roman quay with remains of stone bollards (p. 268).
(5, 6) Ruins of Roman buildings exposed on shore (p. 269).
(7) Roman and earlier ruins exposed by shore, including possible remains of Greek or Hellenistic harbour works (p. 269).
(8, 9) Remains of Roman quay or large sea-side villa (p. 269).
(10) Wall of the Roman period or later (p. 269).
(11) Stretch of narrow concrete walling, presumably Roman (p. 269).
(12) Walling of squared and chamfered stone blocks. Possibly remains of Greek or Hellenistic harbour works (p. 270).
(13) Chapel of Ayia Paraskevi.
(14) Roman fish tanks cut in the rock (p. 270).
(15) Roman or Byzantine defence walls.
(16) Early Christian basilica church.
(17) Ancient walls, including some of the Minoan period, exposed in cliff face (p. 266).
(18) Column and masonry blocks on harbour bottom.

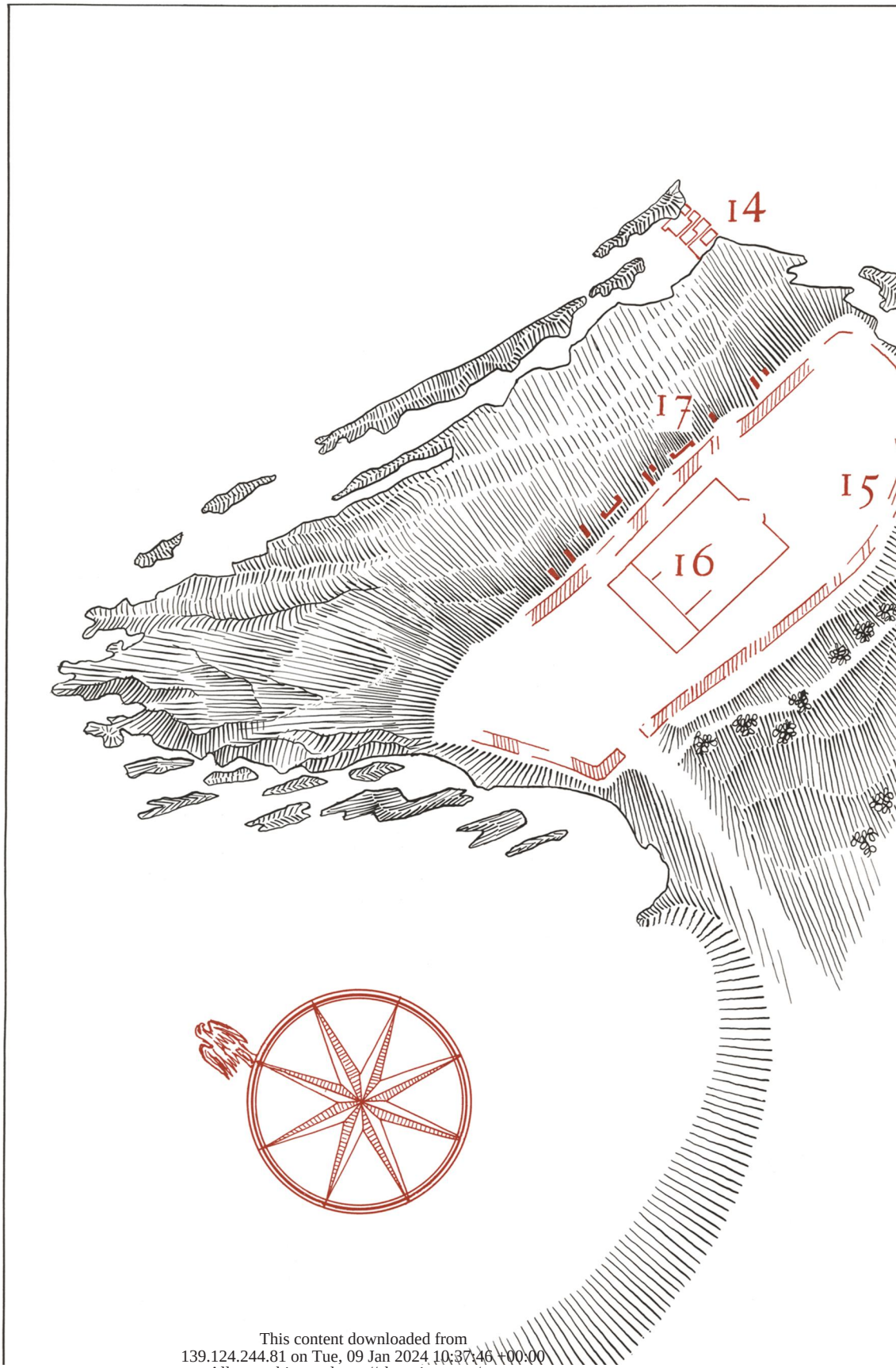
Chersonisos lies on the north coast of Crete about 25 kilometres east of Herakleion on the west edge of the Bay of Mallia. It was probably in ancient times the best harbour on the north coast between Herakleion and Olous farther east. At one time the sea-port of Lyttos, about 15 kilometres distant from it inland, it later became an independent city issuing its own coinage. Strabo mentions the temple of the pre-Hellenic goddess Britomartis, or Dictynna, that once stood here.

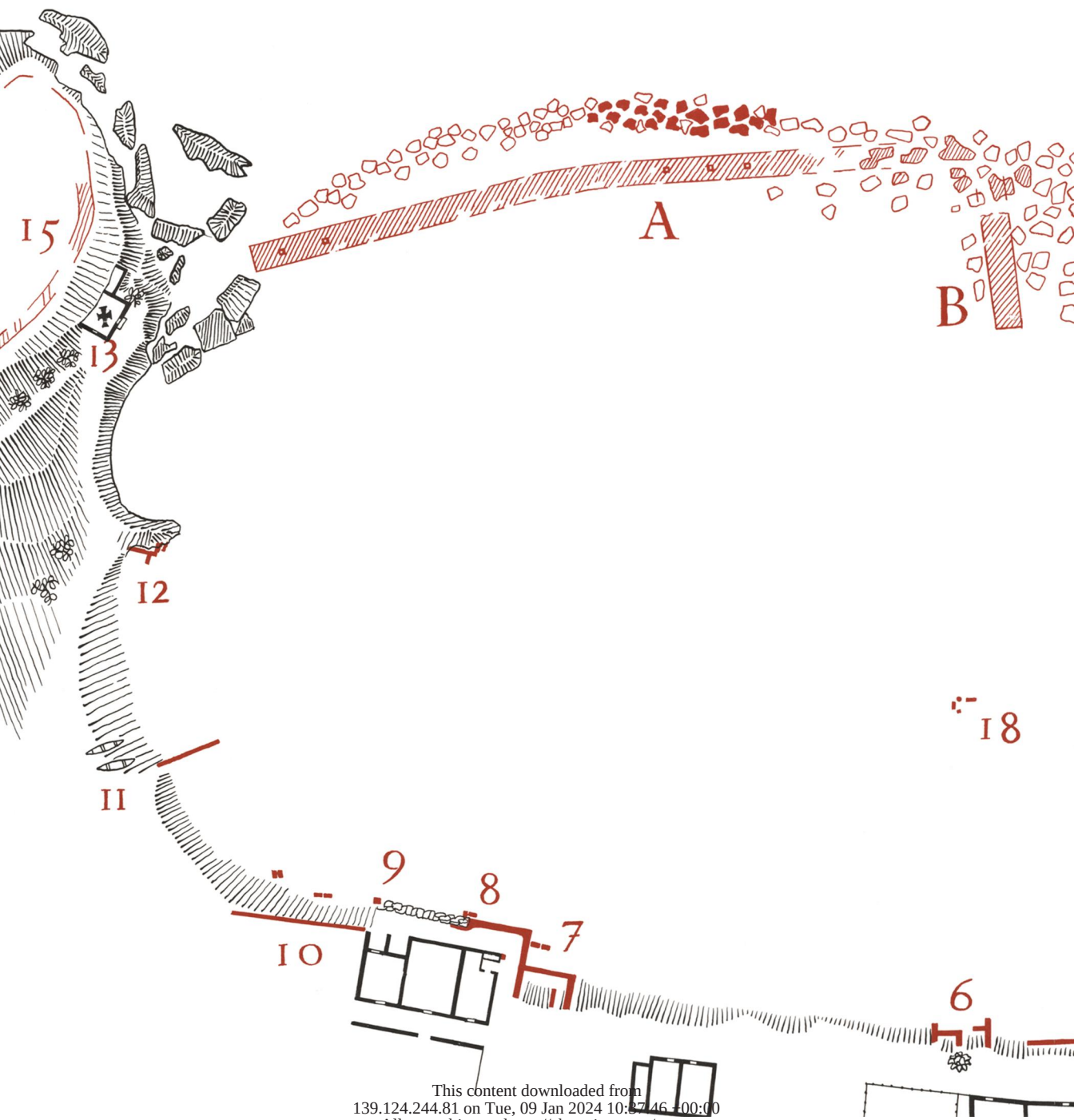
The rocky and defensible promontory (plate 64*a*) jutting into the sea, flanked by wide and sandy beaches, provided an ideal site for an early settlement. There was a town or village here in the Bronze Age, to judge from Minoan sherds among the walls of houses exposed at the bottom of an occupation deposit 6·50 m. thick in the cliff face on the north-east edge of the promontory. This headland may have formed the acropolis of Chersonisos in Classical times; but the concrete defence walls surrounding it (15 on Plan) are probably late Roman or Byzantine, and an interesting Early Christian church here (16 on Plan) has been explored by Xanthoudides

[11] *Archaeology of Crete* 3 and n. 1. See Spratt, *Travels and Researches in Crete* (1865) ii. 232 for Phalasarna. For an exhaustive discussion of this question of the rise of sea-level in the Mediterranean since ancient times, see now J. M. Cook, pp. 11 f., n. 13 above. Cf. Diolé, *Four Thousand Years Under the Sea* (translated by Gerard Hopkins, 1954), 283 f., Appendix A. Note that the (translated) excerpt referring to Phalasarna contains an important error of fact: the supposed ancient quays lie 18 feet *above* and not, as stated, *below* the modern sea-level.

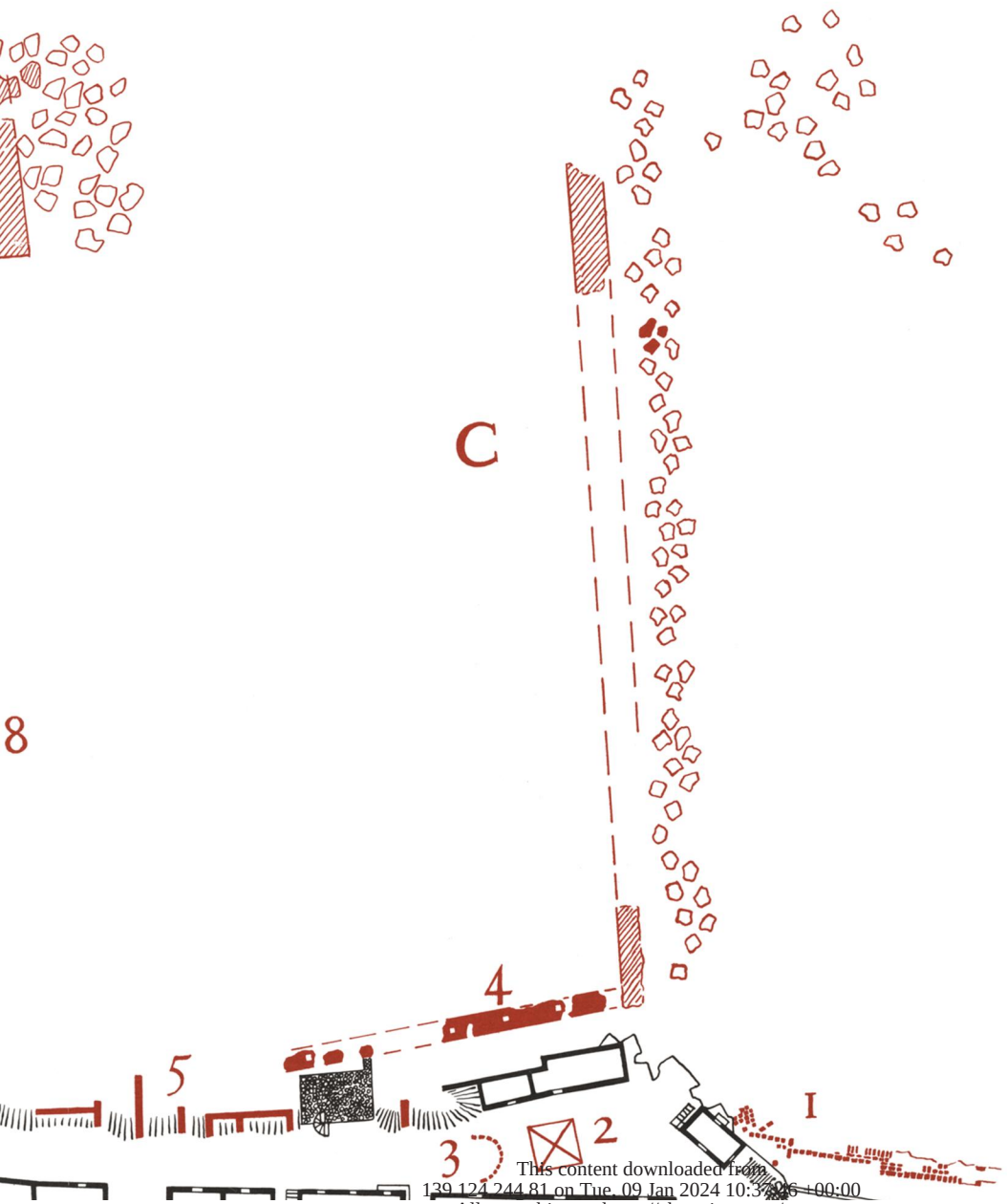
[12] Evans (*PM* i. 298) estimates 'a subsidence of quite two metres since Roman times' at Chersonisos; but this is clearly too much.

[13] See Kirsten, *RE* Suppl. vii. 84 f.; Guarducci, *Inscriptiones Creticae* i. 33 f.

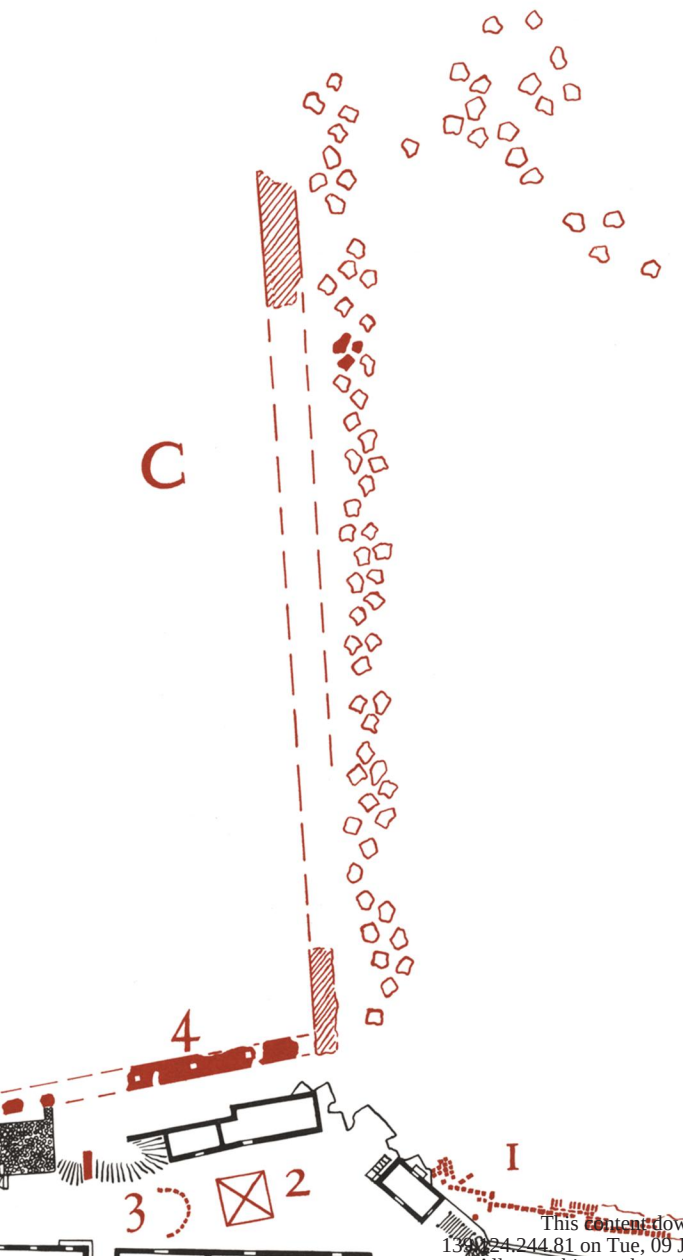


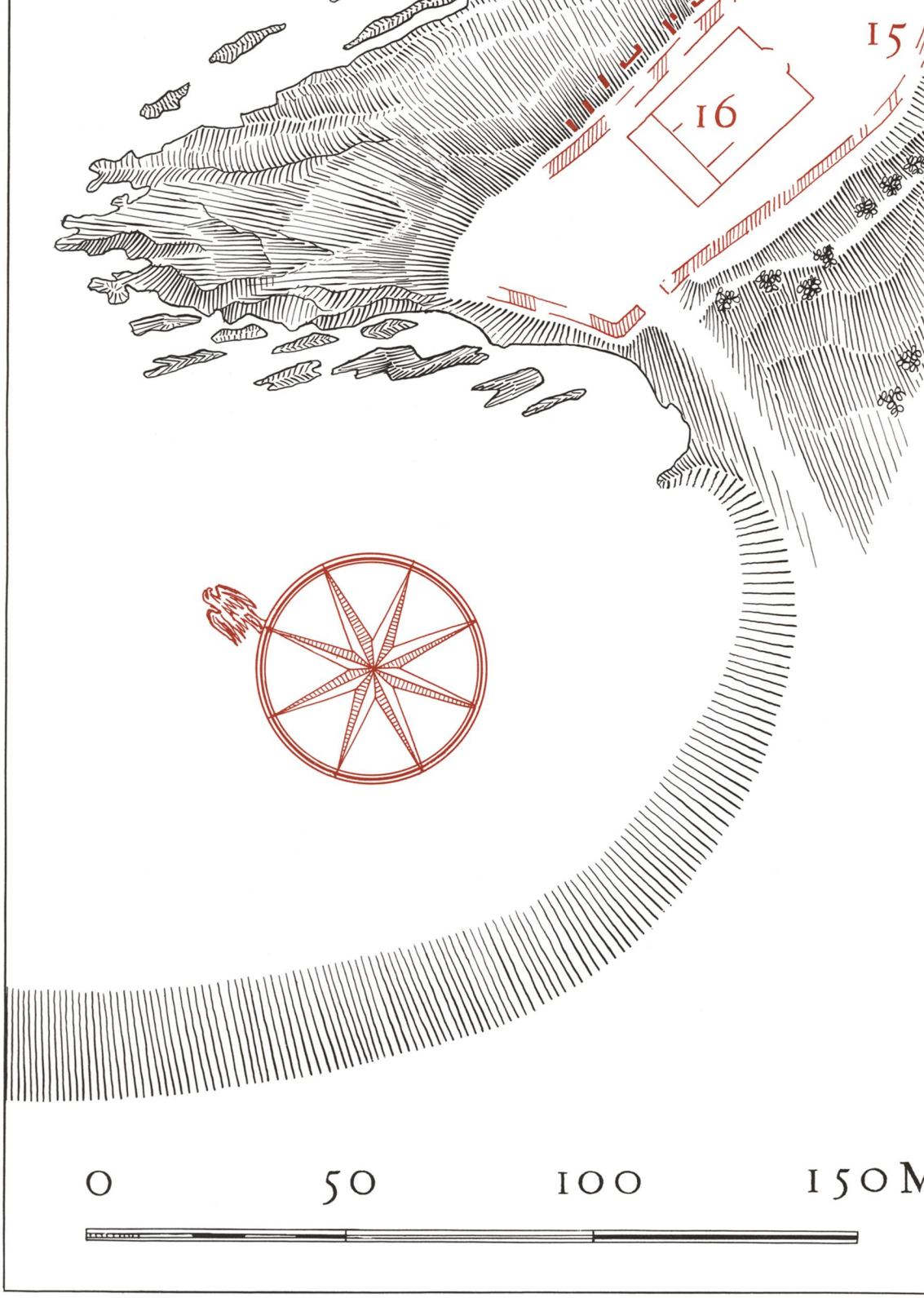


ΧΕΡΣΟΝΗΣΟΣ



ΙΕΡΣΟΝΗΣΟΣ





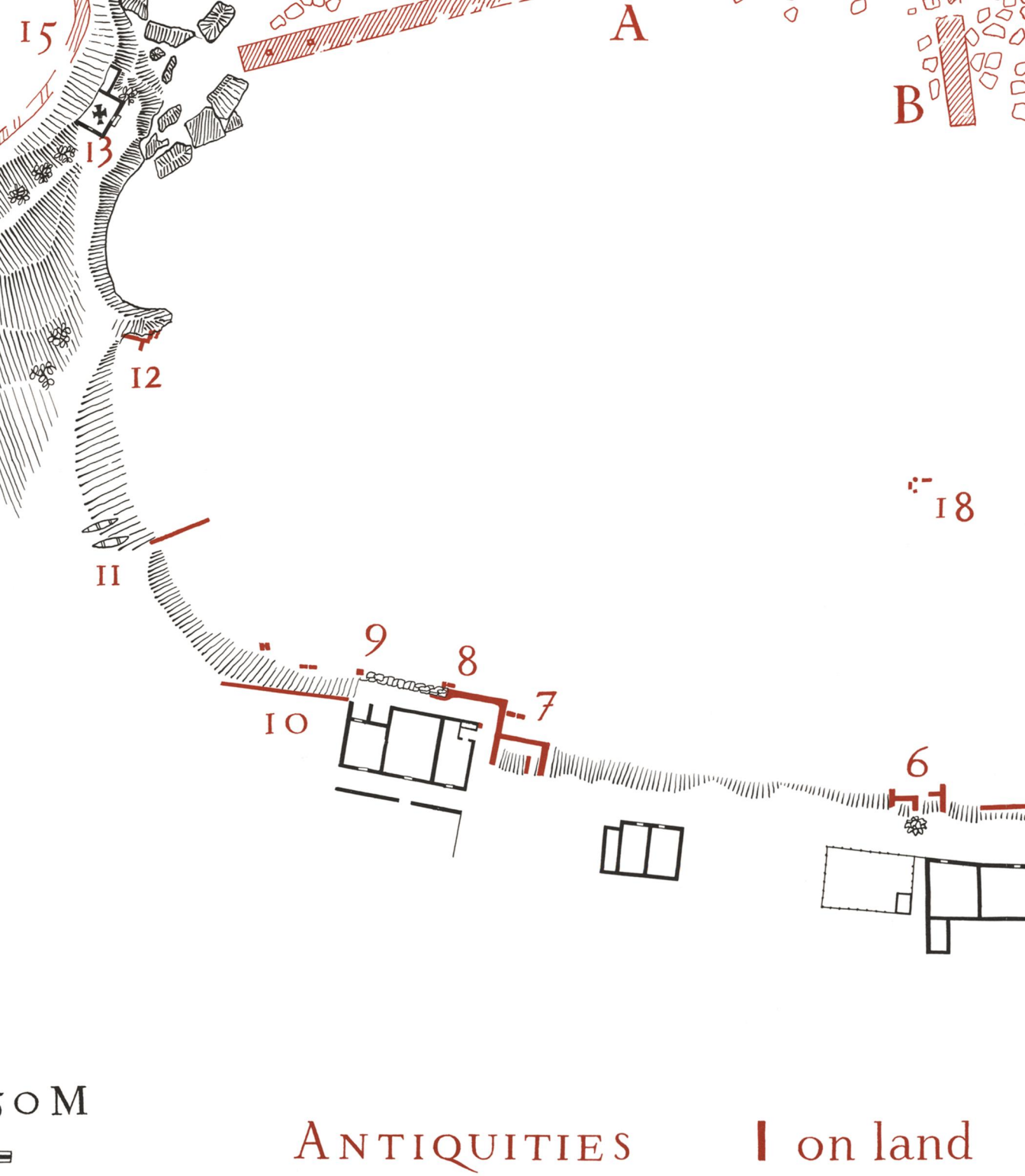
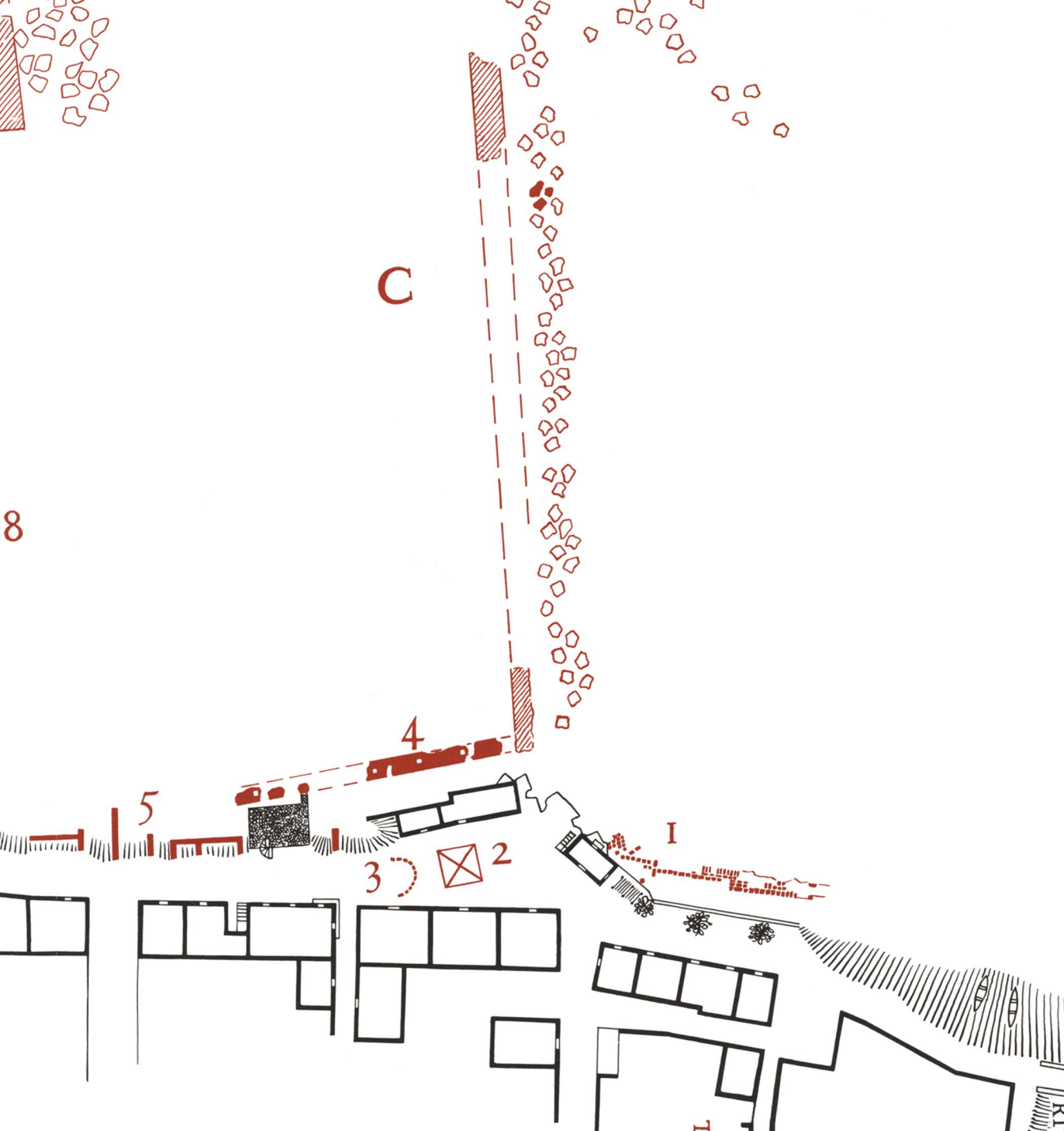
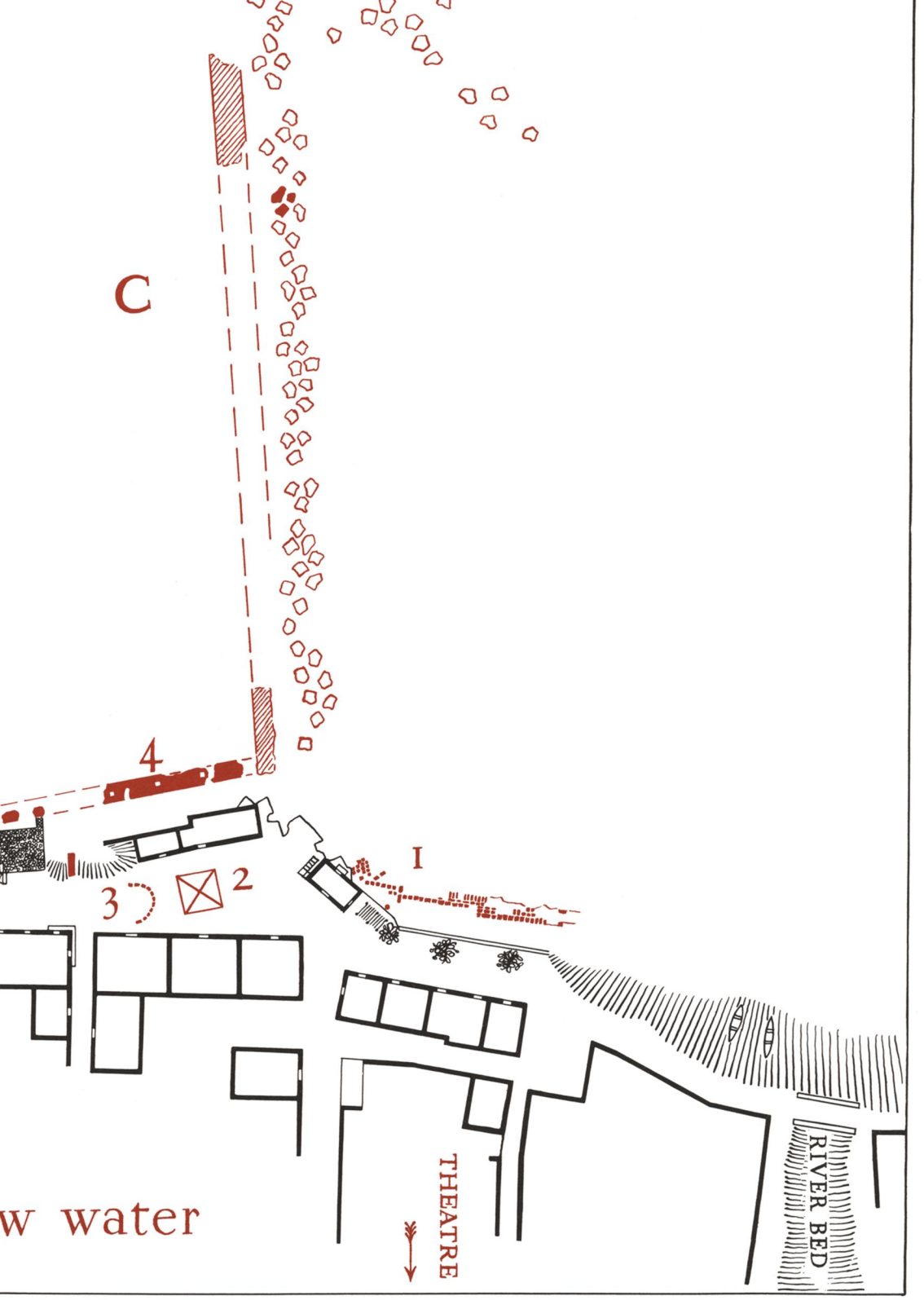


FIG. 2 SKETCH PLAN OF CHERSONISOS HARBOUR





and again recently by Orlandos.[14] The ruins of the Roman city, including a theatre, can be seen in the fields to the south and west of the headland. These ruins cover an extensive area, and together with the considerable harbour works suggest the importance and prosperity of Chersonisos as a sea-port town in Roman times, if not earlier.

(*a*) *Roman Harbour Works*[15]

The Roman harbour was bounded on the east and south by massive concrete moles (A, B, C) (PLATE 64*c*, *d*), making a roomy and well-sheltered anchorage roughly rectangular in shape, and measuring some 270 metres long and 150 metres across. The entrance, between moles B and C, was about 90 metres wide.

In fair weather vessels probably berthed alongside the series of moles (A, B, C), which offered between them (estimating A and B together as 175 metres, C as about 165 metres long) some 330 metres of wharfage inside the harbour. The west end of B can still be traced, but the seaward (eastern) extremity of C is not certain, as this stretch of mole has been virtually destroyed.

There were also quays built along parts at least of the harbour shore (see below, p. 268). But it seems as if much of the north end of the harbour by the promontory had always been left a sandy beach where boats could be drawn on shore as now.

The sea moles (A, B, C) are tolerably well preserved, and form an impressive monument of Roman harbour engineering. They are between 5·20 and 5·30 m. wide, built of concrete and rubble, with originally perhaps a facing of small squared blocks of stone, which only survive in places near the bottom of the parts of the moles exposed above the present sea bed.

The southern mole (C) has been much shattered, as has the strip between the northern stretches A and B. This strip appears to have turned at a more or less sharp angle, and not in a gentle curve, as far as it is possible to judge from the ruins that survive. There may have been a lighthouse here on the angle where the two stretches A and B met.

The original top surface of the moles only remains in a few places, notably at the north or shoreward end of A, and again to the south of the bend in A. At these points the top of the mole is just awash, more or less flush with the level of the sea today.

On both these parts of mole A can be seen the stumps of rectangular stone bollards, running in a line down the centre of the mole. The two of these preserved near the north shoreward end of the mole are 9 metres apart. But the three visible in the south section are at intervals of about 8 metres. The bollard nearest the shore at the north end of the mole measures 0·65 m. in length (from north to south) and 0·55 m. in width.

Along the inward face of mole A are what appear to be traces of vertical recesses, at regular intervals of about 6·80 m., alternately large and small and measuring between 1·0 and 1·50 in depth from the surface of the mole and between 0·60 and 0·80 in width. Such recesses might have housed wooden steps, or stone bollards or other mooring devices like iron rings; or else they could have held large timbers standing proud of the face of the mole to prevent ships from chafing their sides against it.

When they were built the moles probably stood to a height of about a metre, more or less, above the surface of the harbour: here at least, therefore, we have good evidence for a rise in the sea-level of about a metre since Roman times. The sea here cannot have risen much more than a metre, since, apart from the extra height that this would give the moles, the bottoms of

[14] *ADelt* 1918, Par. 31; Ἔργον τῆς Ἀρχ. Ἑτ. κατὰ τὸ 1956, 118 f. Chersonisos was once the see of a bishop, and the name of the nearby village of Episkopi continues the memory of this. See Guarducci, *Inscriptiones Creticae* i. 34, for references to bishops here in Early Christian times.

[15] See Lehmann-Hartleben, 'Die antiken Hafenanlagen des Mittelmeeres', *Klio*, Beiheft xiv (1923) 252. The harbour works are there ascribed to Roman Imperial times at the earliest. Vitruvius (v. 12) has an illuminating chapter on hydraulic construction in this age.

the Roman fish-tanks (p. 270) are only some 2·00 below the modern surface, and they must obviously have been at least half a metre, and probably a good deal more, below the level of the sea at the time they were excavated.

The harbour over most of its area is now fairly shallow, with a sandy bottom, and has certainly silted a good deal since ancient times. But in the entrance between moles B and C the water reaches a depth of 6 metres. Outside the harbour on the south side of mole C the water is today between a metre and 2 metres deep, with a steep drop into what appears to be the submerged continuation of the stream bed on the south edge of the ancient city (south-west corner of Plan, FIG. 2).

A flat stone measuring about 0·60 × 0·40, with a hole pierced through its centre, was seen lying in deep water at the foot of this steep bank, and may be an ancient anchor.[16] A similar pierced stone was also noted at Ayioi Theodhoroi.

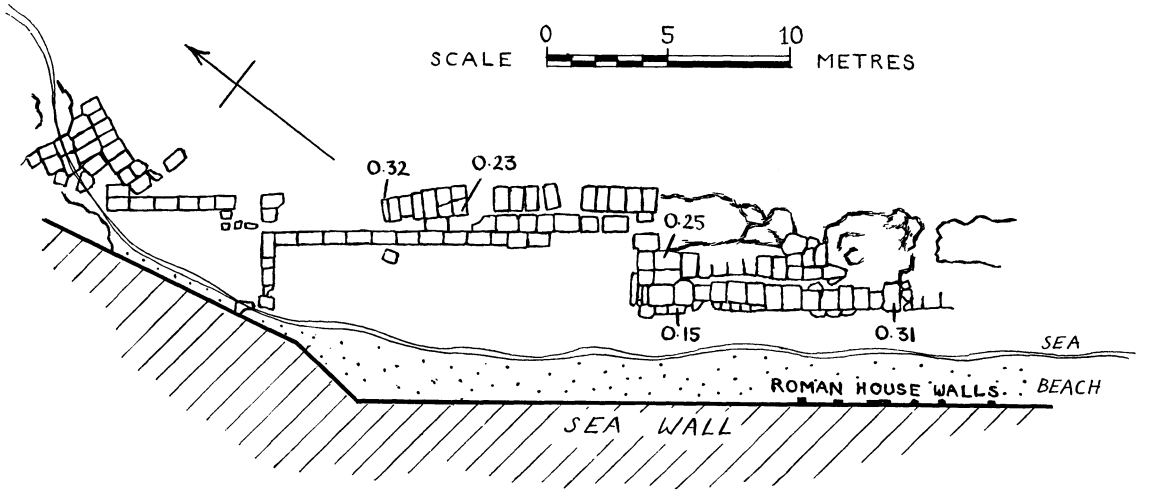


FIG. 3. AREA OF SQUARED BLOCKS AT 1 ON PLAN, FIG. 2
(Figures give depths of tops of blocks below modern sea-level.)

(*b*) *Quays and other remains of the Roman Period along the Shore on the west side of the Harbour*

What seems to be a stretch of quay is preserved in the south-west corner of the harbour and is traceable running for a distance of about 60 metres or more northwards from what may be the beginning of mole C (4 on Plan, FIG. 2). This quay is constructed of concrete like the moles, and it is about 2·70 across at its widest point, standing to a maximum height of over 0·65 above the modern sea-level. That is to say, its top was a good half metre or more higher above the harbour level than the tops of the moles.

Only the southern 30 metres of the quay now survive above sea-level. This stretch is in two sections, of which the longer (northern) part has a line of three rectangular bollards near the east or seaward edge, the bollards being about 0·50 long (from north to south) and 0·45 wide, with intervals of 8·30 and 8·55 m. between them. The shorter (southern) section of quay surviving above sea-level is separated by a gap of 2·20 m. from what appears to be the beginning of mole C.

This last consists of a stretch of concrete running for *c.* 15 metres eastwards, with the top just awash like the tops of the other moles. But only a width of 2·60 is now visible, whereas the other

[16] Diolé, *Four Thousand Years Under the Sea* 298, Appendix C.

moles are *c.* 5·30 wide; it may originally have had a greater width, and the remaining part may have been destroyed, or the top of it destroyed and the rest buried in sand. At its eastern end this possible section of mole terminates abruptly, but in a rough face; the water where it ends is only 1·80 deep, with a sandy bottom which may hide traces of a continuation. What is visible certainly seems to run more or less in line with the surviving section of mole C, which begins about 100 metres to the east.

Another series of walls, evidently Roman, projects into the harbour farther to the north (7–9 on Plan). At 7 is a brick wall; while at 8 beyond it a stretch of concrete walling, which rises to a maximum height of 0·75 above present sea-level, might be remains of a quay like that at 4. But this complex is more likely perhaps to be part of the ruins of a large sea-side villa.

To some great villa presumably belongs the interesting mosaic-adorned fountain (2 on Plan).[17] The four sides of the low pyramid, from the centre of which the water flowed, are appropriately adorned with pictures of sea-fishing and boating. An apse (3 on Plan) visible in the surface of the modern road just to the north of the fountain, and walls of brick and concrete exposed in the high bank forming the west boundary to the beach beyond it as far as 5 and 6 on the Plan, may also belong to this or to some other large house extending to the water's edge.

At 11 at the north end of the harbour, where the beach curves round to the east, a solitary stretch of concrete wall 0·60 wide is visible running from the bank at the edge of the beach into the sea, and can be followed for a distance of over 10 metres from the shore. It may be the remains of a small Roman pier or jetty, or simply a garden wall, seeing that the sea-level has risen as much as a metre here since Roman times.

(*c*) *Breakwaters*

Outside the moles, on the east of A and the south of B and C, run breakwaters of huge rough boulders. The tops of these breakwaters are now submerged, except for a short stretch opposite the bend in mole A and an isolated piece south of C, which rise above the modern sea level. The line of the breakwater outside mole A is particularly easy to trace. It does not run exactly parallel to the mole, and opposite the midway stretch of the mole there is quite a space between mole and breakwater. It is therefore not impossible that the breakwater belongs in fact to an earlier period than the moles. Chersonisos was certainly an important harbour long before the Roman period, and at one or two points along the shore indications of what may be harbour works of earlier times can be observed.

(*d*) *Earlier Harbour Works*

These possible traces of earlier harbour works consist of structures built of carefully squared blocks fitted together without cement, which may be remains of quays of Hellenistic or earlier Classical times.

The most extensive of these remains are to be seen in shallow water by the shore just outside the south limits of the Roman harbour, between it and the stream bed (1 on Plan, FIG. 2 and FIG. 3). The tops of large blocks, measuring over a metre long and half a metre wide, are, or were in the summer of 1955, exposed here for a distance of some 40 metres just below the surface at the edge of the shore. These may be relics, perhaps the top or pavement, of an early sea-wall or quay at this point.

Blocks of the same size and character, with their tops just above or below the present sea-level, can be detected at various points in the area of 7–9 on the Plan near the north end of the harbour. There are two blocks in a line running north–south with their tops 0·30 below

[17] See Xanthoudides, *ADelt* 1918, Par. 31.

sea-level to the east of the Roman brick wall at 7. In the sea immediately in front of the Roman concrete wall at 8, just to the north of these, are more squared blocks at the same depth (0·30) below the surface.

Farther north still, about 10 metres beyond the end of 9, two blocks were visible in the autumn of 1956 in the sea with their tops 0·20 below the surface; and about 10 metres north of these again was another pair of blocks, not quite in the same alignment, exposed on the shore. The wall 10, which runs on more or less the same line as these last in the bank that bounds the shore to the west, is also built of squared blocks, but is presumably Roman or Byzantine, as the joints are filled with cement.

At the extreme north end of the harbour at 12, where a low spur of rock projects into the sea, are remains of a structure built of fine dressed masonry, the blocks having bevelled edges (PLATE 64*b*). At the north end a wall, of which two courses are visible, is built up against the cliff face, and the structure appears in fact to be a terrace wall in front of the cliff here. On the south the upper courses have disappeared, and only the tops of two lower courses are visible, awash or (the course beneath) 0·30 below the present sea-level. Two blocks running in a line on the west of the structure may be fallen or part of a later addition. Whether this structure had any connexion with early harbour works at this point is not certain.

(*e*) *The Fish-tanks* (14 on Plan, FIG. 2, and FIGS. 4, 4*a*)

On the north-east side of the promontory round the corner from the harbour there is instead of a beach a wide, flat shelf of bare rock which slopes down under the present sea-level.

Cut into the submerged part of this shelf at its east end, where it stops in a low underwater cliff, there are three rectangular compartments, set in a row, running north-east to south-west, with their floors between 1·95 and 2·20 below the water. That nearest the shore (A) is the largest, and measures about 4×3 metres; the smallest (B), in the middle between the other two, is only $2 \times 1{\cdot}25$ metres across.

These compartments are evidently fish-tanks of the Roman period, designed to be fed in their original state by a constant flow of sea water, coming and going through an elaborate series of channels which were between 0·50 and 1·0 wide. The large compartment A has two channels leading into it, one at each end of the seaward corners. The smallest (B, in the centre) has a single channel running into it from the sea, but another channel opposite on the west side must have somehow served as an outflow to carry away the water as the waves washed in through the first channel. The outlying compartment C appears to have had no less than three channels, one on the east, another opposite on the west like the centre compartment B, and a third cut through the high reef of rock which protected the tanks from the north for a distance of some 10 metres to the open sea on that side. This northern channel, at least over part of its length, appears to have been a tunnel, to judge from the spring of the arching roof, of which some trace survives.

The sides of the tanks were evidently raised above the natural surface of the rock in which they were cut by artificial walling. A fragment of this walling is preserved, with a bonding course of triangular tiles set in cement, on the boundary dividing B from C. There is a large shapeless mass of concreted masonry, apparently in position, at D just to the west of the outer tank C, and further traces of concrete are visible on what appears to be the north edge of the tank complex, where the rock rises sharply and makes an angle at E on the Plan.

The whole complex may have been roofed, and would then have appeared something like a modern boathouse by the water's edge; but there was nothing to suggest a roof beyond these remains of concrete walls.

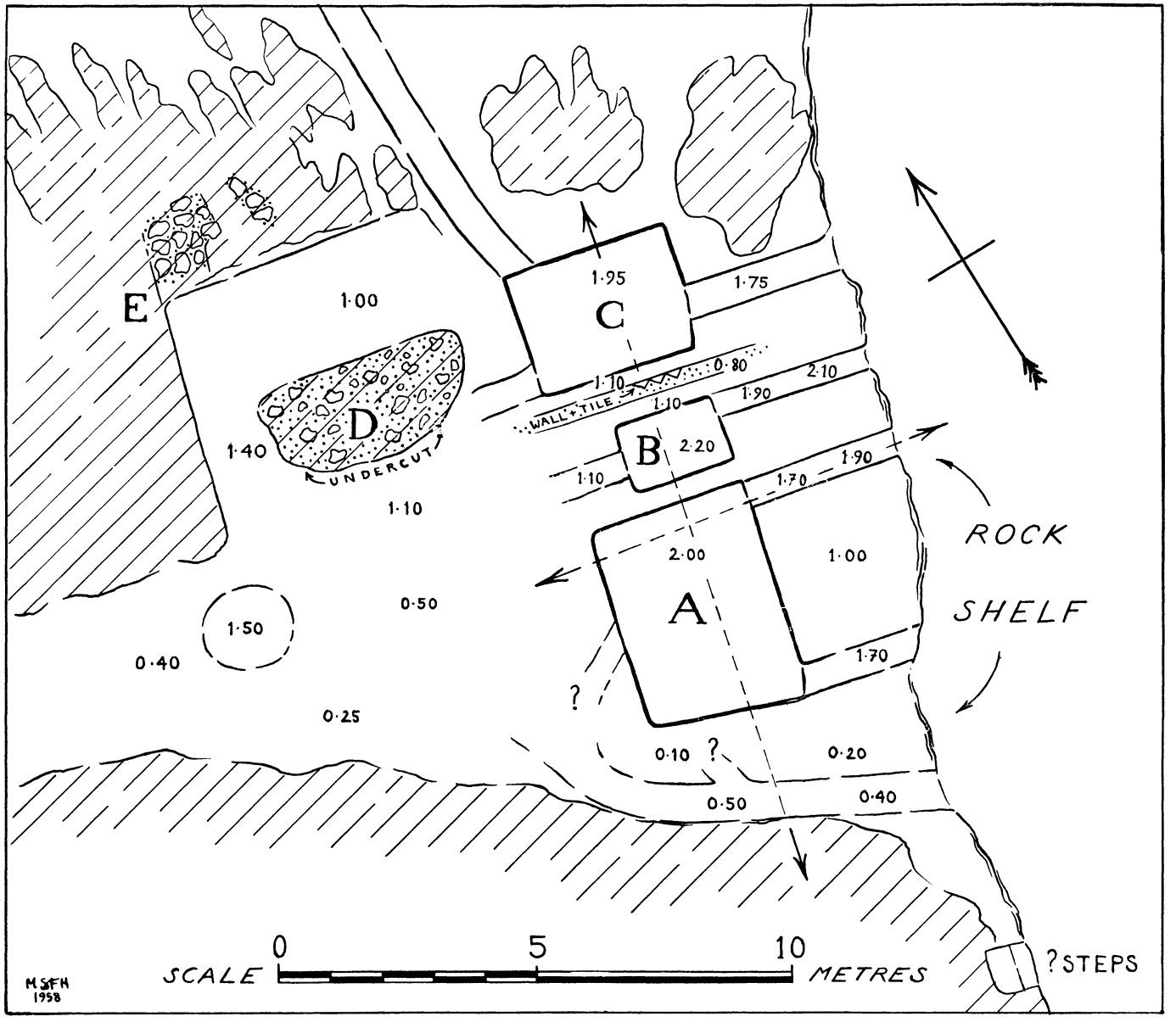


FIG. 4. FISH TANKS CUT IN THE ROCK AT 14 ON PLAN, FIG. 2
(Figures give depth below modern sea-level. Parts above sea-level today shaded)

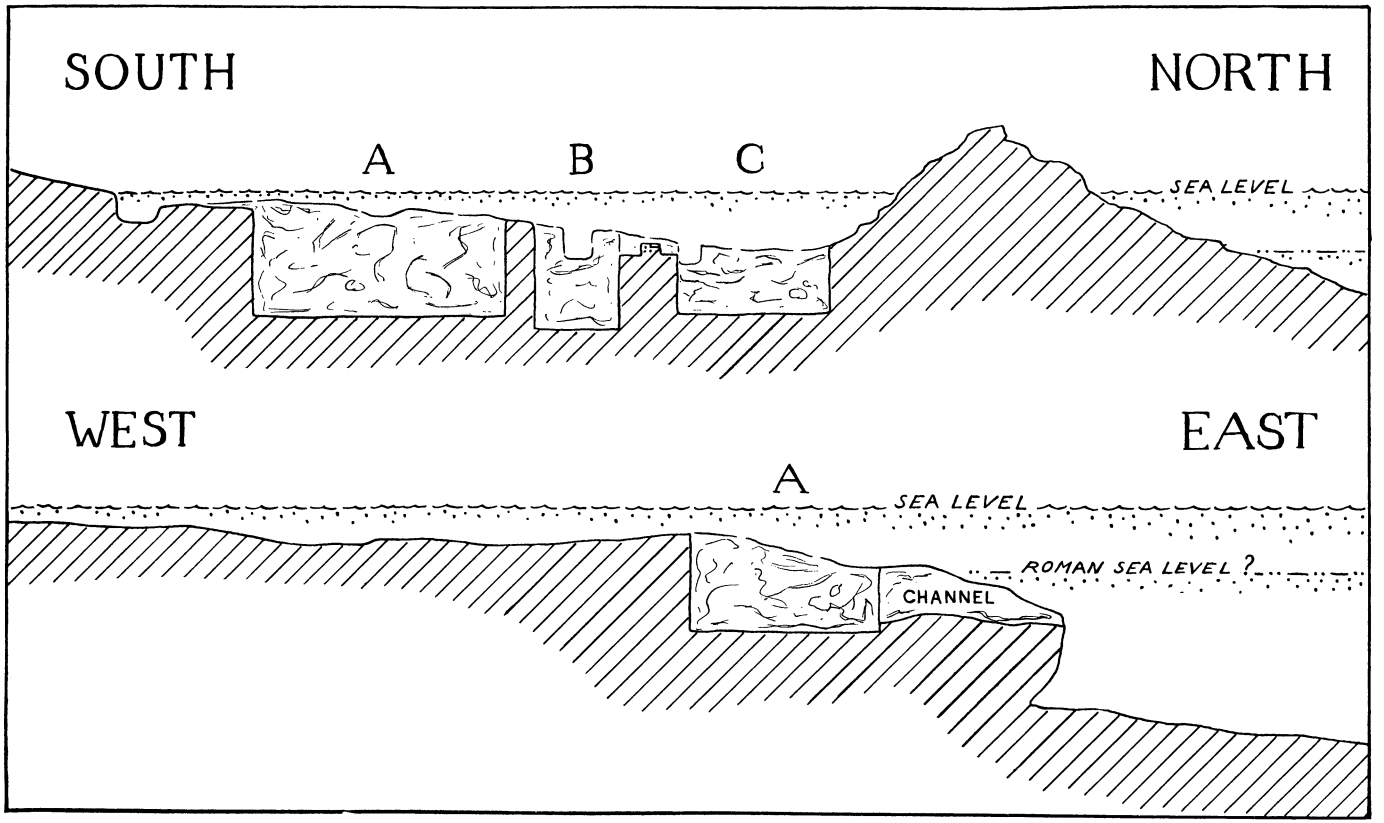


FIG. 4*a*. SECTIONS THROUGH FISH TANKS

Over the sea bottom to the west of the headland, and to a lesser extent to the north and inside the harbour, are scattered many fragments of amphorae (FIG. 9, 1–4), but nowhere in such quantity as to indicate a wreck. For the most part these fragments are concreted together or form a mass with the rocks on which they lie. There are also some rectangular blocks, which may come from the Roman defence wall (15 on Plan) on the headland, since blocks of the same type are seen in a stretch of what appears to be part of this wall a few metres north of the path-way leading to the entrance in the south-west corner.

Fragments of a column and two stone blocks in 3 metres of water off the reef projecting from the north-west point of the headland may possibly come from 16, the early Christian basilica church. The column, which is unfluted with a diameter of about 0·55 m., is exposed for a length of 1·20 above the sea bed. Other architectural fragments, including a short length of column of small diameter and some dressed stones, in 7–8 metres depth of water about 30 metres east of the rock shelf with the fish-tanks, may also have come from the basilica church or from other buildings on the headland.

MOCHLOS

The island of Mochlos, with an important Early Minoan settlement and cemetery,[18] lies just outside the eastern approaches to the Gulf of Mirabello on the north coast of Crete. In the Bronze Age, when the sea-level was certainly lower, the island appears to have been joined to the mainland by an isthmus, making it a promontory with a harbour on each side.[19] The island now lies about 150 metres distant from the nearest point on the mainland (PLATE 64*f*), and there is 1–2 metres depth of water over the ridge of the now submerged isthmus, which can be traced extending in a curve with its concave face open to the north-west. The isthmus before subsidence was probably shaped much as the submerged ridge is today, with the sides falling away fairly steeply from a flat top. Rough seas often run in either direction over these shallows of rock and weed, strong currents flowing in the vicinity during stormy weather.

The Minoan settlement was situated on the southern, that is the lee or landward, side of the promontory as it then was. A narrow stepped pathway descends alongside the outer wall of a large ruin built of dressed stones lying about 15 metres from the shore, obliquely to the lower slopes of the settlement, and then disappears among boulders lapped by the sea. Originally the steps may have continued over these boulders and led on to the north end of the isthmus.

In a depth of 1½–2 metres, about 50 metres south of the island, close to the sunken isthmus and in the angle formed by the north end of it and the island shore to the west, are traces of what seems to be ancient walling built with uncemented rough stones, which may be remains of dwellings, or else part of a Minoan retaining wall for the isthmus. A small goblet of Early Minoan type (FIG. 10, 5) was recovered from 5 metres of water in this area.

Farther west from this point what might appear to be the face of a wall built with concrete can be seen running in a direction parallel to the island shore and 12–15 metres distant out from it. But heavy marine growth here makes it difficult to distinguish for certain whether this 'wall' may not in fact be a natural formation. It might, if it is artificial, be part of a sea wall, and, if concrete, must date from the Roman or Byzantine period, when there was an extensive town here covering the island and stretching eastwards on the mainland opposite. Then or later in Byzantine times the island was defended with fortifications like the headland at Chersonisos. At a depth of something less than 2 metres this 'wall' has a deep undercutting which

[18] Seager, *AJA* xiii (1909), 273 f.; *Excavations in the Island of Mochlos* (1912).

[19] Pendlebury, *Archaeology of Crete* 3.

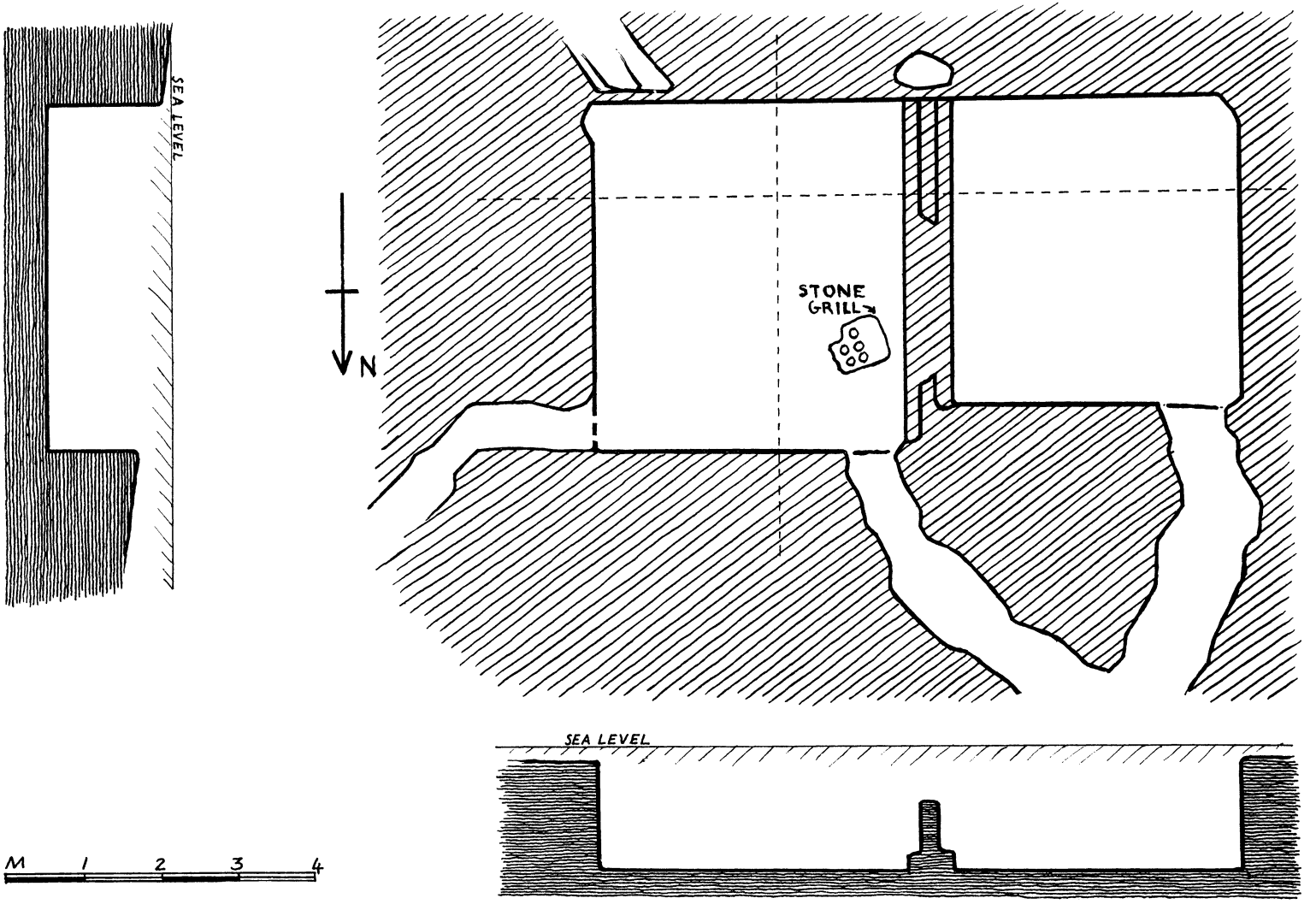


FIG. 5. FISH TANKS CUT IN THE ROCK AT MOCHLOS

penetrates about 0·80 m. No trace of submerged buildings was found east of the sunken isthmus, although the remains of the Minoan settlement cover the slopes of the island in this area.

It was thought that the deep waters immediately below the cliffs with the Minoan necropolis at the western edge of the island might produce objects fallen from the tombs above. But it was impossible to make a thorough exploration with aqualungs here, or indeed anywhere at Mochlos, owing to the very fresh wind and heavy seas. A more cursory examination with schnorkel equipment of the water encircling the island failed to reveal anything of note.

Fish-tanks (FIG. 5, PLATE 64*e*)

The mainland shore east of the present-day hamlet of Mochlos is composed chiefly of low cliffs intersected by small ravines. Shelves of rock extend from the base of the cliffs into the sea. They feature occasional submerged natural channels, perhaps the courses of winter torrents cut through the rock before subsidence.

About 70 metres along this shore to the east, and only a few metres from the water's edge, lie two submerged rectangular compartments, the one slightly larger than the other, cut in a flat shelf of rock and resembling those at Chersonisos (p. 270). These compartments like those at Chersonisos are evidently fish-tanks of the Roman period. The compartments were divided by a wall of rock, of which the upper part, now largely missing, was considerably thinner than the lower. Three rock-cut channels lead from the compartments seawards.

In the lower compartment, close to where one of the channels enters it, was found a broken stone slab (L. 0·49, W. 0·42) pierced with several holes (PLATE 63*a*). This stone could fit in an upright position across the mouth of the channel, and it would seem likely to have been a grate or filter, to prevent the fish from escaping, while permitting a flow of water between the tank and the sea. The other channels were no doubt separated from the sea outside by similar filters.

The floors of the pools lie about 1·50 m. below the modern sea-level. The seaward edge of the compartments now stands only 1·10 m. above the floors; and, even allowing for the fact that the edge may have suffered some erosion in the course of centuries, the tanks are unlikely to have contained more than a metre's depth of water. As the sea rises and falls according to the prevailing wind, the waters in the pool must have come as high as the top of the rock on the seaward edge, or even overflowed it at times. The sides of the compartments may therefore have been raised by walling, as seemed to be the case at Chersonisos. But no trace of this was observed.

A cavity, which appears to be artificially cut in the rock at the shore end of the partition wall between the compartments, would give a man come to net fish for the table a secure foothold, and enable him to work his landing-net in either pool; or alternatively, it might have served as a place into which he emptied the fish out of his net.

Some 20 paces along the shore east of the fish-tanks and near the sea's edge is a hole about 1·20 m. in diameter. The vertical sides of the hole are only visible to a depth of 0·30 m., since earth and pebbles have filled it to this level. It may be a scour hole similar to many observed at Chersonisos.

PSEIRA (FIGS. 6, 7)

The island of Pseira is situated in the eastern part of the Gulf of Mirabello, about 1·5 nautical miles from the nearest point of the north coast of Crete and about 2 miles west of Mochlos. 'The eastern coast line is indented by three sandy coves separated from one another by tongues of land, the central one of which juts out into the sea for some 200 yards. On the top and sides of this narrow point and on the adjoining hillside to the south once lay a flourishing Minoan

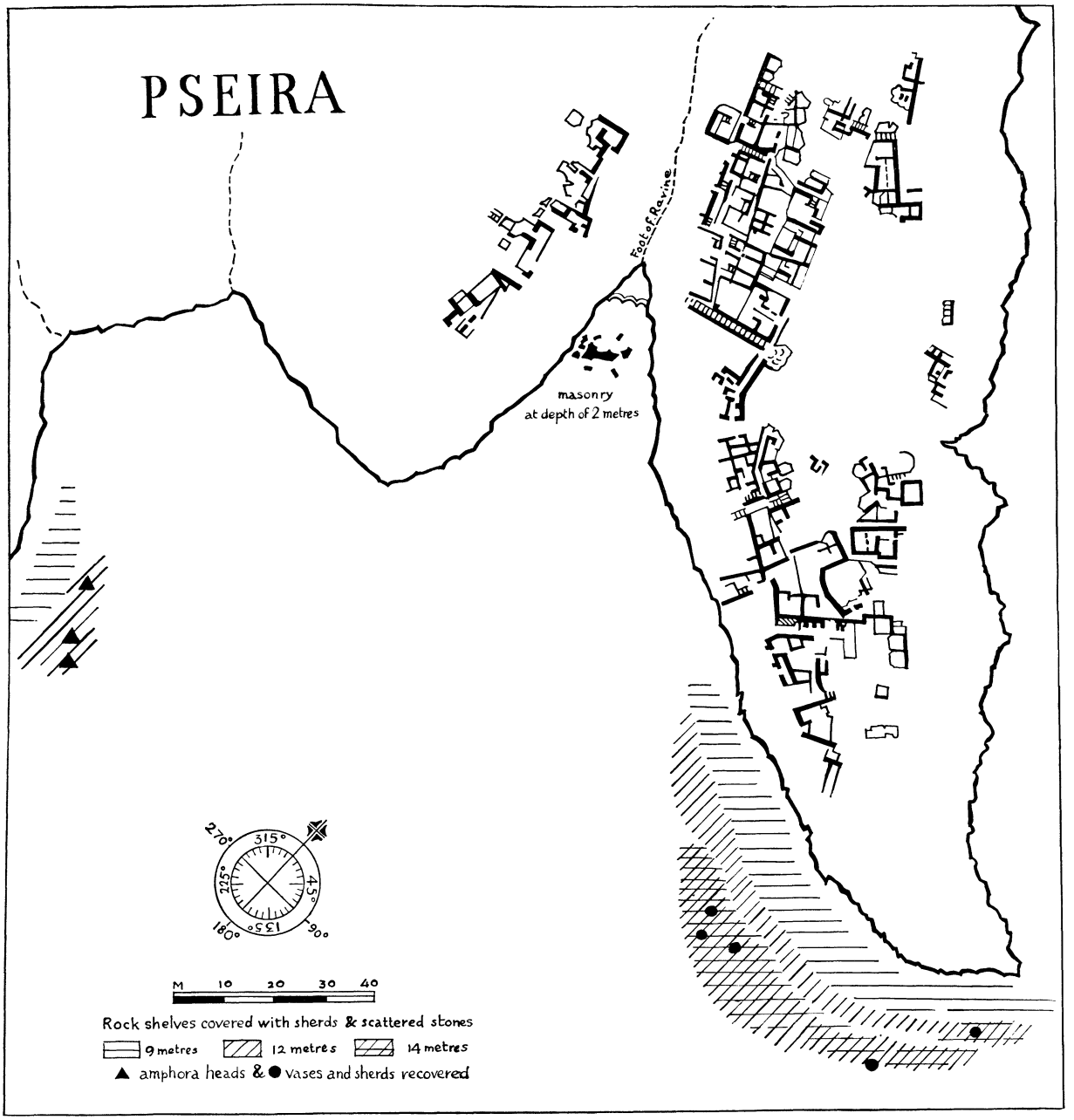


FIG. 6. PSEIRA HARBOUR

settlement which evidently owed its existence to the excellent harbourage for small craft offered by the sheltered cove on the south side of the point. It is exposed solely to the east, and an easterly gale is a thing of rare occurrence in Cretan waters.'[20]

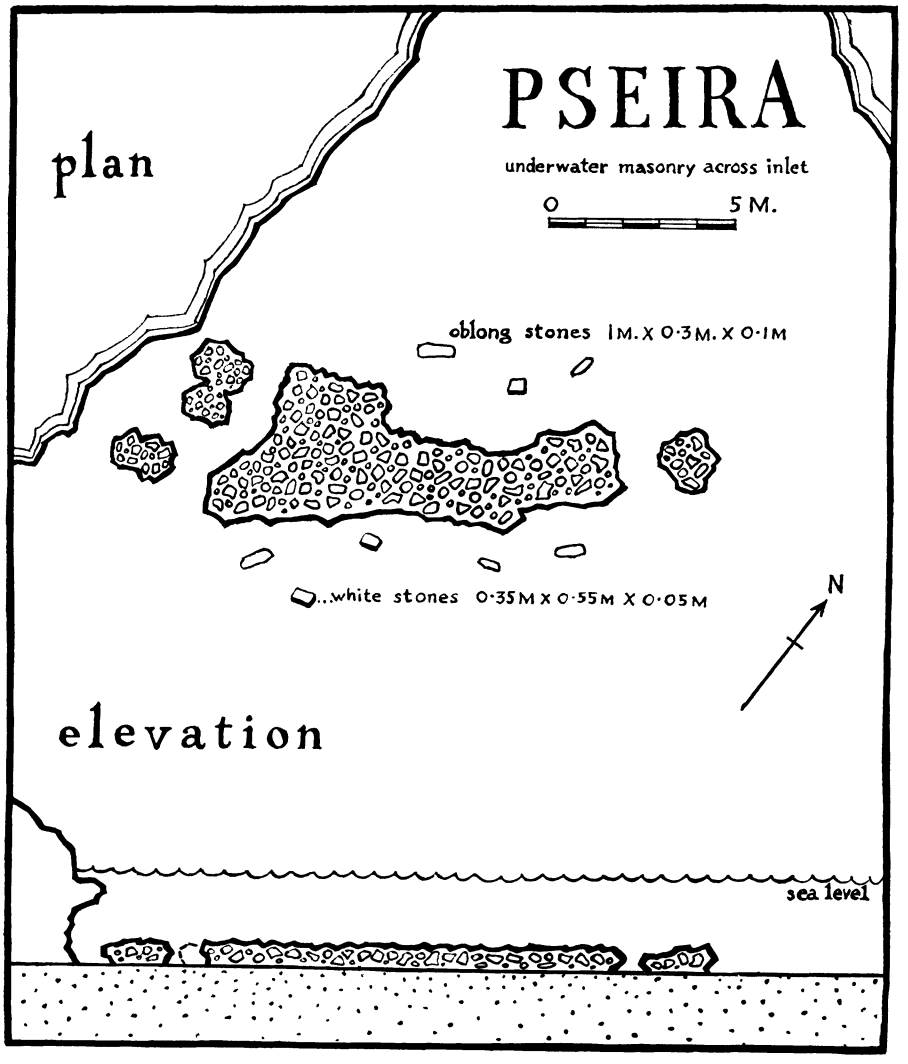


FIG. 7. ROMAN MOLE IN PSEIRA HARBOUR

The settlement was also occupied in Roman times: 'On the topmost ridge of the island lie the remains of a Roman military camp, probably a beacon station.' Furthermore, Roman remains were discovered in the course of excavations in the vicinity of the cove, 'showing that this cove was occupied in the same manner and at the same periods as the town site itself'.[21]

Irregular blocks of concrete masonry, presumably remains of a Roman water front, were found lying at a depth of 1·50–2 m. across the head of the cove (FIG. 7). The largest section is

[20] Seager, *Excavations in the Island of Pseira* (1910) 6. [21] Ibid. 7.

about 7·50 m. long; this and other parts of the structure only project 0·50 above the sea bed. The whole is considerably pitted by erosion, and no straight edge can be seen. However, it may be conjectured that before subsidence the mole stretched right across the cove and presented a front some 15 metres long to the sea.

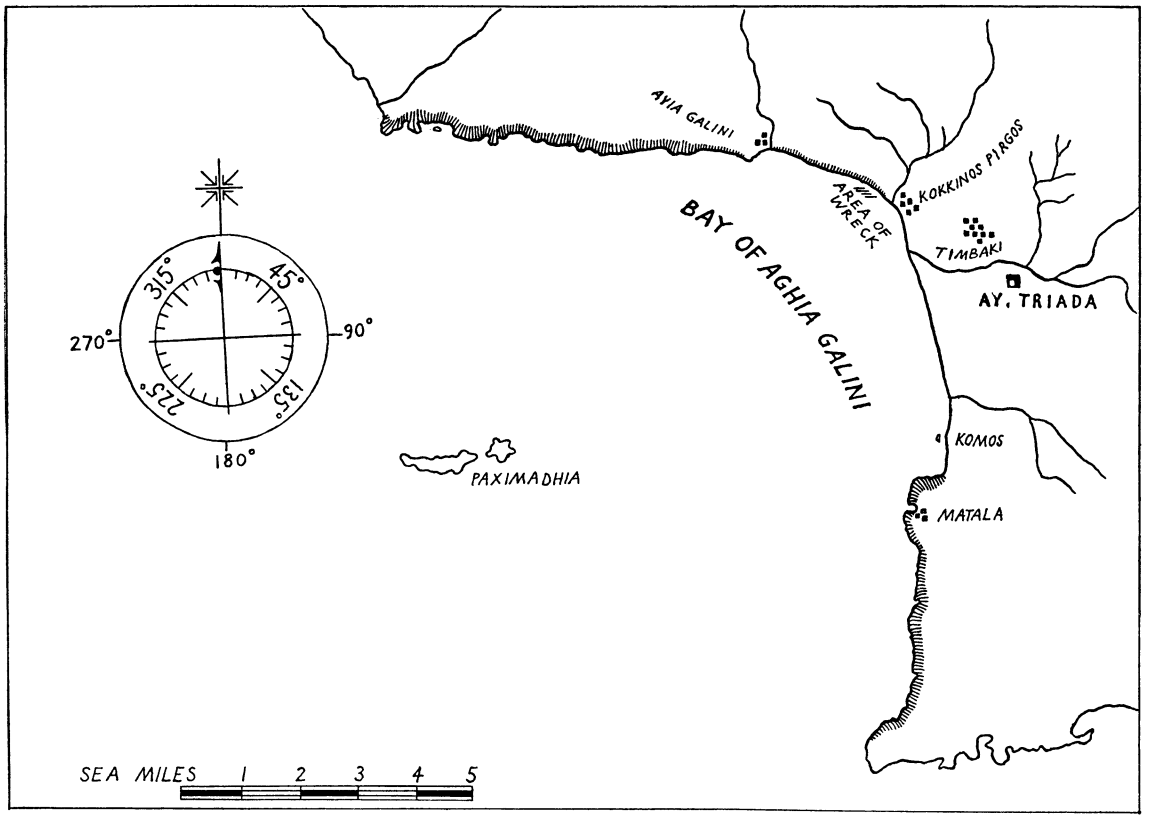


Fig. 8. Bay of Ayia Galini

Several Minoan vases, complete or nearly complete, which had evidently fallen into the sea from the settlement on the slopes above, were found lying in 10–12 metres of water some distance from the shore. Others were recovered from about 14 to 15 metres depth off the east point of the main settlement, among remains of fallen masonry and heavy deposits of concreted sherds (fig. 10, 6–11, plate 65*b*, *c*).

Ayia Galini (fig. 8)

The bay of Ayia Galini lies in the north-east corner of the Messara Gulf on the south coast of Crete. The shore of the bay, between Kokkinos Pirgos in the east and the small harbour of Ayia Galini (or Eremopoli, ancient Sulia) on the west, is bounded by high cliffs overlooking a narrow beach.

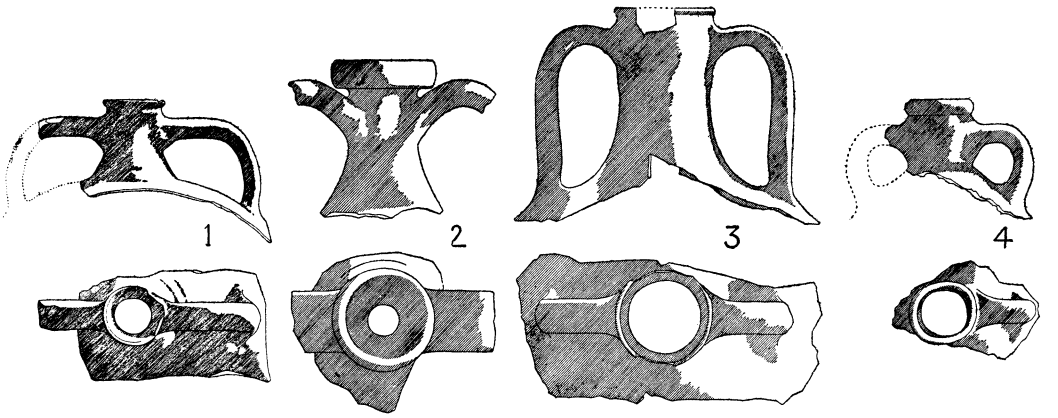


Fig. 9. Amphora necks from Chersonisos (scale 1:4)

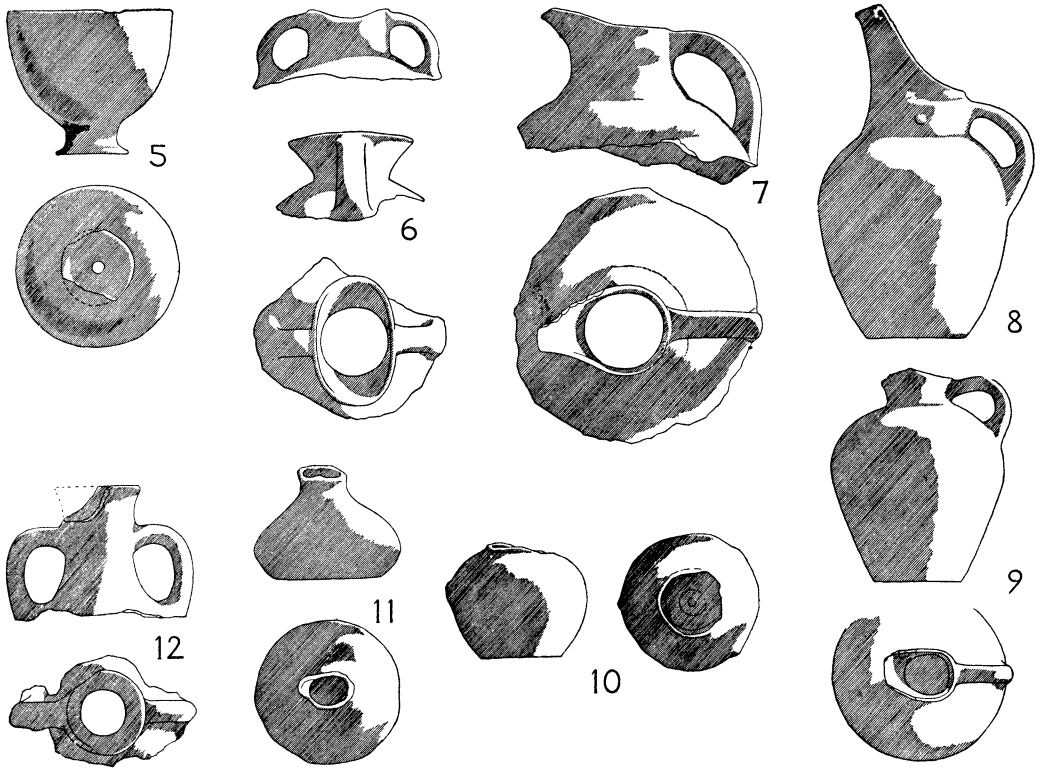


Fig. 10. Vases from Mochlos (5), Pseira (6–11), and Ayia Galini (12) (scale 1:4)

It was in this area that a fisherman of Ayia Galini, Mikhaili Variatakis, in April 1937 discovered the remains of an ancient wreck.[22] Fragments of bronze statuary, bronze figurines, and other bronze objects, together with some pieces of lead, were recovered.

The bronzes were evidently part of the cargo of a ship which ran ashore on this stormbound coast, and a legend recounted by the oldest inhabitants of Ayia Galini says that a pirate vessel which had looted antiquities from Gortyna and Phaistos was once wrecked somewhere here. The finds apparently belong to both the Hellenistic and the Roman periods. Professor Marinatos has therefore suggested that such a cargo might be the stock-in-trade of an itinerant bronze founder or metal merchant of Roman times.[23]

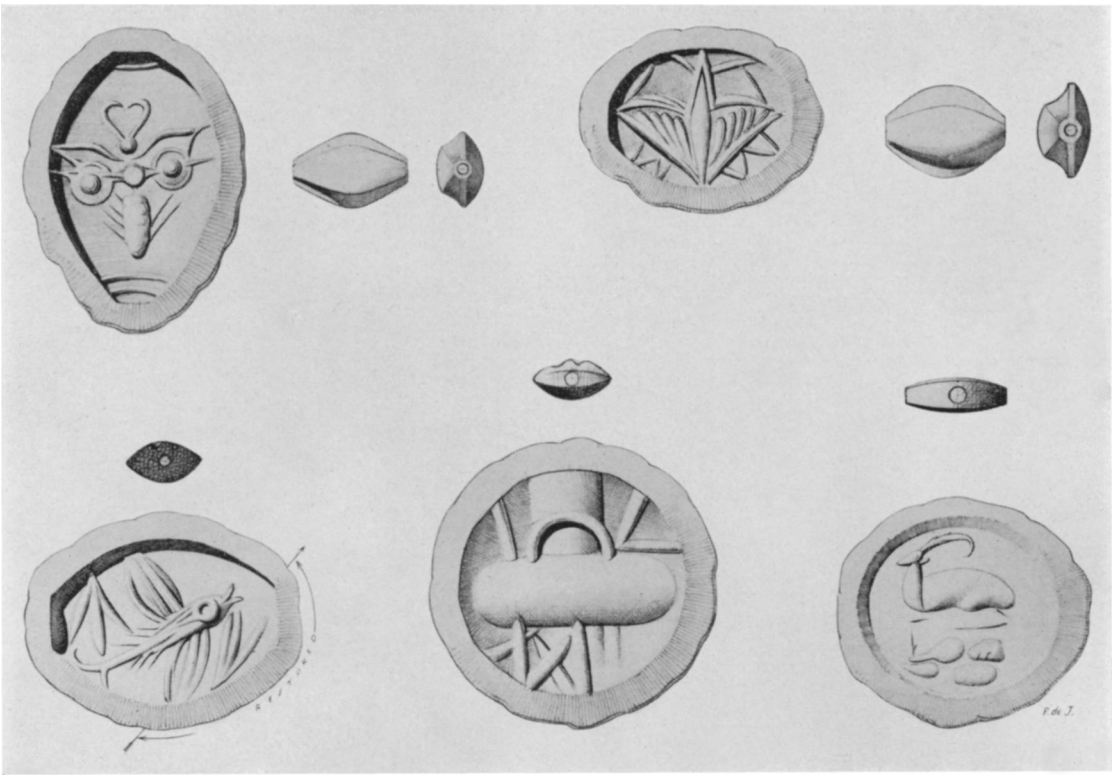
At the invitation of Dr. Platon an attempt was made to rediscover the wreck. Variatakis was engaged to guide the party to the scene of his finds, about 150 metres off the mouth of the easternmost ravine (known locally as Kakoskala) between Kokkinos Pirgos and Ayia Galini. The sea bed here lies at a depth of about 5 metres; low shelves of rock, some overhanging, crop up from the sandy bottom, and weed grows in dense patches.

From the area which Variatakis indicated were recovered some fragments of pottery of Roman date (FIG. 10, 12) and a strip of thin lead sheeting (L. 0·40, W. 0·145), such as might have sheathed the planks of a ship's underside (PLATE 65*d*). This lead sheeting is perforated by a number of small round holes, which may have been made by the nails fastening it to the hull.

No further evidence of a sunken ship or its cargo came to light, probably because at this time of the year, in August, any remains would be overlaid with silt and sand. The wreck was first discovered in April, a season when the ravines are often filled with torrents carrying the melted snows from the mountains; at such a time silt and sand lying on the sea bed close in-shore are likely to be swept into deeper water by the currents flowing at points where swift torrents debouch into the sea. Variatakis recollects that it was snowing, but the torrents were dry, when he made his discovery. Early spring would therefore seem to be the more promising season in which to make an attempt to locate the wreck and its cargo.

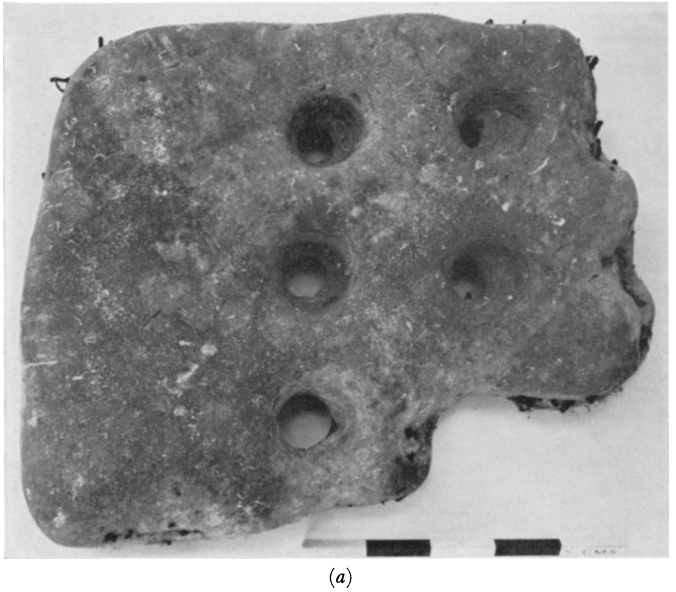
JOHN LEATHAM
SINCLAIR HOOD

[22] For an account of the discovery and finds, see *AE* 1948–9, Ἀρχ. Χρον. 1–6. Cf. Ἐπετήρις Ἑτ. Κρητικῶν Σπουδῶν 1 (1938) 610–11, 2 (1939) 529.
[23] *AA* 1937, 229–34.



A MINOAN CEMETERY ON UPPER GYPSADES

SEALSTONES AND IMPRESSIONS. *Upper row* (*L. to R*) II. **4** (2½:1, 1:1), II. **5** (1½:1, 1:1). *Lower row* (*L. to R.*) VII. **21** (3:1, 1:1), VII. **20** (3:1, 1:1), XVIII. **5** (2:1, 1:1).



(*a*)

(*b*)

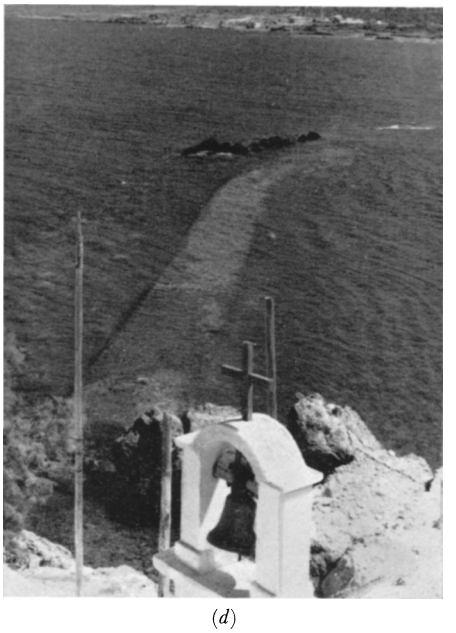
SUB-MARINE EXPLORATION IN CRETE, 1955

(*a*) STONE GRILL FROM FISH TANKS AT MOCHLOS. (*b*) VASE FROM MOCHLOS (5 on FIG. 10)

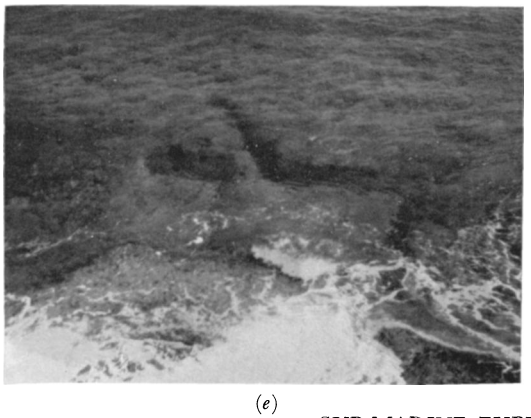
(*a*)

(*b*)

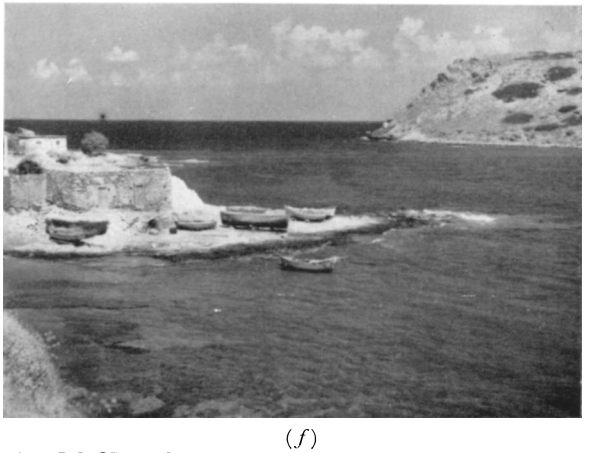
(*c*)



(*d*)



(*e*)



(*f*)

SUB-MARINE EXPLORATION IN CRETE, 1955

(*a*) CHERSONISOS: VIEW NORTH ACROSS HARBOUR FROM 6 ON PLAN, FIG. 2, TO HEADLAND. (*b*) CHERSONISOS: CHAMFERED BLOCKS AT 12 ON PLAN, FIG. 2. (*c*, *d*) CHERSONISOS: MOLE (A) LOOKING SOUTH FROM HEADLAND. (*e*) MOCHLOS: FISH TANKS. (*f*) MOCHLOS: SUBMERGED ISTHMUS LOOKING NORTH FROM MAINLAND.

(a) (b) (c) (d)

SUB-MARINE EXPLORATION IN CRETE, 1955

(*a*) Chersonisos: fish tanks. (*b*) Vase from Pseira. (*c*) Vases from Pseira (L. to R.: 8, 6, 10 on Fig. 10). (*d*) Lead plate from Ayia Galini.