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The MARINER'S MIRROR
WHEREIN MAY BE DISCOVERED HIS
ART, CRAFT & MYSTERY
after the manner of their use in all ages and among all Nations

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FROM ROPE TO CHAIN

ON THE DEVELOPMENT OF ANCHORS IN THE MEDITERRANEAN

By Honor Frost

A GREAT deal of new evidence relating to marine archaeology has emerged from the sea in recent years. It has, among other things, helped to explain certain pierced stones that are common in Mediterranean waters, and has also contributed to our understanding of the development of the anchor in classical times. The sea-bed used to be familiar only to professional salvage men and sponge-fishers, but after 1943 Commandant Cousteau's invention of a safe and simple method of diving made it accessible to amateurs. Where the excavation of submarine sites is concerned, the claims made by these part-time free-divers are often exaggerated; all excavation entails heavy and sustained manual labour and, underwater, such work requires skill and training. Observation, on the other hand, is within the capacity of pleasure-divers and some interesting information has already resulted from their submarine forays.

In 1927 when Dr Moll published his scholarly study on ancient anchors[1] his only sources were documentary. He was neither in a position to relate ancient anchors to their place in the history of navigation, nor could he interpret the function of even late Roman anchors from the written or pictorial evidence at his disposal. Ironically, it was in that same year that Mussolini started to drain Lake Nemi, an operation that revealed not only

two Roman ships, but also their anchors complete with component parts—metal, wood and rope—*in situ*. The discovery disproved some of Moll's theories; nevertheless, the evidence he collected is very precious to us now, though it does not include the various categories of stone anchors.

My own interest in these matters was aroused when I dived on ancient anchorages in the Mediterranean, and on harbours such as Tyre, and noticed that a variety of stones pierced with one or more holes littered the bottom. Local divers and fishermen were able to explain how these had been rigged, for stone anchors are still in use in parts of the Mediterranean (and indeed in other places where there are primitive boats). Knowledge of how the things worked would by itself have little archaeological significance were it not that, as Dr Moll pointed out, anchors have always had symbolic associations. Once the objects have been recognized for what they are, it follows that we may find similar stones or their representations in the context of datable sites on land.

After diving on the ancient harbour of Tyre, I noticed a collection of votive stone anchors in the Bronze Age Temple of the Obelisks at Byblos, further north on the Lebanese coast (Figs. 2–5). It would be an interesting, but quite separate, study to trace the symbolic significance of anchors in different civilizations: in the neolithic Tarxein temples of Malta, in Minoan palaces, at Delphi (where there were votive lead stocks), at Delos and other places where collections of miniature votive anchors have been found, or the connexion of anchors with the cult of Heracles (mentioned by Moll), through the crypto-Christian graffiti in the catacombs to the representations of anchors in Emblem Books published after the Council of Trent, to the current meaning given to a tea-leaf anchor found in the bottom of a cup. Anchors, of course, are also found on land in more prosaic contexts: in ancient quarries, for instance, where they may lie among the half-finished querns and millstones manufactured on the spot. I shall, however, confine myself to direct observation, using collections of votive anchors only for purposes of dating. The subject is in its infancy and the new sources of information will continue to produce material for interpretation.

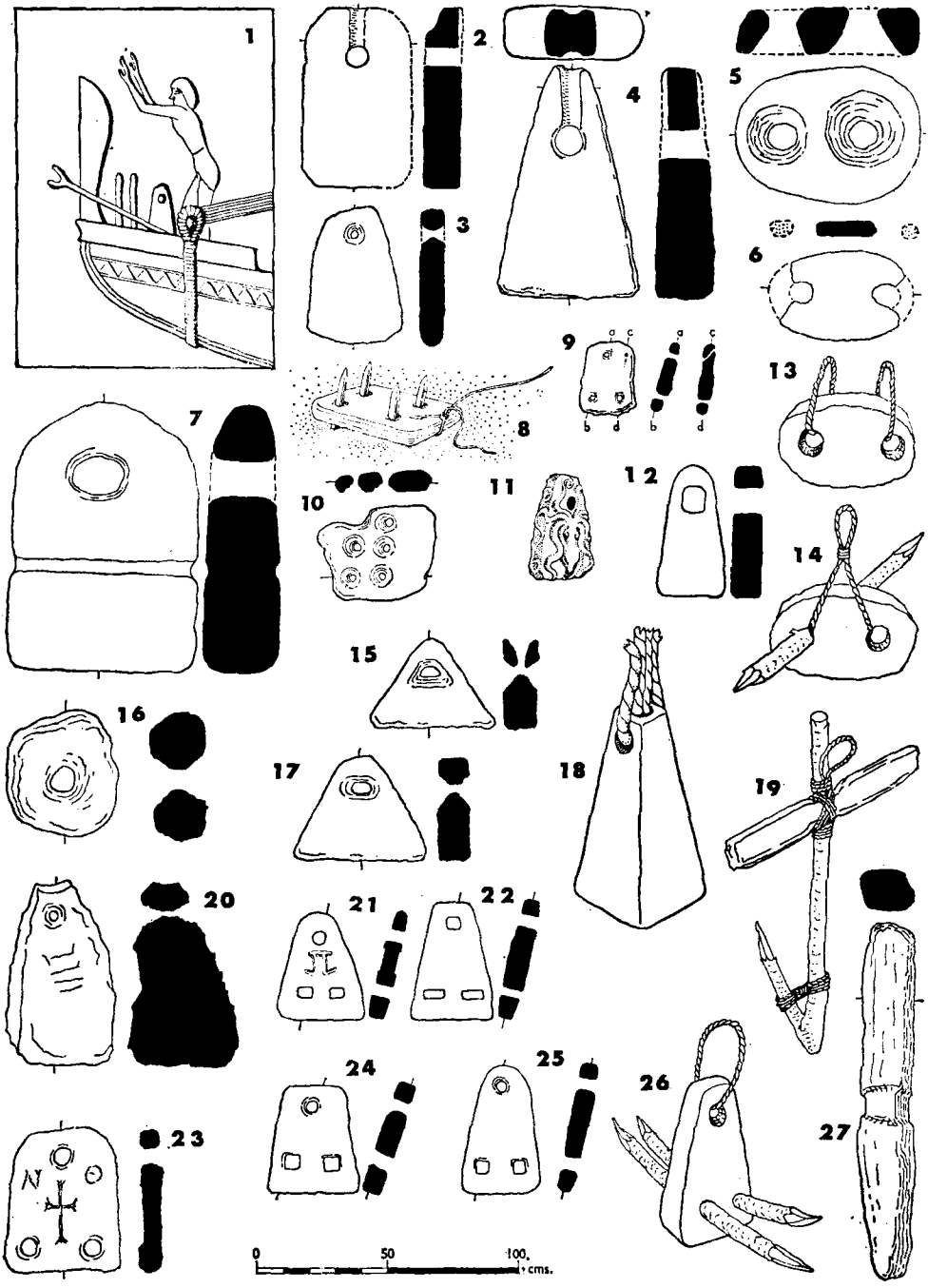
Before going into detail we should note two leading implications of this line of research.

First, *once particular forms of anchors have been attributed to specific cultures, it follows that variations in their design will suggest variations in the navigational habits of the cultures concerned.* In order to pursue this idea the evidence of the objects themselves must be supplemented by records and analyses of the marine sites—the type of sea-bed or the kind of anchorage—where a certain kind of anchor has been found in quantity. Unfortunately divers have not yet formed the habit of recording their observations, or

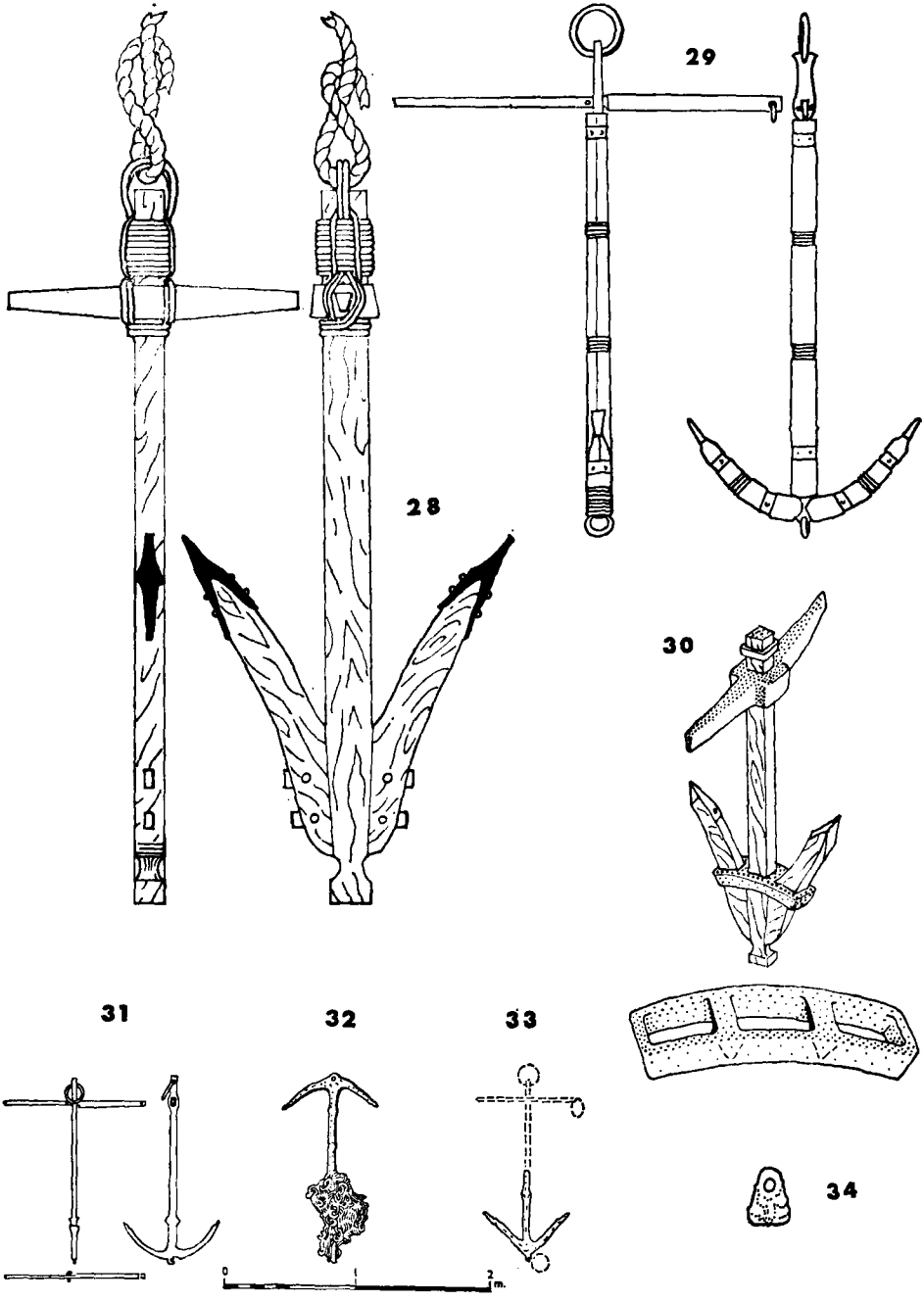
marking on charts the places they have visited. From my own, and therefore limited, experiences it would seem that, as well as on ancient harbours and anchorages, stone anchors are found on off-shore shallows. Quantities have been reported, for example, on the submarine Plâteau des Chèvres off Marseille. Lead stocks and the concreted remains of iron anchors are also found on such places. I have, however, never seen or heard of a stone anchor near a precipitous rock, or a cliff that continues underwater to any considerable depth. A simple stone weight would not hold on sides so steep. On the other hand, it is a fact that numbers of lead stocks and all-metal anchors are wedged into the fissures of submarine cliffs, or lie on the sand at their base (where they must have dropped after failing to become engaged and after breaking their ropes).

It seems surprising that either type of anchor should be found on apparently dangerous off-shore rocks and shallows which are avoided by modern shipping. Jal, the French naval historian, and more recently Frédéric Dumas[2] have both helped to explain these puzzling sites by pointing out that, because ancient ships could not, in all probability, sail against the wind, storms or a sudden change of wind would force them to turn about and seek shelter or drop anchor where they might. Although storms would drive them into a bay, a temporary fluctuation in the weather (in the Mediterranean the wind can change with the sun in the course of a single day) would cause them to drop anchor on the nearest shallows, where they would have to wait until they could resume their course. Submarine graveyards of lost anchors substantiate this theory, but to elaborate it further, statistical records would have to be compiled.

Secondly, *the remarkable difference in scale between stone anchors and metal and wood anchors* (cf. Figs. 1–27 and 28–34, noting that the latter are shown at exactly half the scale of the former) *may also have a bearing on the history of navigation*. This difference is so pronounced that in order to get the Roman anchors on to a page, I have had to reproduce them at half the scale of the stone anchors. To emphasize this, I have drawn a representative stone anchor (Fig. 34) on the same page and to the same scale as the fluked examples. At first glance this discrepancy in proportion might seem to indicate a corresponding change in the size of ships: the larger the anchor the larger the ship. In the case of ancient stone anchors (modern stone anchors are, of course, used only on small boats), I do not think that this was necessarily so. There is no reason to believe that Phoenician, Minoan or Egyptian ships were always smaller than Roman merchantmen. Indeed, Borreux and others have estimated that Egyptian ships could attain a length of 60 m. Minoan ships are represented with as many as fifteen oars to a side which implies a length of at least 21 m., and similar calculations



Figs. 1–27. (For legends, see p. 6.)



Figs. 28–34. (For legends, see overleaf.)

can be made for other vessels including triremes (which are also thought to have carried stone anchors).

The fact that stone anchors are smaller and less efficient than those with stem and flukes does, on the other hand, mean that ships carrying the former had either to choose their course in accordance with their anchor, or, that

Fig. 1. Egyptian stone anchor standing on the prow. From a bas-relief in the tomb of King Sahu-re, *ca.* 3000 B.C.

Figs. 2–5. All from the Temple of the Obelisks at Byblos. Phoenician, about 1900 B.C. In every case the stone is a soft, buff-coloured limestone, hammer-dressed. Fig. 2 is built into the temple, near its northern entrance.

Fig. 6. From the Phoenician settlement on the island of Motya, off Sicily; found in the waters of the lagoon. Compare this rare shape with Fig. 5 from Byblos.

Fig. 7. Found and drawn in the sea at Tabarja near Byblos; probably Phoenician. Being exceptionally large, the belt-like groove would have taken the auxiliary rope needed to raise this anchor.

Fig. 8. A modern sand-anchor, showing how the transverse sticks would engage it in the bottom.

Fig. 9. Modern concrete sand-anchor found at Tabarja; note the diagonal piercing for the rope.

Fig. 10. A pebble stone pierced with five holes, found on the Minoan site of Mochlos; possibly a sand-anchor.

Fig. 11. Minoan rock-anchor with an octopus carved in low relief on a hard, red stone; found in the Palace of Minos at Knossos.

Fig. 12. Another Minoan rock-anchor found at the Palace at Mallia in Crete.

Figs. 13, 14. Modern two-holed anchors used by fishermen; compare the Phoenician examples, Figs. 5 and 6.

Fig. 15. Rock anchor from Tarxein temple (Maltese neolithic 1600–1500 B.C.); compare the intercommunicating piercings with the trireme anchor Fig. 18.

Fig. 16. Round stone anchor from Marathon Bay; compare Plate, fig. 1.

Fig. 17. Rock anchor from Temple at Ta Hagarat; Maltese megalithic.

Fig. 18. Reconstruction of one of the trireme anchors from the Maritime Museum, Piraeus, illustrating the use of the intercommunicating rope-holes.

Fig. 19. A Malayan example of the use of the stone stock.

Fig. 20. Rock anchor of undressed granite-like stone; piercings which started at either side have left an elbow bend in the middle of the hole. Dover Museum.

Figs. 21, 22. Composite anchors of Agde stone, found in the sea near that town. The letter incised on both sides of Fig. 21 may be of a Greek script of the fourth century B.C.

Fig. 23. Composite anchor found in the sea off Bodrum (Halicarnassos or Mesy) with incised cross and two letters; possibly Byzantine. Note the round holes common to eastern Mediterranean anchors.

Figs. 24, 25. Composite anchors found on an off-shore shallow near Marseille.

Fig. 26. Modern, composite, drag-net anchor.

Fig. 27. Stone stock from Marathon Bay.

Fig. 28. Lead-stocked wooden anchor from Nemi.

Fig. 29. Wood encased iron anchor with movable stock, from Nemi.

Fig. 30. Reconstruction illustrating the use of the leaden assembly piece on a wooden anchor.

Fig. 31. Iron anchor with movable stock from Pompeii.

Fig. 32. Iron anchor and chain from Veneti fort; Dorchester Museum.

Fig. 33. Concreted remains of iron anchor from Roman wreck, Borelli Museum.

Fig. 34. Stone anchor drawn to same scale as the fluked anchors.

the ships themselves had to be powered by oars as well as sails. As yet these problems cannot be solved from the evidence of ancient wrecks. Many classical ships have been found with most of their anchors *in situ*, but no Bronze Age ship has been discovered to date, with even one of its anchors in place. Time and improved techniques of submarine excavation are bound eventually to fill this gap in our knowledge.

Such are the hypotheses I deduce from evidence found in the sea.

Three kinds of stone anchor

Analysis of the objects themselves shows that stone anchors can be grouped according to the way they functioned. Some of them can be dated. The three main functional distinctions are first: simple weight-anchors where the stone is pierced with a single hole for the rope. These could be used on a rocky bottom but would tend to drag on sand; they can therefore be termed 'rock-anchors'. The second type of stone anchor is designed expressly for use on a sandy bottom. This 'sand-anchor' consists of a small flat stone with three or more holes through which sticks are wedged; these protrude on either side and serve to engage the anchor in the sand. Another hole is left for the rope. Thirdly and last come the 'composite' stone anchors for use on either rock or sand. In design they combine the functions of rock- and sand-anchors. Usually triangular, with a rope at the apex, they have two holes for sticks at either side of the base. Being slightly larger than the sand-anchor proper they combine weight with grip.

Sand-anchors

A Lebanese sponge-diver first taught me the all-important distinction between rock- and sand-anchors. In Lebanon, the sponge industry was introduced after the last war; this, combined with the country's prosperity, meant that modern diving equipment was adopted at the outset. Greek and Turkish sponge-fishermen use standard—and at that very well worn—apparatus. The house where I lived in Lebanon overlooked a bay where sponge-boats put in at night during the fishing season. Propinquity, and the fact that I dived with the same gear, allowed me to get on friendly terms with the crews. When on the sandy bottom of the bay, I found a puzzling stone pierced with four holes (Fig. 9), one of the men explained that it was a sand-anchor such as poorer fishermen made for themselves, sometimes out of concrete. It so happened that on the other side of the bay, where there were rocks, a much larger stone (Fig. 7) with a single hole was stuck in the bottom of a crevice.

These sponge-divers had a modern metal anchor on their own boat, nevertheless, when I went fishing with them they continued to instruct me

in the use of rock- and sand-anchors. In the sea, contrary to conditions on land, sand is sterile and rock fertile; sponges therefore grow on rock. The Lebanese sponge beds, incidentally, struck me as different from others I had seen in Greece and Turkey (I do not know the largest and most fertile beds off the North African coast). In Lebanon the bottom is mostly flat with a uniform covering of slime over both sand and rock, which makes it relatively difficult to detect sponge beds. My friends often fished on a bed lying several kilometres off the mouth of the Dog River, at a depth of about 40 m. In order to locate it the Captain went through the immemorial performance of putting his ear to the bottom of the boat: if he heard a 'swish-swish' it meant we were over sand, while a 'click-click' meant there was rock and we could drop anchor. I had noticed this practice of listening to the bottom in other Mediterranean fishing boats, but never connected it with choosing the appropriate anchor to drop. Its purpose is, however, very apparent when we consider how small caïques, whether engaged in transport or fishing, cruise for days only putting in to the coast at night for the crews to sleep and take on a supply of fresh water. In darkness or in cloudy water they must first listen to the bottom and then choose their anchor accordingly.

Rock-anchors

Within the general distinctions between rock-, sand- and composite stone anchors, it is unrealistic to attempt to trace any further development. All early Mediterranean thalassocracies seem to have moored their ships by much the same method. The only difference between a Minoan and an eighth-century Cypriot anchor is one of finish. Where the standard of craftsmanship was high, the anchors were finely cut and sometimes embellished, whereas later, but less highly civilized communities, were satisfied with any undressed stone provided it was the right weight and had a hole through it. We may therefore start by examining the already-mentioned collection of anchors found in, or built into, the Phoenician Temple of the Obelisks (ninth century B.C.) at Byblos. M. Dunand the archaeologist in charge of this excavation found five anchors; in my opinion Fig. 5 is also an anchor and brings the total to six. The large anchor (Fig. 7) which I found at the bay where I was staying (at Tabarja, a few miles south of Byblos) is not, of course, votive, but it may well be of the same period as the Temple anchors which it resembles. Tabarja like Byblos is an early site, though it has never been excavated. With one exception all these anchors are triangular or curved at the top with a single hole at the apex. One of the anchors from the Temple is now in the Beirut museum; it bears the incised drawing of an oar (the others are unmarked); they are all hammer-dressed.

M. Dunand thinks they were votive offerings to Isis, the Lady of Byblos. It would be interesting to know whether they were brought from Egypt or whether they were of local manufacture, offered by pilgrims leaving the shrine.

The limestone from which these anchors were made might, as far as I could observe, have come from the vicinity, but the stone has not to my knowledge been examined by a geologist. Nor does their shape look Egyptian, for Egyptian paintings and bas-reliefs show pyramidal anchors (though model ships of the dead, designed to transport a single soul, sometimes have round anchors). The pyramidal anchors are shown standing in the bows. The Byblos anchors might have been up-ended, but they could never have stood on a ship in motion as the anchor from the tomb of the Egyptian Vth dynasty King Sahu-re (*ca.* 3000 B.C., Fig. 1) evidently does. In relation to the figure standing beside this anchor, it seems to be much the same size as those at Byblos. The ship has ten oars which are so grouped that they take up half the total length of the vessel; at a rough estimate this would make the ship at least 30 m. long, thus illustrating the point made earlier that the size of a stone anchor bears no relation to the size of the ship to which it belongs.

Rock-anchors with two holes

For many years I hesitated before deciding that the exceptional, oval stone with two holes at Byblos (Fig. 5) was also an anchor. The dubious function of the double holes made it a somewhat inconvenient object to find on a site where the rest of the collection could neatly be classified as rock-anchors. In due course, however, a similar stone was brought to my notice. It came from another Phoenician site: the island port of Motya off Sicily, where it had been found in the lagoon. This object (Fig. 6) is ranged among another collection of triangular Phoenician rock-anchors (all from the surrounding waters), in the garden of the small museum founded by Mr J. Whitaker who excavated Motya. Rodrigues Santamaria in his invaluable dictionary of fishing tackle[3] explains how oval anchors are used today in the Spanish dependencies (Figs. 13, 14). There is therefore no reason to doubt that these two stones are anchors, or from their provenance that they were of a type used by Phoenician sailors. The shape is, however, rare in comparison with the contemporary, triangular rock-anchors.

Sand-anchors are also rare; when an example is found in the sea, it is usually in an undatable context. These small, flat stones designed for use on sand would naturally be lost on sandy bottoms and quickly be covered with silt. I have never noticed a sand-anchor on a land site. Multiple piercings make them fragile, and in a fragmentary state they would be unobtrusive. Archaeologists in general are unfamiliar with stone anchors.

On land, heavy rock-anchors are left where they were found, often being interpreted as tethering posts or being in some way associated with architectural fixtures. Small stones with holes are, on the other hand, usually 'lifted' together with portable finds and taken to a depot for classification. When the nature of sand-anchors is more widely appreciated, it may well be that specimens will be recognized among the hitherto uninterpreted objects from past excavations.

It is certainly logical to assume that wherever rock-anchors were used there must also have been sand-anchors, since their functions were complementary. It does not follow that in ancient times sand-anchors were accorded the same symbolic significance as rock-anchors. Their service being limited to safe, inshore moorings, sand-anchors may never have acquired the dramatic associations of their weightier counterparts.

Minoan anchors

Before I became familiar with modern sand-anchors, I had seen a flat stone pierced with five holes and broken at one corner lying in a rock-cut tank in the Minoan settlement of Mochlos in Crete (Fig. 10). Mochlos was resettled in Roman times, when the tank may have been cut as a *piscina*. It has been suggested that the stone was a grille for shutting the seaward entrance of this fish-tank.[4] Once broken the object might have been used for this purpose, but it seemed odd to me that in a wooded countryside a grille should, laboriously, have been cut out of a hard pebble stone. After seeing sand-anchors, I have little doubt as to the original function of the Mochlos stone. Judging from the context in which it was found, it may well have been a Minoan sand-anchor.

Egyptian and Phoenician triangular rock-anchors reminded me of another Minoan stone which I had seen in the Heraclion Museum (Fig. 11). This elaborately carved object, found in the Palace of Minos by Sir Arthur Evans, has been called a 'weight-stone' because it happened to correspond in weight to the copper ox-hide ingots that lay next to it. Such ingots are now known to be of no standard weight, so the coincidence is without significance. Furthermore, similar stone anchors have since been found elsewhere in Crete. I came across one of these in the Palace at Mallia. The Heraclion example, with its octopus in bas-relief, is so elaborate that it might well have been manufactured for votive use, whereas the Mallia anchor was unadorned. M. Dessenne, who excavated Mallia, very kindly sent me the following information:

'The anchors which you saw [there had apparently been two but one had disappeared] were found in the Palace in a part which was next to

Fig. 1. Lowering a round stone anchor; from a Cypriot vase of the eighth century B.C. (Photo.: British Museum.)

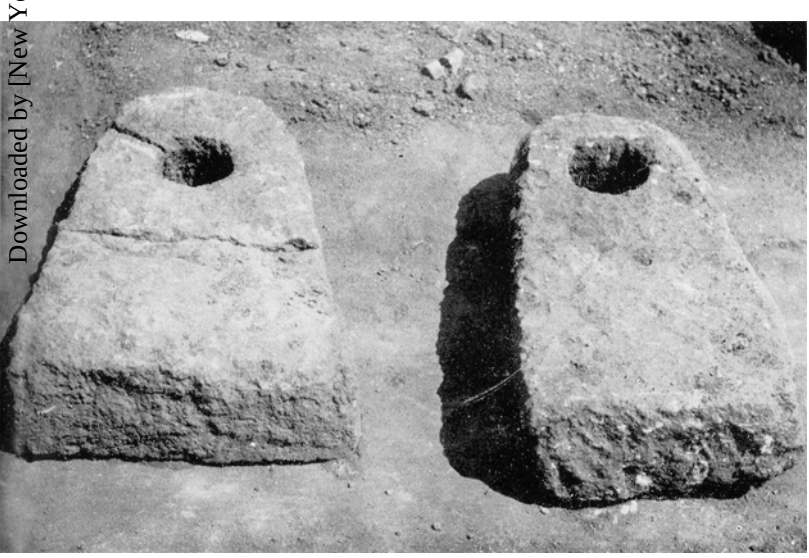


Fig. 2. Left. Anchors from the Minoan Palace of Mallia in Crete. (Photo.: French School of Archaeology in Athens.)
Right. Inscribed anchor from Bodrum or Mesy. (Photo.: J. J. Flory.)

(Blocks reproduced by courtesy of Routledge and Kegan Paul from *Under the Mediterranean* by Honor Frost.)

(*Facing p.* 10)

a stone-cutter's workshop, excavated in 1956. It was some way from the sea...about 400 m. from the beach. The anchors were certainly not in a sanctuary, but in a building which, to judge from the general plan, from the traces of burning and from a bronze disk found there, was probably used for making fire in order to work bronze. All the objects in the stone-cutter's workshop, date from the first palace, that is to say, for Mallia, from Middle Minoan I to II.'

I am also indebted to M. Deaux, director of the French School at Athens, who later sent me a photograph of the two anchors (Plate, fig. 2). The broken example on the left closely resembles the Byblos anchor (Fig. 4). Judging from the Mallia anchor which I myself saw (Fig. 12), the stone was freshly cut and had never been used in the sea. Probably both had been made in the same workshop as produced the Mallia collection of bowls and gems; perhaps they had been the first easy task given to an apprentice.

The use of round stone anchors, such as I have seen on the bottom of the ancient harbour at Tyre, and have already mentioned in connexion with Egyptian ships of the dead, is graphically illustrated on a Cypriot vase of the eighth century B.C. in the British Museum (Plate, fig. 1), where a little man seems to be lowering one of these anchors from a boom. Two round anchors were found by a French expedition on the bottom of Marathon Bay.[5] I illustrate one of these (Fig. 16). Unfortunately it cannot be dated as it was not found in the context of a wreck. The same expedition also collected a number of stone stocks to which we must revert later.

Maltese rock-anchors

More datable anchors have been found in Malta on temple sites. One triangular example (Fig. 15) comes from a Tarxein temple (Maltese neolithic, 1600–1500 B.C.) and the other (Fig. 17) from a megalithic temple at Ta Hagarat.[6] The Stone Ages in Malta roughly correspond with the Bronze Ages in Palestine.

The triangular Tarxein anchor (Fig. 15) is interesting because the holes are pierced in such a way that they intercommunicate. This puzzled me for some time until it was explained, as usual by a sailor, who happened to be on duty at the Piraeus Maritime museum where there was a trireme anchor with similar piercings (Fig. 18). Intercommunicating holes allowed the extra security of double ropes and knots. This might seem unnecessary on an anchor so small, but we do not know what type of rope was used in Malta at that date. Elsewhere, both Homeric and archaeological evidence agree that ropes were made of plant fibre such as papyrus, or *phragmites communis*, the common reed. If the Maltese lacked the wherewithal to make

strong ropes, they compensated for it in ingenuity by anticipating the later system of double knotting.

'*Trireme anchors*'

The Piraeus anchors (Fig. 18), of which two stand by the gate of the Maritime Museum and no less than ten in the yard of the nearby Archaeological Museum, were all dredged out of the adjacent Zia Liman. This harbour was used by a fleet of triremes in classical times. All the anchors are heavy and pyramidal. I have never seen this shape in the sea; which in itself is further confirmation that they were used on triremes, for we have yet to discover the wreck of a ship of war. Wrecks are marked on the sea-bed by their imperishable cargo. Amphorae or statues stick out of the sand, but a warship which keeps its decks clear for action would on collapse become covered by silt. Further, since warships were dependent on oars, they were not subject to those vagaries of weather which forced merchant ships to moor on off-shore shallows where they so often lost their anchors. There are, however, types of bottom where even a warship, or at least a large pyramidal stone, would remain noticeable; it is in all probability only a matter of time before the sea will divulge this secret.

Rough-cut rock anchors

Two examples of yet another type of rock-anchor were found at la Courtine, a Ligurian oppidum near Toulon where stone was quarried and worked from about the seventh to the second centuries B.C. These anchors made from local stone that was left undressed are roughly pear-shaped. The single hole at the top is pierced, according to M. Layet,[7] 'à la manière néolithique', that is to say boring was started at either side of the stone and eventually met in the middle. It will be seen from the sections illustrated that many stone anchors were pierced in this way. Craftsmen working on well-shaped, dressed stones usually got a bull's eye, being able to calculate where the borings would meet, but this was not so easy when the stones were shapeless. In the Courtine anchors the piercing changes direction, leaving an elbow bend in the middle of the hole. There is a similar anchor, with the same primitive boring, in the Dover Museum (Fig. 20). The stone is a form of granite and unlikely to be local to Kent; the provenance of the anchor is not clear, but there is every likelihood that it was brought as a souvenir from the Mediterranean in recent years.[8] There is, on the other hand, evidence of at least one Roman wreck in the sea off Whitstable, at a place known as Pudding Pan Rock, where fishermen often bring up pottery in their nets, and it would not be surprising to find a Mediterranean anchor of that date in Kent.

Three-holed composite anchors

The third and last category of stone anchor can be regarded as transitional, being a compromise in design between rock- and sand-anchors and a link between these and the metal and wood, fluked varieties. Elsewhere I have called these composite anchors 'Byzantine-Arab', because they were common at that period. It may be to this kind of anchor that Stephanus Byzantinus refers in his book *de Urbis*[9] when he says that there was a town in Egypt called Ancyra, which derived its name from the manufacture of anchors at a local stone quarry. There is, however, evidence that composite anchors came into use much earlier than Byzantine times. The stones are flat and basically triangular with a hole at the top for rope and two at the base for wood. Anchors like this are still current in the Persian Gulf, and were used until quite recently on Arab boats in the Mediterranean.

Documentary evidence for the development of anchor design is scant: the poetic term *εὐναί* used by Homer meant 'stone for anchoring', while *ἄγκυρα* meant 'hook'. It is conceivable that, towards the end of the Bronze Ages it occurred to sailors that a rock-anchor might be more effective if it did not depend on weight alone—if it were combined with a hooked branch cut from a tree (a device still used by many primitive peoples). Judging by the Levant today, all sorts of anchors must have been used contemporaneously. There was no clean break in development, but rather a change of emphasis at each innovation. A conscious distinction between rock- and sand-anchors persisted. Isidorus writing in A.D. 600[10] gives the following definition: 'Anchor comes from the Greek, which, like a hand, grips *either sand or stone*' (the italics are mine).

On the sea-bed, three-holed composite anchors are more numerous than rock- or sand-anchors, but to my knowledge, none has been found in association with land remains. In design there is a striking difference between Levantine specimens and others from the western Mediterranean. In Lebanon, Greece and Turkey composite anchors have round holes, whereas in France and Spain the piercings on either side of the base are rectangular, though the rope-hole remains round (cf. Fig. 23 with Figs. 21, 22, 24 and 25). In the west these anchors also tend to be smaller. Structurally, rectangular holes are difficult to justify: a narrow slat of wood being far more likely to snap under stress than a naturally rounded branch.

The fact that no composite anchors have been found in such places as temples makes them difficult to date. I am convinced that the majority of those from inshore moorings, especially in the east, are modern. On the other hand the off-shore sites where these anchors occur in quantity suggest that they must have served on ancient, if not prehistoric, ships. The first marked,

and therefore significant, example that I saw was in Turkey. On three consecutive years I spent some months at Bodrum, one of the centres of the Turkish sponge trade. The village is on the site of Halicarnassos, and in Byzantine times there was a small town there called Mesy. In contrast with Lebanese divers, the Turkish sponge men had never heard of stone anchors. This was surprising in a place where folk memory goes back a long way and few foreign innovations have been introduced. Perhaps the Seljuk and Ottoman invasions were responsible for a complete break in tradition.

The Bodrum divers have an unsurpassed knowledge of their coastal waters and in Caria, where a long history of piracy is combined with natural hazards, there are many ancient wrecks. Unfortunately, no lead stocks remain to mark the courses of classical ships, because they have been collected by modern sponge-divers who melt them down and re-use them for their own leads. I questioned local divers, drawing for them the various types of stone anchors and explaining how they had been used. This produced results in the second year, when three composite anchors were reported, lying close to each other, near a lighthouse that marked the approaches to the harbour of Bodrum itself. The marked anchor (Fig. 23) (which was the smallest of the three) was raised; it is now in the Bodrum Castle Museum. The incised cross and Greek letters rule out a classical origin, while the fact that stone anchors were not used on Turkish boats suggests that the specimen may have been Byzantine, dating from the port of Mesy.

In France, Figs. 24 and 25, now in the Borelli Museum at Marseille, were found on the off-shore submarine Plâteau des Chèvres; they were not on a wreck and are therefore undatable. Figs. 21 and 22, however, come from the sea off Agde, a town which was not only an early Greek colony, but where quarries of volvic stone have been worked since the place was first settled. The origin of the letter incised on both sides of Fig. 21 is as yet uncertain. It has been suggested that it might be Etruscan. Alternatively, Reinach lists a similar character (but with only one serif and that on the left-hand) in a Greek script of about B.C. 300;[11] the letter inscribed on the anchor might well be a variant of this form.

While there was certainly a fourth-century Greek settlement at Agde, a bronze Etruscan jug found in the sea there (now in the local museum) shows that the town also had trade connexions with Etruria. Both the marked and the unmarked Agde anchors are of local stone; this supports the theory that they were not imported, but made on the spot by the settled community. I should, incidentally, mention that I first saw these anchors at a place called Balaruc, a few miles east of Agde, where they had been left

by the diver who discovered them (they are now in the Agde Museum). Etymologically, Balaruc (from Baal) is Phoenician, but it would be far-fetched to suggest a Phoenician origin for the anchors. The incised letter is not Phoenician, nor has this form of anchor been found on Phoenician sites on land. The composite anchors from Lebanese coastal waters all have round holes and are probably of a later date. All that we can say for certain is that the marked anchor at Agde must be pre-Roman. As to the function of this type of anchor, we can again consult Rodrigues Santamaria who states that this type is still in use, but only on drag-nets, in the Balearic islands (Fig. 26).

Stone stocks

In grouping stone anchors according to the way they functioned I have omitted 'long stones'; these are merely adjuncts to wooden anchors, adjuncts, moreover, which need not be made of stone. Van Nouhuys[12] gives a Malayan example of their use (Fig. 19). There are alternative methods of attaching the stones to their wooden stems and flukes: sometimes they are surrounded by a veritable cage of sticks which is then lashed to the stem. Along the French Mediterranean coast, long stones (usually slate) are very common. They were almost certainly used by fishermen, probably to weight their tackle rather than to anchor their boats, for the stones are found in narrow submarine gulleys at places accessible only to small craft and where these would only have stopped for purposes of fishing. The reverse is true of the heavier stone stocks, mentioned earlier, which were collected by a French expedition from the bottom of Marathon Bay (I illustrate one of these, Fig. 27). Many large, well-cut stone stocks have also been raised by divers off the east coast of Sicily.[13] These came from the same type of submarine site as lead stocks and composite anchors. Lead stocks may have derived from stone prototypes, but I am inclined to think that the use of stone persisted, as a poor man's substitute for lead, and that for a long time both materials were used contemporaneously.

Lead stocks

Naval historians have long been familiar with lead stocks from examples found on land or dredged out of harbours, but until the Nemi anchor was discovered, they were unable to interpret their exact function. In recent years free-divers have collected from both off-shore sites and ancient wrecks innumerable specimens ranging from dinghy-sized stocks that can be picked up in one hand to six-footers which it takes five men to lift. Some stocks bear talismans like *astragals*, or Medusa's heads, or inscriptions such as 'Zeus Zoter' (Greek sailors still call on Zeus as their saviour). Such

lead stocks are often presented to museums with the result that scholars, being already familiar with the objects, have started to build up 'type-series' and specialist articles are appearing in archaeological journals.

To explain the superabundance of lead stocks, we need look no further than the account of St Paul's wreck (Acts XXVII, v. 28): his ship must have carried at least eight anchors, while there is evidence that they were even more numerous on other vessels. Jal, though he wrote before the now-familiar graveyards of lost anchors were discovered, again helps us to understand this phenomenon: 'What quantities of anchors these sailing ships would loose, for they often had to moor fore and aft, having no room to swing in those forced anchorages which were frequently in the middle of shoals, or on dangerous reefs which they could not avoid.'[14]

On present findings, lead stocks from datable wrecks range from about the second century B.C. right up to Byzantine times. As with stone anchors and stocks, there must have been a good deal of overlapping between lead-and-wood and the later iron anchors: both the latter have been known to occur on the same wreck.

Methods of dating

In addition to the evidence of marine archaeology, there are many other ways of dating these anchors. The Seleucid family, for instance, used an anchor as its emblem, thus providing us with pictures of what were probably lead stocks as early as the fourth century B.C. Moll dates the introduction of part-metal anchors as early as the seventh century B.C. He also quotes Pliny on the anchor as being an Etruscan invention, but we shall have to wait for the discovery, or rather the excavation, of an Etruscan wreck to settle this point. In China, as we might expect, there is mention of stone and also metal anchors as early as 2000 B.C., while surprisingly, wooden anchors with lead stocks (identical in construction with the Mediterranean variety) were used there as late as the nineteenth century A.D. This, incidentally, must have escaped Dr Moll when he tried to interpret the function of classical, lead stocks (dissociated from the wooden parts) and took these for flukes.

From the Nemi anchor and others since found in the sea, both the structure of the whole and the function of the lead stock have become perfectly clear. The Nemi anchor (Fig. 28) was completely preserved in sweet-water mud. The position of the heavy stock (its weight was a factor that misled many scholars) is explained by Commandant Cousteau:

'Why did the ancients put the weight at the top of their anchors? It was because they had no chains for mooring; instead, they had to use ropes. When a modern ship pulls on its chain, as a result of wind or current, the

flukes of the anchor remain stuck in the bottom, because the heavy chain exercises a tangential traction, which is transmitted horizontally on the sea-bed. The light ropes used by the Greeks and Romans would lift the stock of a modern anchor and dislodge the flukes, so that the boat would drift. A heavy, lead stock neutralizes the pull of the rope. It keeps the wooden flukes in position and maintains that horizontal angle which ensures a good grip and firm mooring.'[15]

The function of lead stocks was constant, but there are subtle variations in the way they were made. Some have a core of wood inside the arms while others are solid lead. All stocks have a box-like opening in the middle to take the wooden stem of the anchor, but occasionally there is a bar of lead across the middle of this box; sometimes there are several of these bars. Bars at first suggested that the wooden stems that fitted these stocks must have been made in two pieces which were pushed through the opening on either side of the bar or bars, then lashed together below and above the stock. The idea was not entirely convincing, for two pieces of wood would obviously be weaker than one. However, no other explanation sprang to mind and reconstructions were drawn in this way until a French diver, M. Georges Barnier, solved the problem by examining a stock with the remains of its stem, which he found *in situ* on a wreck off Anthéor.[16]

Though the crown of this Anthéor anchor was made of a single piece of wood, its lead stock did have a bar across the stem-hole. Barnier examined the lead and decided that it must have been sand cast. 'Sand' is a slightly misleading term when we visualize what actually happened. The wooden stem of the anchor, with a hole pierced through it at the level of the stock, must have been up-ended in clay soil. A mould of the stock was then scooped out at the level of the stem-hole. When molten lead was poured into the mould, it flowed through the hole in the wood. Thus the stock was cast on to the stem.

In the sea the wooden stem and flukes of anchors are nearly always missing; on a wreck the anchor would be left exposed when the ship sank. Anthéor was exceptional: the ship must have come to rest on the bottom in such a position that sand quickly gathered around the anchor, covering and thus preserving part of its stem.

Another lead component sometimes used in this type of anchor is the three-slotted assembly piece (Fig. 30) which reinforces the junction of stem and flukes. This junction constitutes a very apparent structural weakness and it is odd that it should not have been reinforced more often. Even more surprising is the fact that the few assembly pieces that have been found were made to fit relatively small anchors. The Anthéor, like the Nemi stock, measures just over 2 m. As at Nemi, therefore, the overall

length of the stem must have been about 5 m. and the span of the flukes $2\frac{1}{2}$ m. Without a boom it would have been almost impossible to drop one of these anchors.

When we consider that a Roman ship carried eight to twelve anchors on deck, and even if we regard the Nemi and Anthéor anchors as exceptionally large, they still help us to visualize the size of the ships that carried them. To a diver, these anchors and the cargoes he has seen on the bottom give a clearer impression of scale than representations, such as the ships on Trajan's column where pictorial conventions have enlarged the human figures out of all proportion. The vast amount of cargo salvaged from ancient wrecks like those off Mahdia, Anticythera or the island of the Grand Congloué (though in no case was the salvage complete) confirms these impressions for non-divers. To relate an antique cargo to the remains of the hull that carried it will be no easy task, but eventually, when scientific methods of excavation and recording are practised underwater, they will produce conclusive evidence as to the nature of ancient ships.

Iron anchors

Iron anchors with small, relatively light, movable stocks were current in Roman times; I would suggest that their use depended on the availability of chains, since as Cousteau has explained, they would never have held without chains. As usual there are a certain amount of misleading texts: Philo of Byzantium states that chains were used as early as 332 B.C., as a result of divers cutting the mooring ropes of Alexander's fleet during his siege of Tyre.[17] Philo was writing several hundred years after the event, and though his deduction is logical, in the absence of proof it smacks of wishful thinking. A much more persuasive mention of chains occurs in Caesar's *De Bello Gallico*.

Caesar found himself at a disadvantage during an engagement with the fleet of the Veneti, a tribe from southern Brittany. He records the circumstances, and compares the performance of the Veneti with the Roman ships. Now Caesar was not a sailor, and to us the comparison between two unknown kinds of ship is not very enlightening, but these drawbacks are inherent in most texts. He gives sufficient detail for many interesting inferences to have been drawn about the vessels, and one definite and precious statement about anchors: 'the Veneti anchors were secured fast by iron chains instead of cables'.[18] From this statement the Veneti were credited with the invention of the anchor chain. The tribe had relations with the Wessex coast where they plied a trade in sling-stones, and whither they eventually emigrated. In 1881 an anchor and chain (Fig. 32) were

found in a Veneti hill-fort, Bulbery Camp, east of Bere Regis; they are now in the Dorchester museum. The anchor is iron, no stock is visible, but it may not have been in place or it may have been made of wood. Another anchor which closely resembles the Dorchester specimen is at Pompeii (Fig. 31); a third, from a Roman wreck off la Ciotat is now in the Borelli Museum at Marseille. In the latter instance only the flukes, part of the shank and bits of rings have been preserved. It is the ghost of an anchor: the iron had 'disappeared' through immersion in salt water, leaving its shape within a mould of concretion that formed at roughly the same rate as the corrosion took place. Concretions are fragile and difficult to raise; hence the missing portions.

Wood-sheathed anchors

I must now revert to the second Nemi anchor (Fig. 29) which, though made of iron, was encased in wood. If the Nemi ships were indeed constructed by Caligula, this anchor would post-date the iron ones with chains which Julius Caesar had seen in the Channel, indicating that chains had not become current in the Mediterranean by the first century A.D. At Nemi, a length of rope was found attached to the iron anchor. When examining Ucelli's most excellent excavation report[19] we must keep in mind that it was written when free-diving was in its infancy and there was little comparative archaeological evidence coming from the sea. The report, however, concluded that both the Nemi anchors were representative, and that the wooden-sheathed iron anchor had not been designed expressly for use on the atypical bottom of the lake. In the opinion of the experts whom Ucelli consulted, the wooden sheath was intended to prevent the anchor from sinking too deeply into the mud. All that was required of an anchor was that one fluke should become engaged in, and that its stock should rest on, the bottom. Ancient windlasses, they suggested, might not have been very efficient. Furthermore, if an anchor were to sink into the mud, the elasticity of ropes and the strain that would have to be put on them would have made the loss of the anchor inevitable. Another opinion was that making wooden anchors had become obsessional with the ancients, a habit they could not easily break; but this we may dismiss.

The recent discovery of two other wooden-sheathed iron anchors in the river port of Agde, on the Herault, confirms that the second Nemi anchor was not unique. Though heavily concreted, the Agde anchors are recognizably the same as the Nemi specimen. That they were preserved at all is again due to the alluvial mud in which they were found. Anchors of this kind are unlikely to be preserved in the sea, where they would, in contrast to the hulls of their ships, seldom be subject to sand-burial.[20] Left

exposed on the bottom, the iron would corrode and the wooden sheath would be eaten by xylophagous worms. It may be that wooden-sheathed anchors were expressly designed for use on muddy bottoms and that, at a certain period, as with rock- and sand-anchors, they were always carried as an alternative to lead-stocked anchors, to be used according to the requirements of a particular anchorage.

When chains were substituted for ropes, the wooden casing disappeared from iron anchors and the principle of the modern anchor was established. In one respect, both types of early iron anchors were in advance of their time: they had movable stocks. As Ucelli points out, before the Nemi anchor was discovered, the first movable stock had been attributed to Capt. Rodger, R.N., who showed his prototype in the Exhibition of 1851. After the Nemi excavation movable stocks were claimed as a Roman invention, but in view of Julius Caesar's remarks about the Veneti, the innovation may, after all, have originated in the north.

1 A. Moll, 'History of the Anchor', *Mariner's Mirror*, Vol. XIII, p. 4.

2 A. Jal, *Archéologie Navale* (Paris, 1840). Frédéric Dumas, *Deep Water Archaeology* (London: Routledge and Kegan Paul, 1962).

3 Benigho Rodrigues Santamaria, *Diccionario de Artes de Pesca de España y son Possessiones* (Madrid, 1923).

4 John Leatham and Sinclair Hood, *Journal of the British School at Athens*, Vols. 53, 54 (1958–59), p. 263.

5 F. Braemer and J. Mercadé, *Bulletin de Correspondence Hèllènique*, p. 145, 1953.

6 J. D. Evans, *Prehistoric Malta*, Vol. I, No. 1, p. 89. Certain stones are built into the recently excavated temple at Skorba in Malta (see *Illustrated London News*, 12 August 1961). Two double-holed stones resemble the Byblos anchor Fig. 5; a pyramidal stone with one hole below the altar, described as a 'tethering post for sacrificial animals', may have served previously as an anchor.

7 Jean Layet, *La Courtine* (Toulon, 1949), pp. 100–1.

8 Presented to the Dover Museum by Mr Hickson, it had originally belonged to Admiral Douglas, late of Walmer. The writer would be interested to know whether any member of the S.N.R. could say where Admiral Douglas found this anchor.

9 Ed. Berkel (1688), pp. 20–21.

10 *Etymologia*, Book XX.

11 S. Reinach, *Traité de l'Epigraphie Grec* (Paris, 1885), p. 204.

12 J. W. van Nouhuys, 'The Anchor', *Mariner's Mirror*, Vol. 37, No. 1 (1951), p. 17.

13 I am indebted to Mr Gerhard Kapitän for this information.

14 A. Jal, *Archéologie Navale*, Vol. II (Paris, 1840), p. 169.

15 J. Y. Cousteau and F. Dumas, *Le Monde du Silence*, Editions de Paris (1954), p. 139.

16 An underwater photograph of this stock appeared in *Mariner's Mirror*, Vol. 48, No. 2 (May 1962), Plate 3, facing p. 88; unfortunately in this picture the nozzle of an air-lift and the cloud of mud it raised obscure the crown of the wooden stem. Another photograph of this stock with the stem showing, taken at a later stage of the excavation, appears in *Under the Mediterranean*, by Honor Frost (Routledge and Kegan Paul, 1963), Plate 4. In this book I also give a description of this wreck, known as the '*Chrétienne A*'.

17 Philo of Byzantium, *Veteram Mathematicorum Opera*, compiled: Théviot, 1693.

18 *De Bello Gallico*, III, 13.

19 Guido Ucelli, *Le Navie di Nemi* (Rome, 1950), pp. 234–41.

20 See 'Submarine Archaeology and Mediterranean Wreck Formations', by Honor Frost, *Mariner's Mirror*, Vol. 48, No. 2 (May 1962).