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The offshore island harbour at Sidon and other Phoenician sites in the light of new dating evidence

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Introduction

Promising harbour research along the Lebanese coast was halted in 1967 by political events in the Near East. As nothing has been published on this subject since Poidebard's major, pioneer studies on Tyre (1939) and Sidon (1951) a summary of the new, though incomplete, findings is warranted. Existing sources, scholarly though they are, are liable to be wrong on facts involving submerged remains. Authors who could not dive were easily deceived either by second-hand reports, or by appearances seen from the surface, neither of which they could verify. Poidebard's much quoted 'moles' south of Tyre have proved on inspection to be natural phenomena. Jean Lauffray, his collaborator at Sidon, was convinced (Poidebard & Lauffray, 1951: 73) that there was no submerged masonry around Sidon Island; in fact, the extensive remains that exist there are the main subject of this article.

Sooner or later these mistakes were bound to be noticed, but not so the dating evidence for rock cuttings; any contribution to this subject deserves welcome and scrutiny. The crucially important proto-harbours of the Phoenician homeland have never received the attention they merit, because archaeologists have lacked acceptable bases for deducing their dates. Now the geographer Paul Sanlaville's most recent paper (1972) suggests new methods of dating sea level changes and, therefore, of dating ancient harbour works along the Lebanese coast (see Fevret *et al.*, 1966, 1967; Sanlaville, 1970, 1972; Sanlaville, *et al.*, 1967, 1969). On the most cautious assessment, his discoveries have already corrected the absurd attributions to the Crusaders by backdating certain rock-cut installations, with certainty, by 1500 years. More precise earlier datings should emerge from the combination of Sanlaville's findings with architectural and historical facts.

The geographical findings summarized

Very briefly, M. Sanlaville's work consists in the identification of specific sea level changes which, being caused by eustatic pulsations, affect the entire length of the Lebanese littoral.

Dating of sea levels higher than the present can be obtained by analysis of the remains of dead Vermetidae (molluscs that can live only at mean sea level). Two dates emerge, but one of them is tentative. This is the earlier or Zennadian sea level which is traceable, though its remains are sparse, at +2 m. The C-14 result of 1118 ±80BC should represent the end of the period, i.e. the time by which the sea had retreated to such an extent that the molluscs could no longer survive. From other evidence M. Sanlaville argues that the entire span of the Zennadian period was from 2000 to between 1500 and 1000 BC (Sanlaville, 1970: 287–96, 301). The later or Tabarjian level, +1 m, is much more strongly marked, both by the lines of dead molluscs and by a wide erosion shelf, or *trottoir*. From C-14 tests, corroborated by sherds embedded in the rock, it has been deduced that this period began in the 2nd century BC and ended late in the 2nd century or early in the 3rd century AD (Sanlaville, 1970: 280–7, 301). The only consistent geological evidence as yet accepted for a sea level below the present is the Flandrian, which appears as a cliff with abrasion marks, submerged to a depth of 2–3 m along most parts of the coastline.

The difference between the pre-Bronze Age

Flandrian and the middle to late Bronze Age Zennadian levels totals some 4–5 m. The post-Flandrian rises therefore occur during periods which interest archaeologists, but it is not yet certain at which time, or times, during these rises the sea level coincided with the present or when it reached the Zennadian level. Such is the bare outline of M. Sanlaville's current research.

This summary of complicated findings addressed to geographers, not archaeologists, is necessarily over-simplified. Detailed correlation with archaeological evidence will entail lengthy systematic field research, which cannot begin until stability returns to the Near East. But it is not too soon to pose some questions worth pursuing, or to examine the significance of such indisputable evidence as the Tabarjian Line. When this unequivocal line of Vermetidae runs along the base of a wall, that wall must certainly have been built before the 2nd century BC.

Sea levels higher than the present are relatively easy to establish and to date from the traces they leave on dry land. By contrast, levels below present (the well-marked Flandrian shelf excepted), being eroded and covered by sand or weed, are harder even to recognize, let alone date. A problem is therefore presented by the traces of submerged architecture which, along the Levant coast, do not accord with the single pre-Zennadian, and therefore pre-Bronze Age sea level, lower than the present, that emerges from this stage of M. Sanlaville's research.

Typical rock-cuttings on the island off Sidon

The rock island of 'Zire'[1], some 540 m long, lies parallel with and 1 km from the coast, opposite Sidon's ancient, rock-cut harbour on the mainland (Fig. 1). Shaped like a boomerang, the southern half of this Island, or reef-outcrop, has been flattened on the landward side to form a quay. Protective double sea-walls have been left standing on the weather side. An islet at the southernmost tip was part of this scheme before wave erosion broke it off from the main Island (Fig. 2).

Sea-walls, in some places single and in others double, were an essential protection against winter storms. They exist at Sidon just as they exist at the other sites with which it will be compared. Where the natural rock was low, such walls had to be heightened by courses of colossal masonry (usually quarried from the quays which they were going to

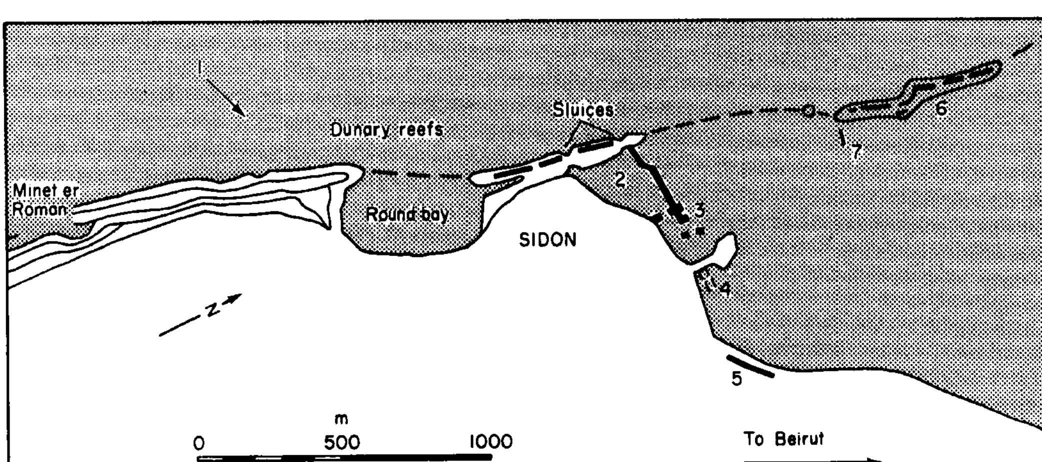

Figure 1. Sidon: the closed port within the city walls, and the island anchorage for foreign ships. Remains of ancient harbour works are shown in solid black. Key: 1, direction of prevailing wind; 2, the closed ports; 3, blockships sunk in 1634; 4, artificially deepened channel connecting the closed ports with the landing quay that served the outer anchorage; 5, this landing quay; 6, the island anchorage for foreign ships; 7, jetty, probably Roman. (Frost, 1963*a*: fig. 19).

Figure 3. A. Rock-cut sea-walls at Sidon Island (looking towards the Islet); all traces of superstructure have been removed. B. Similar walls on the seaward side of the Island of Arwad; in the middle distance the best-preserved section of the original wall: five courses of blocks set on top of the 2 m-high rock-cut wall (total height 9 m). Another stretch of the original wall can be seen in the background.

Figure 4. Rock-cut mooring bitts (Fig. 2: no. 11) seen from inside the Island. The Tabarja line runs along their base.

protect). Along one stretch of the sea defences on the Island of Arwad five courses of masonry still stand on top of the rock-cut wall (Figs 3A, B). The wall itself is 2 m high, giving a total height of 9 m. Often, however, as at Sidon, the upper courses have disappeared, because most ancient harbour-works served as quarries for later generations.

The earliest harbour-builders, or rather 'carvers', being restricted by the shape of the reefs available to them, frequently sited their quays and warehouses dangerously near to the weather side, where, despite the protection of a sea-wall, the small masonry of buildings was liable to be swept away during winter tempests. Consequently, store-rooms were best carved from the solid rock. One such chamber was hewn between the double sea-walls, towards the south of Sidon Island (Fig. 2: no. 3).

Towards the northern end of this Island quay, a complex of mooring bitts (Figs 4 and 2: no. 11), which according to Homeric descriptions are the hallmark of a good harbour, is hewn from the rock that stands at the water's edge. Others, at water level along the main quay, are now almost invisible (Fig. 2: no. 12). The still serviceable bitts are mostly concentrated in this central portion of the Island, where the shore takes a westerly turn, though a few are to be found farther north.

In the northern sector the rock-cut installations become less clear. The natural rock being lower, this sector is more exposed to the waves than the southern, where, it follows, the most important installations would have been sited. Being thus exposed, all the northern rock-cuttings are badly eroded; their purpose has been further obscured by later quarryings, a fate which, as we have seen, befell to a greater or lesser degree nearly every ancient construction on a rocky outcrop along the Levant coast. Most archaeologists who visited Sidon Island (Poidebard and Renan excepted) seem to have been more impressed by the dubious quarryings in the north than the walls and chamber in the south, so that they tend to dismiss the entire island as a mere quarry, a view that is now conclusively disproved by the submerged remains that surround it.

The basic pattern of the installations on Sidon Island conforms to Poidebard's definition of Levantine proto-harbours: namely, that reefs and islands, which provide the only natural shelter along this exposed coastline, were adapted as harbours during the period before men had learned to found walls under water and build moles. Examples of the technique exist at the Island of Arwad (Aradus) in

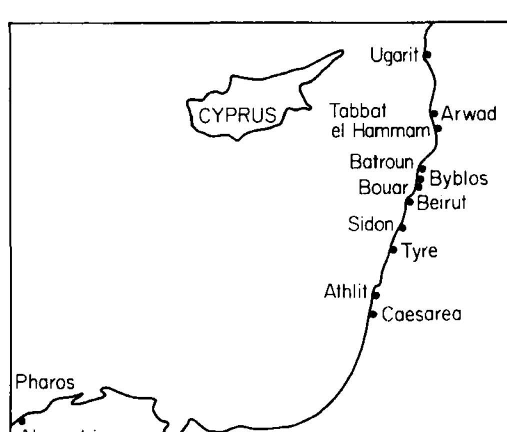

Figure 5. Map of the Levant coast showing sites mentioned.

Syria; at Tripoli; at Einfe and Batroun in northern Lebanon; at Tyre in the south and, indeed, at the 'closed' mainland harbour of Sidon itself (Fig. 5).

Despite scholarly guesses, attributing different dates to these distinctive rock-cut harbours, their architectural homogeneity is so striking as to bring to mind Renan's answer to similar disputes about the nature of Phoenician art: 'Cela est d'art Phénicien qui se trouve à la fois à Tyr, à Sidon, à Byblos et à Arados et ne se trouve pas ailleurs' (Renan, 1864: 25).

The sea-walls, too, are invariably connected with 'Phoenician' sites.

Submerged masonry around the Island
(see Fig. 2)

Starting from the south, a platform of rock less than 3 m under water lies to landward between the Islet and the saddle of rock that now joins it to the southern tip of the main Island. Beyond this platform the depth falls abruptly to a sandy bottom at some 7 m. Lines of colossal blocks, 3 m long on average, are placed as riders at the southern extremity of the shallow platform (Fig. 6). Farther along

Figure 6. The aligned 3 m blocks at the edge of the rock-shelf off the Isle (Fig. 2: no. 9).

it, towards the main Island, large paving-stones show through a sparse covering of sand.

At the base of this platform, some 12,000 m^3 of masonry, including carved stones, columns and revetment plaques, have spilled over into the deeper water (Fig. 7). At the north end of this platform a jetty, still visible above water, juts out from the southern tip of the main Island. The foundation-course of a twin jetty, virtually parallel to the first, lies under water at the opposite extremity of the rock-cut quay that stretches the length of this half of the Island. The upper courses of the second jetty must have been deliberately removed; only

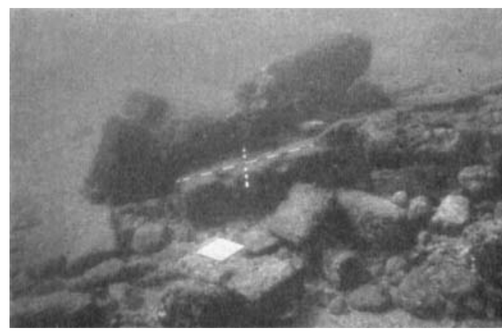

Figure 7. Column-base and dovetailed blocks on the sand at the base of the tumbled rubble between the Islet and the Island (Fig. 2: no. 13).

two of the colossal cuboid blocks from its second course remain on the bottom and these are displaced (Fig. 8A and B). The complex of mooring bitts already mentioned begins after this submerged jetty.

In the confused northern sector, a single opening has been cut through the rock at water's edge; it leads to an artificially flattened area which, as already mentioned, is difficult to interpret. There is no sign of a rock-cut quay, equivalent to the one in the south. But under the water astonishing piles of broken masonry lie parallel with the shore along the entire length of this sector (see Figs 2 and 9). They even extend beyond the Island to the north. These piles contain a very large proportion of broken revetment plaques, such as have already been noted in the tumble of masonry to the south. The plaques are made of quartzite—a significant point, to which we shall return.

Proof that the Island was not a quarry

The volume of the submerged masonry, mostly *imported* stones, that we surveyed is by

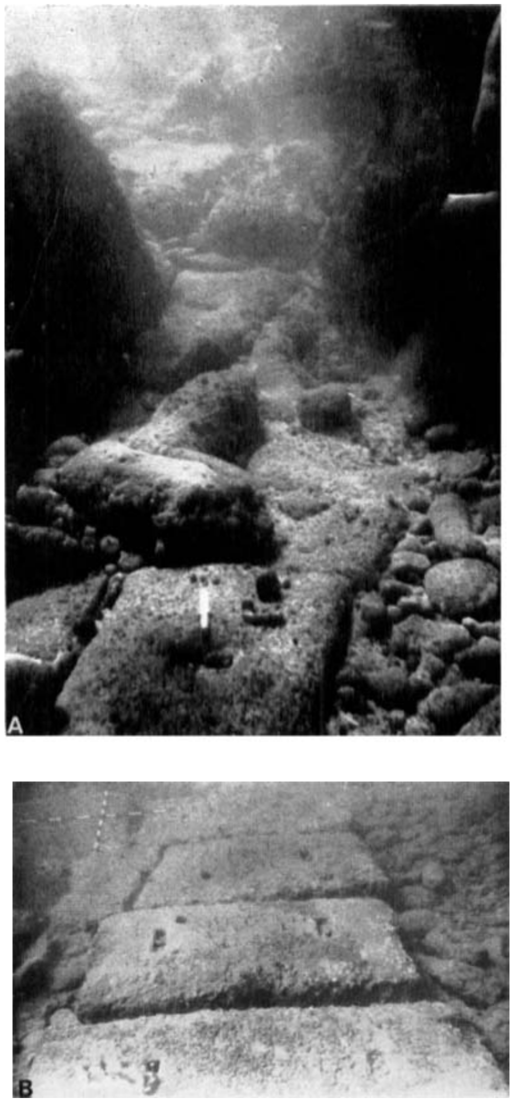

Figure 8. A. Stone with lifting-slot showing, in the foundation-course of the southern jetty; part of the upper course can be seen to the right (Fig. 2: no. 5). B. Similar blocks forming the foundation-course of the dismantled northern jetty (Fig. 2: no. 6).

Figure 9. One of the piles composed largely of quartzite revetment plaques which the current has distributed along the north-eastern section of the Island (Fig. 2: no. 1).

itself conclusive proof that the Island was no mere quarry. My collaborator, the engineer M. J. Chaumeny, calculated that its volume amounted to 20,000 m^3. This, of course, must represent far less than the total volume of the original structures, because all cut stone on the Island had been removed, and there is ample evidence that the top courses of such underwater structures as the northern jetty had also been taken at later dates for re-use on the mainland. Only the foundation course of this jetty remains.

M. Chaumeny also estimated that the volume of stone that had been quarried from the Island itself amounted to some 25,000 m^3, and so, since a roughly equal volume of stone had to be *imported* to build the Island's harbour-works, it is clear that stone would not have been quarried for export.

Excavating in an active element

The sea is an active element. On land the way to understand a ruin is to open it up, plan it, and then deduce the positions of columns and blocks from the way they have fallen. Sea currents falsify even the force of gravity. The reconstruction of marine architecture is a tougher intellectual problem. The first thing to find out is the force that was responsible for breaking an installation. Once this is established, the function of the installation itself becomes apparent, harbour-works being expressly intended to control the movement of water. When unsuccessful, they will be broken and redistributed by the same movement. To attempt a theoretical reconstruction one has to trace in reverse a complex process. As is the case at Sidon, destruction by man may add to the complications.

The significant factors at Sidon are: first, the strong north-flowing coastal current which touches the offshore Island; second, the prevailing offshore south-west wind, and the surface currents provoked by it which eddy round the Island. There is also a strong north wind, though this has effects which are less marked.

One of Poidebard's aerial photographs (Fig. 10) shows how the south-west wind

Figure 10. Aerial photograph by A. Poidebard, showing the current eddying round Sidon Island under the influence of the prevailing south-west wind. Photo by courtesy of the Institut Français d'Archéologie, Beirut.

strikes the Island. The calmest surface water is along the line of mooring bitts, but during our survey in the winter months of 1966 a north-flowing counter-current nearly always ran under water in this sector. This underwater current was responsible for redistributing in piles the broken masonry along the Island's northern shore and even beyond it. The masonry must have been deliberately thrown into the sea; it may have come from buildings or from a now vanished quay along this sector, or even from farther south.

By contrast, the break between the Islet and the Island is plainly caused by natural forces alone. The rock being low at this juncture, the walls built to reinforce the weak point have been swept over the landward edge of the reef, together with the elaborate constructions that they sheltered. Here the volume of the tumbled masonry is estimated as 10,200 m^3. That the constructions had been elaborate is apparent from the variety of building stone and decorative elements in their tumbled remains (Fig. 11).

Another interesting calculation made by M. Chaumeny[2] was that these 10,200 m^3 of masonry would have been sufficient to build a 9 m-high sea wall across the gap, and many other structures behind it. Large quantities of some stones were imported from the mainland opposite; others, such as locally rare or non-existent materials like syenite, granite and quartzite that were obviously used for decoration, came from farther afield. This again refutes the arguments of those who still maintain that the Island itself was never more than a quarry.

That it had been mistaken for a quarry is, however, understandable, since not a single loose cut stone is to be seen on the surface of the Island. Storms, combined with man's constant need for building material, have left almost no vestige of the ancient structures: almost, but not entirely. A sign that an artificial wall once bridged the gap between Island and Islet is to be seen at the southernmost extremity of the Island's seaward rock-cut wall (Fig. 2: no. 8). Though much worn, its line continues at sea level across the erosion *trottoir*. The *trottoir* itself must, of course, have taken form before the break. Just before this point a notch cut into the rock-wall itself shows that a second course of blocks was once keyed into it. Nothing remains of the other end of this wall on the Islet, which is hardly surprising, given the lowness of the rock. To found a sea-wall here, blocks would have had to be lodged in rock-cut foundation-trenches. Examples of the method survive at Arwad and comparable sites. By further weakening

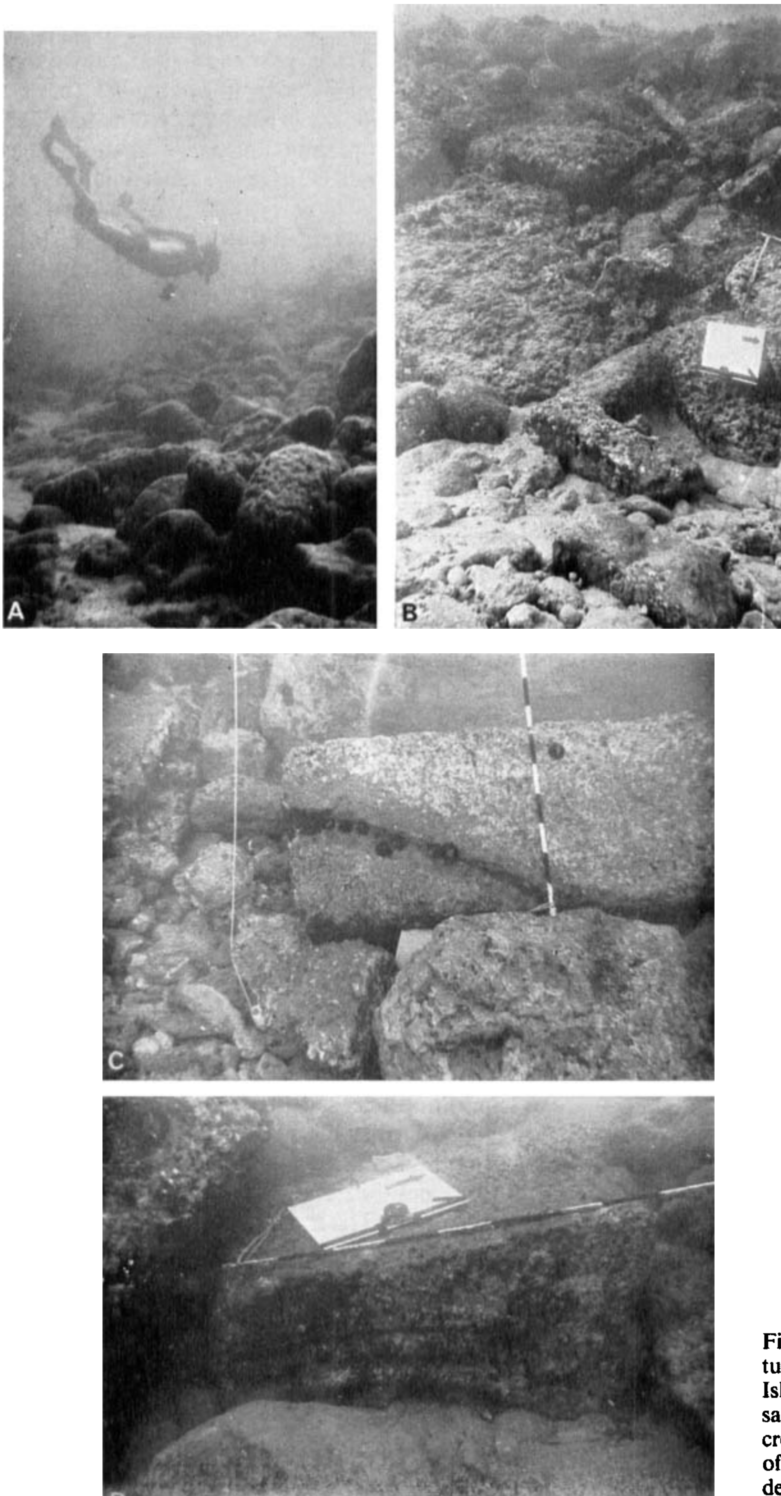

Figure 11. A. Profile of the tumbled masonry between the Islet and the Island. B. The same from the front; note the crest of the stone-fall. C. One of the cut blocks. D. Another detail: part of a Byzantine-type lintel.

the low rock, such trenching would eventually have doomed the new wall itself.

'Galloping' erosion

Poidebard points out how, once reefs had been weakened by cuttings, the forces of erosion were accelerated. In interpreting marine remains, archaeologists should guard against the assumption that erosion is always a slow and regular process. When winter storms tear up modern concrete installations, people marvel at the stability of the adjacent 'Phoenician' walls, forgetting that the weaker sections of 'Phoenician' harbours must have suffered the same fate as the modern. Whenever man's desire for an extra few square metres of reef-space caused his sea-defences to be broken, erosion started to gallop. At Sidon the submerged masonry manifests the existence of ancient buildings, but elsewhere, as at Arwad, they may be virtually obliterated without trace. During two consecutive years in the nineteen-sixties, I searched Arwad for a 'palace with mosaic floors' which Renan had seen in the eighteen-sixties; also for structures reproduced in a First World War copy of *L'Illustration* (Oct. 2, 1915: 362–4).

It was not until I was photographing Arwad from the air that I noticed the outlines of a large building showing through a shallow rock-pool on a low-lying part of the Island. On the ground even the foundation-courses of this building, let alone its mosaic floors, were hidden under weed and a layer of recently cemented beach-rock.

Architecture suggested by the submerged masonry around Sidon Island: the buildings to the south

Setting aside archaeological caution in the interests of clarity, I shall now postulate the kind of constructions that the Sidonian remains could represent.

The 3 m riders set on the edge of the natural rock-platform at the southernmost extremity, off the Islet (Figs 2: no. 9; and 6), suggest a heavy, protective construction linking up with sea-defences running along the weather side of the Islet and eventually joining the rock-cut walls of the main Island. A barrier at the southernmost extremity would have deflected the swirl of the south-western breakers round the Island so that a space of some 90 × 40 m of sheltered rock would have been gained on the now submerged platform.

That this platform was once a quay is indicated by the paving stones already mentioned, which are in place in front of the present gap between the Islet and Island. The presence of this quay is further suggested by a cross-shaped cutting (Fig. 12) that survives on

Figure 12. The rock-cut emplacement for a winch, on the Islet (Fig. 2: no. 4).

top of the Islet; Poidebard took it to be the lodging for some kind of winch. Any machine in this position would have been useless without a quay in front of it and a wall behind it to protect it from the waves.

We assume, then, a now vanished sea-wall. That buildings once stood on the now submerged platform can only be deduced from the remains of their masonry in the deep water along its landward side. Those remains consist of: (a) large mortised and notched blocks (notching is typical of Phoenician ashlar construction, being a means of keying stones into each other); (b) column-bases (I noticed no capitals); (c) columns of various sizes and varieties of stone; (d) a quantity of broken quartzite revetment plaques (the percentage here is not as high as in the piles of rubble along the northern sector of the main Island); and (e) some fragments of carved lintels (see Fig. 11D). Stylistically some of the carving is late, possibly Byzantine; other architectural elements are much earlier. Dates will be discussed later; suffice it to say now that the masonry in this sector covers a considerable time-span. It can be assumed from all this that a number of highly decorated buidings, protected by a sea-wall and fronting on a quay, once occupied the platform.

The jetties

North of this area the surviving jetty juts out from the tip of the main Island. Its lower courses are identical in style with those of the corresponding jetty to the north (Figs 8A, B and 13); both will be discussed later. The upper courses of the southern jetty, being above water, have been described by Poidebard & Lauffray (1951: 73–4). They may not be of the same date as the foundations; indeed, it would be surprising if the top had not been repaired in the course of centuries, so its details need not be recited here.

The rock-cut chamber

The most interesting surviving structure on the Island is the chamber cut between the double sea-walls and communicating with the main quay through a door in the landward wall. Renan called it the 'bain des femmes' because in his time the ladies of the town bathed there, taking advantage of the privacy it afforded and the fact that it contained clear, shallow water, brought in when waves flooded two rock-cut channels. The practice seems to have stopped.

The original function of the chamber is disputed, but I have no doubt that it was once a dry store room, a depot for goods landed at this outer harbour before they were transferred to the mainland by lighter (or vice versa). Its construction shows that the chamber was once dry: its rock floor, which was just above sea level, had two courses of paving-blocks laid on top of it (Fig. 14).

Figure 13. View taken from the top of the sea-wall, showing: the remains of the southern jetty (to the right); one of the rock-cut channels; paving-blocks partially covered by sand on the quay (marked by the measuring-cross); and, at water's edge, some of the lower level of mooring bitts (Fig. 2: no. 12).

Figure 14. View of the 'bain des femmes', showing: the submerged, double course of paving-stones (below the figure); the Tabarja line (just above the level of the rock-pool); and the groove cut in the wall, presumably for lodging the roof of the chamber.

This precaution against damp is still used in the inhabited houses on the Island of Arwad, whenever these are built on the rock by the sea. Had the Sidonian chamber been intended as a fish-tank, there would have been no need for a double or even a single course of paving-blocks. The channels which now allow waves to spill clear water into the chamber were probably pierced at a later date, after all depots had been transferred to a mainland harbour, leaving only fishermen or bathing ladies with a use for the room on the Island. The chamber was roofed, but how is not entirely clear. The maximum height of the reef coincides with its inner, 6 m-high wall (its outer, seaward wall, now both quarried and eroded, seldom attains a height of 2 m). A groove runs along the inner wall at the level of the lintel of the entrance door, almost half way up the wall (see Fig. 14). The ends of roofing-beams, or stone slabs, could have been lodged in this groove. It has, however, one curious feature: its lower edge, instead of being a horizontal shelf, curves downwards. Two explanations spring to mind: either the roof was pitched to seaward, so that storm water could drain off, or the lower edge of the groove was chipped away when the roof was being dismantled. Not one explanatory block survives; even on ground level, the double paving-stones are *in situ* only round the edges of the floor, as those that were in the middle have all been removed. The limits of the three external, rock-cut walls are also somewhat obscured by wear and subsequent quarryings.

Certain questions may never be answered: whether the roof was flat or pitched; whether its span of 10 m was covered by cedar-wood beams (a timber of this length survives inside the Step Pyramid at Saqqara), or, on the assumption that there were central supports, by stone slabs. The height of the groove in relation to the inner wall suggests a third possibility: that there may have been first-floor rooms, just as there may have been communicating lateral rooms at ground level. What is reasonably certain is that the main chamber represents the earliest surviving depot. As will be seen, it cannot have been built during the Christian era.

Obscure features of the unexcavated central quay

As already noted, this initially rock-cut quay had been paved, probably some centuries after being hewn, with blocks of local sandstone roughly 1 m long (see Fig. 13). Similar blocks now below sea level show that the quay once extended beyond the present water-line. All the blocks are now covered by sand, being only partially and occasionally revealed after storms. The stones have not been surveyed. In 1966 excavation was beyond both our means and our briefing (which confined us to the underwater remains and their relation to the shore); our work was interrupted and never completed. The earlier surveyors had, presumably, no incentive to excavate the quay, because, not having noticed the underwater remains, they were not convinced that there had been buildings on the Island.

The underwater remains now prove the existence of such buildings, some of which must have been sited on this protected quay as well as on the more vulnerable platform to the south. To the south the sea swept all that stood on the platform into the deep water. Unfortunately the buildings on the main Island were dismantled by men who removed all the serviceable blocks, throwing into the sea only the useless, decorative stones, such as the quartzite revetment plaques.

However desirable a survey of the foundation-courses on the quay may now seem, it must be recognized that their excavation would be fraught with new technical difficulties. Were the loose sand to be removed, recently cemented rock-hard sand would still obscure many cut stones. Elsewhere at the water's edge, near the surviving jetty, one alignment of blocks is so eroded and so cemented that Poidebard did not consider it to be man-made. I take the opposite view, since the course can now be compared with similarly cut and eroded blocks in the middle of the jetty of the 9th century BC excavated by Braidwood at Tabbat el Hammam in Syria (Fig. 15; Frost, 1972: 112).

Despite the water-worn condition of these stones at Tabbat there is no doubt that they are man-made, since on either side of them the other blocks in the same alignment are well preserved. The blocks at the landward end have been protected by silt, while those that are under water at the opposite extremity show more than one course above the bottom. Anyone excavating the main quay on the Island at Sidon would need considerable comparative experience not only of marine architecture, but also of the various local forms of geological camouflage.

Three small cuttings on the shore of the quay, in front of the highest stretch of wall outside the chamber, superficially resemble slipways (Figs 2 and 13). They are, however, too narrow and too shallow and their sides too irregular ever to have served this purpose. They may have been trench-like foundation-courses for structures made of large blocks jutting out from the shore. At the water's edge, grouped round each of these cuttings, are the worn outlines of the now useless mooring bitts. They attest a sea level lower than the present. Finally, at the northern end of the quay, at the base of the wall, a line of holes for tethering cattle extends for a distance of some 70 m. Each boring in the rock floor is U-shaped in section, a handle of rock having been left in the centre, under and around which a rope could be passed. Similar tethering-holes spring to mind in, for instance, the Roman precincts of the Temple at Baalbek, where the sacrificial animals were tied; no date is deducible, but the same system was used in the prehistoric temples in Malta and, indeed, in Arab buildings. Having witnessed on the one hand, Turkish cattle on the hoof being sent by caïque to the Levant for the Bairam feast, and on the other, the good people of Sidon celebrating this feast by seemingly meaningless trips to the Island, I suspect that the tethering-holes are Islamic and that they were used until the time that this trade was switched from sea to land, after the building of a good road. The upshot of this summary of all that is visible on the quay is that there is little to explain the fragments of masonry, made from imported stones, that lie on the bottom parallel with the north-eastern shore of the Island. There may have been a built quay in this sector, but we should now turn to history for clarification.

History

In 1966 excavations began by the almost shelterless bay of Minet er Rouman to the south of Sidon. They revealed well-preserved Chalcolithic houses, Late Bronze Age graves, Iron Age tombs and Late Hellenistic and Early Roman burials (Saïdah, 1969, 112–25). Though this has no direct bearing on the outer harbour, the presence of imported artefacts attested a flourishing port. This being so, the rare natural shelter of the reef would have been put to use from earliest times.

The mainland harbour adjoining the town is bounded to the south by a spit of rock which geologically is part of the same offshore reef as the Island (see Fig. 1). It has been suggested, because of a 3rd century AD text by Achilles Tatius (quoted below, p. 87), that both parts of the reef were once joined.

The mainland harbour has been described by Poidebard: its sea-defences, which were largely rock-cut, were an extension of the city walls, so that it can be regarded as a 'closed' Phoenician-type harbour, i.e., one that was used to contain the town's own ships while foreign craft lay in the outer, or Island, harbour.

According to F. C. Eiselen (1907) Sidon first became a city around 2800 BC. In the Tell el Amarna letters of the 14th century BC, a Sidonian king joins the rulers of Byblos, Beirut and Tyre in fruitless requests to Amenophis IV for protection against invaders from the north. From then on the records of Sidon's successive destructions and reconstructions seem endless; they can be summarized briefly because only two bear on the outer harbour.

Egyptian domination was followed by a period of Sidonian prosperity under the Assyrians during the 13th and 12th centuries. Enriched by the manufacture of Tyrian purple dye from *Murex* shells, Sidon briefly led the confederation of Levantine city states. There followed conquests by Tiglath Pileser I of Nineveh (1094), Ashur-nasir-pal II (879) and Shalmaneser III, who defeated the Aramaean King Ben Hadad, while the Phoenician tributaries, including Sidon, were in coalition with Ahab of Israel. By 732, the Phoenicians again transferred their loyalties to Egypt. Sennacherib therefore chased Luli, King of Tyre and Sidon, to Cyprus, replacing him by a pro-Assyrian king.

Probably the first reference to the Island, as opposed to the city, comes in 675, when Esarhaddon (Sennacherib's son) punished the again rebellious Sidonians by destroying the town. He commemorated the event by an inscription (Eiselen, 1907: 9) which implies that an important part of the town was on an Island. He describes himself as 'conqueror of *Sidon which is in the midst of the sea*' and which 'casts its walls into the sea'. Eiselen comments that these 'walls' could refer either to harbour buildings, or to a sanctuary of the Phoenician sea-god Ṣid, erected after the Phoenicians had supplanted the earlier Canaanite population.

The Babylonian Empire lasted 58 years and was followed by the Persian. Cambyses conquered Syria, Palestine and Cyprus in 525, basing his first satrapy at Sidon, It was during this Pax Persica that the town reached the peak of its prosperity and power. Sidonian kings had a good measure of autonomy; the town was, in addition, a temporary seat of the Persian monarch.

Excavations are only beginning to show that Phoenician architecture reached its apogee under the Persians. The most grandiose parts of the Temple of Eshmun (god of medicine) were built on the hill above Sidon, while superb fortresses sprang up all along the coast (Dunand, 1968, 43–51). Phoenician rather than Persian builders were responsible, just as Phoenician engineers were responsible for bridging the Hellespont for Xerxes and cutting him a canal through the Athos peninsula (Hdt, vii: 100).

Phoenician sailors served the Persians as mercenaries (though they refused to attack 'their own sons' at Carthage). During the Greek wars the entire Phoenician fleet was under the command of the Sidonian king, who took precedence after Xerxes himself: we know that Xerxes travelled in a Sidonian flagship under a gold awning.

Under 351 BC Diodorus (xvi: 41–45) mentions 100 triremes and quinqueremes at anchor in the Sidonian harbour. Without entering into arguments about the banking of oars and the dimensions of these ships, but taking their size at its smallest (as governed by the number of rowers), it is evident that not more than 26 could have fitted into the town's closed harbour. In its present silted state it only takes 25 fishing-boats.

The earliest and far from clear description of the Sidonian harbour is by Achilles Tatius (I:1), writing in the 3rd century AD:

> 'there is a double harbour in the bay, wide within but with a narrow entrance, so as to land-lock the sea with a gentle curve . . .'.

This has been interpreted as meaning that the Island had been artificially joined, along the now submerged section of the reef, to its extension that is tangential to the shore and forms the southern boundary of the closed harbour. The suggestion is very unlikely, because the submerged section is under 6 m of water and there is no sign on the bottom of the very considerable amount of masonry that would have been required to build such a mole.

Tatius continues:

> '. . . where the bay makes an inward turn towards the right, a second inlet has been channelled out to let the water in; thus there is found a second harbour behind the first, so that in winter, the ships can lie in safety within the second basin, whereas in summer they need not proceed further than the outer port.'

As will be seen from the later descriptions, this last sentence implies the outer Island anchorage, but Achilles Tatius does not specifically mention the Island, indeed he suggests a single complex. Poidebard & Lauffray (1951: pl. XXV.2) have interpreted an aerial photograph as showing an artificial channel to the north, where a causeway now links the Château de la Mer with the shore, but if he is right its function may have been as much to create a through current as to link the closed harbour with landing quays, which he discovered on the southern side of the very exposed northern bay. There is no reliable shelter for ships in either of the bays, to the north or to the south of the Sidonian closed harbour.

Achilles Tatius' description might never have been taken seriously had not the 12th-century pilgrim Johannes Phocas (1889: 10) read it on the spot and commended its clarity: 'for if you visit the place with its harbour and outer harbour you will find reality exactly agreeing with his description'. An example of wishful thinking, if not of casual reading!

For a convincing appraisal of the outer harbour, we should consult the Chevalier d'Arvieux (1735: 296–7) who saw it after it had been sabotaged in the early 17th century, like all the other harbours along the Lebanese coast, by Prince Faqr ed Din, in order to prevent the Turks from using them. At Sidon, he sank blockships at the mouth of the closed harbour. I have not been able to trace more detailed records, but it stands to reason that he would not have left good mooring facilities along the outer, Island harbour. Even without its installations, d'Arvieux's description shows that it still afforded shelter:

> Il n'y a point à présent de port à Séidé, les vaisseaux mouillent à la rade, à l'abri d'un gros rocher ou écueil, qui les met à couvert du vent sud-ouest. . . . C'est une commodité pour nos vaisseaux qui y mettent ce qui les embarrasse, et même leurs marchandises, quand ils sont obligés de décharger pour s'accommoder. . . . Ces rochers servent de promenade pour les matelots, quand la mer les empêche de venir décharger ou charger à terre. Les marchands y vont aussi pour des parties de pêche et de plaisir.'

A few years later, in his *Journey from Aleppo to Jerusalem*, 1697, Henry Maundrell, who had been staying in the same hostel for foreigners as d'Arvieux, wrote (1963: 59–60):

> 'before the khane is an old mole running out into the sea with a right angle; it was of no great capacity at best, but is now rendered perfectly useless by Faccerdine to prevent the Turkish galleys from making their unwelcome visits to the place . . . all the ships that take in their burthen there are forced to ride at anchor under the shelter of a small ridge of rocks about half a mile distant from the shore to the north side of the city.'

Volney (1787: 191–2) a century later makes the same points, adding that the Island anchorage did not have adequate shelter in really heavy weather. This is borne out by sundry references in Eugene Roger's biography (1965) of Faqr ed Din, when he tells of a magician who caused Turkish ships to be driven on to the shore at Sidon and wrecked. He also lists five Greek merchantmen and three large French ships that dragged their anchors and met the same fate. Evidently the Island needed the installations on its southern shelf and the two jetties.

I have quoted these descriptions, not only for their topographical interest, but because they illustrate the habits of sailing ships, so different from engine-driven craft, especially along this wind-swept, shelterless shore. Even now the liners that use Beirut's large modern harbour have to retreat from it and lie out to sea whenever a strong wind blows. The only difference between ancient and 18th-century sailing ships would have been that the former did not sail against the wind (Frost, 1963*b*: 3), but this would only have made the Island anchorage the more essential.

Anyone unfamiliar with Levantine navigation might be pardoned for missing the importance of this small island, but once its significance is grasped it becomes apparent how great was the value not only of the Sidonian Island, but also of the three other, larger Levantine island harbours: Arwad (or Aradus), Tyre and Pharos. During the Bronze Age, which was the golden age of Levantine archaeology, all harbours had to be adapted from what little natural shelter existed along the coast. These three large islands were so spaced that, as major harbours, they would have been sufficient to ensure the trade of the entire coast (Frost, 1970*b*: 63). The minor harbours such as Byblos, despite that town's commercial importance, would have been no more than ports of call where ships lay offshore. Despite recent harbour constructions at, for example, Haifa, Beirut, Tartous and Iskanderun, the system has not entirely vanished, although with engine-driven ships the home ports such as Alexandria, Piraeus, Trieste and Venice tend to be farther afield.

Dating

Having mustered some geographical, archaeological and historical evidence, we can now re-examine those basically rock-cut installations that have hitherto been considered undatable. At Sidon, Sanlaville has pointed out that an erosion notch 1 m above the present level runs along inside the rock, under a series of mooring bitts (Fig. 4; Sanlaville, 1970: 283). The same line shows on my photograph of the 'bain des femmes' (Fig. 14); the water in the pool does not correspond with the present sea level, but is slightly higher. These marks represent the Tabarja line, which indicates a sea level 1 m higher than the present, which lasted over a period of some 400 years ending at the turn of the 2nd century AD. These rock-cut walls and the paved floor must therefore have been cut at some period before the 2nd century AD.

The same line runs along the rock under the mooring bitts in Fig. 4, but south of these bitts, which stand some 2 m above present sea level, is another group which is now awash. These must already have been obsolete when the former were cut.

Neither of these two groups of bitts would have been useful without a quay on the rocky, now submerged, shelf in front of them, because both men and cargo need a flat surface for disembarkation. Before the Tabarjian rise, possibly during the Iron Age, when the sea level was lower, there must have been landing-quays in front of the bitts. Indeed, as already observed, there are submerged paving-blocks in front of the bitts and also on the shelf of rock joining the Island to the Islet.

Similarly, the top of the southern, extant jetty, which is at present awash, must have stood about 1 m above sea level in order to have been serviceable. The masonry of this, and also of the twin jetty to the north, is Persian in character. Another link with the Persian period is the quartzite revetment, now mostly distributed in piles offshore along the northern sector of the Island. This imported stone has been found on only one other site in Lebanon: the fortress of the Persian period which M. Dunand is excavating at Byblos[2]. When I compared the Sidonian and Byblian revetment, the plaques proved to be identical in size and cut.

History confirms that the greatest period of the Sidonian harbour was during the Persian Wars, so that there can now be little doubt that the quays, jetties and colonnaded buildings, sparkling under their white quartzite revetment, belong to this period. Subsequently the installations may have fallen into disrepair, but they continued in use up to and during the Byzantine period, to judge from the cut of certain masonry such as the lintel in Fig. 11D. The Crusaders are known to have been enthusiastic pillagers of ancient buildings; this can be seen from the syenite columns built into the Château de la Mer in front of the town of Sidon. They may have taken such things as columns from the Island, but it would have been against their own interests to dismantle the quays and jetties. The final destruction of the installations must be attributed to Faqr ed Din.

Until field research can be resumed, the mooring bitts on the lower level, those that are at present awash, remain undated. They obviously antedate those on the higher level, and they must have been cut during a period when the sea level was a metre or so lower than it is now. As already stated, M. Sanlaville deduces a Zennadian level, some 2 m higher than the present, at some period between 2000 and 1500 BC. The bitts must therefore have been cut either during the Early Bronze Age, before this rise, or during the regression between the Zennadian and Tabarjian levels.

The only dating evidence for a sea level lower than the present which I can quote from my own observation alone, is the offshore Island of Machroud at the southern extremity of the Arwad Reef (Fig. 17A). It is opposite the earliest known Phoenician installation to have been *built* in the sea: the jetty at Tabbat el Hammam on the mainland (Fig. 15). Braidwood (1940: 208–18) ascribed this structure, from his excavation of its landward extremity, to the 9th century BC. As I have proposed elsewhere (Frost, 1966), this mainland construction replaced the obsolete and partly submerged offshore installations on Machroud which must have been cut when the sea level was lower than the present. The geologist M. René Wetzel has proposed a regressive vacillation during the Early Bronze Age, i.e. before M. Sanlaville's Zennadian rise. If the Machroud cuttings are of the Early Bronze Age, possibly the lower level of mooring bitts at Sidon are of the same date. This is, however, far from certain, because localized (tectonic) as well as generalized (eustatic) changes must have affected this coastline.

Tyre is the most complex of the Phoenician

Figure 15. The 9th-century Phoenician stone-built (as distinct from rock-cut) jetty at Tabbat el Hammam. The sand-covered tell excavated by Braidwood shows at the top of the photograph.

Figure 16. The rock-cut sea-wall at Batroun (seen from the land); note the steps to the right. Similar steps are cut in the ancient sea-walls round Sidon's inner harbour. The Tabarja line shows on the seaward side of this wall at Batroun, thus proving that it was cut at some period before the 2nd century AD.

ports, being both overbuilt and certainly affected by earthquakes[3], as well as by eustatic and probably tectonic changes in sea level. My own recent research there runs counter to two of Poidebard's findings: (1) his 'small southern harbour' now appears to be a submerged extension of what is probably a Canaanite level of the town; (2) his 'man-made moles' in the southern bay, or 'Egyptian harbour', turn out on inspection to be natural formations, but this will have to be the subject of a separate paper.

To revert to the Tabarjian line: this shows inside the rock-cut sea-defences at Batroun (Fig. 16, Sanlaville, 1970: pl. IIb) thus proving them to antedate the Crusader dating usually attributed to them.

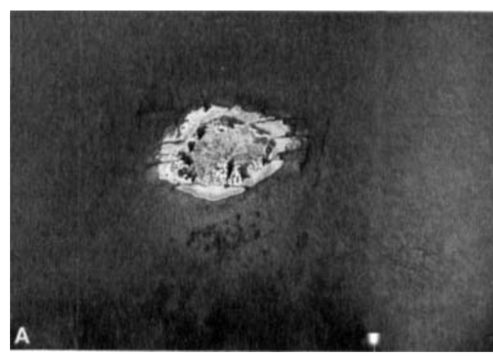

Figure 17. A. The Island of Machroud at the southern extremity of the Arwad reef, opposite Tabbat el Hammam. Here many of the rock-cuttings are submerged; blocks that heightened the rock-cut walls can be seen under water in the foreground. B. The remains of rock-cut walls at Machroud, seen from inside the Island; the erosion at their base could represent the Tabarja line. Hitherto this has not been checked by specialists.

Figure 18. The Island of Arwad, seen from the air; note the rock-cut walls along the seaward side. This photograph, taken by A. Poidebard in 1934, shows local schooners being careened in the landward harbours. Photo: courtesy of the Institut Français d'Archéologie, Beirut.

The Tabarjian line also seems to show in my photographs of Machroud (Fig. 17B) and the sea-defences of Arwad (Fig. 18). This particular piece of evidence is not crucial, because it was already apparent from other signs not only that Machroud was likely to be of Bronze Age date, but that the sea-walls of Arwad were certainly not built by the Crusaders as Dussaud (1927: 113) states. Arwad is the largest and best preserved rock-cut harbour on the Levant coast. In two years' study on the spot (Frost, 1964, 1966) I noted not one, but many signs of sea-level changes. Unfortunately, when, in 1965, M. Sanlaville and I were due to visit the Island (which is in Syria), he to check the evidence of sea-level changes, and I to check a survey that I had made, which was largely based on aerial photographs, politics intervened. Wartime conditions prevented our visiting the Island and the research has never been completed.

There is nothing unreasonable in the attitude of a government at war preventing foreigners from surveying one of its ports. A naturally sheltered spot on an exposed coastline remains an important asset at all periods and during peace or war; I cannot imagine that neutral archaeologists would have been welcome in wartime Britain, had they wanted to survey Chichester harbour for Roman remains. There is, however, a certain irony in reading, as I have often done, translations of the Tell el Amarna letters or similar documents relating to the city states of Syria and Phoenicia and then turning to a modern, local daily. But for the difference in format, the texts, whether in books or newspapers, though millennia apart, were virtually the same.

Acknowledgements

Thanks are due in the first instance to the Emir Maurice Chéhab, Director General of Antiquities, and to the Lebanese authorities for the honour they conferred in entrusting me with the mission to survey the offshore island at Sidon, and for the material help and facilities they afforded.

Knowing that a new harbour building project had been mooted, the Emir Maurice wished the site to be checked so that no submerged antiquities would be destroyed. Thus history repeated itself, for Père Poidebard and M. Lauffray had been called in, in similar circumstances, by the *Régie Général des Chemins de Fer et Travaux Publics* in 1946, when the inner harbour was to be deepened. Though the Island anchorage appears in their book, they had not had a diver at their command beyond the confines of the inner harbour.

I am also deeply grateful to M. Roger Saïdah of the Lebanese Antiquities Service, who, despite the calls of his own important research at Khaldé, was generous with his time and help.

In so far as I have mentioned Arwad and other harbours along the Syrian coast, I should also like to take the opportunity of thanking Dr Selim Abdul Hak, then Director General of the Syrian Antiquities Service and now of UNESCO in Paris, for the missions that he entrusted to me and for his constant support.

I can never adequately express my thanks for the hospitality of the French Institute of Archaeology in Beirut, extended to me over a period of seven years. My debt to M. Henri Seyrig is very great, and it extends also to his successor M. Daniel Schlumberger, the present Director of the Institute. None of the missions herein mentioned could have been accomplished without the practical advice and wise counsel of M. Henri Abdel Nour, then Secretary and now Directeur Adjoint of this Institute.

M. l'Abbé Starcky's knowledge of the superb library has been of inestimable value, as has the advice of so many other distinguished members of the Institute, too numerous to name individually, except for M. Georges Borgy. Probably the greatest living authority on the history of Sidon, M. Borgy is the most generous of 'personal communicators'; it would be a great loss to posterity if his wit and scholarship were only to be filtered through the pens of others. My particular thanks are due to the photographer, M. Der Simonian of Beirut, for taking great pains in the processing of several thousand of my photographs. He had been a personal friend of the late R.P. André Poidebard S.J., the great pioneer of marine archaeology, whose superb photographs he had also processed. During the time I worked on the same harbour sites, hardly a day passed without my having to consult Poidebard's books, and whenever I returned from the field with a bag full of films, I would hear of him from Der Simonian. The latter bore my more amateurish photography with fortitude, rescuing many an indifferent film taken in catastrophic circumstances. Despite this, the sense of continuity was stimulating rather than discouraging; I had one advantage over my illustrious predecessor: I could take my camera under water and return with some scrap of evidence which circumstances had denied to him, so continuing to build up the picture the outlines of which he had already drawn with authority.

The experts to whom I am indebted for opinions and analyses are, again, too numerous to name, nor is it possible in the space of an article to quote their findings. I should, however, particularly like to thank: the marine biologist Dr Carl George, then at the American University of Beirut; the petrologist M. R. Sotorovitch; the Director of the Laboratory of the Ecole Supérieure d'Ingénieurs the R.P. Piere Hartman; also the spelaeologists MM. Sami Karkabi and Souhail Messawer, who helped me to collect stone samples.

Finally, the sound basis of the survey of the Island is entirely due to my collaborator M. J. Chaumeny. Justice cannot be done to his detailed work in an article. During the winter months of 1966 he laboured daily, either in the water above me where he steadied the rubber ranging-rod, signalled to the excellent surveyors, MM. Joseph Khouri and Mahmoud Safi, then pulled on our communication-cord to tell me when to proceed to the next fix. When not immersed, he laboured patiently in the Institute, transferring the angles to paper, on a master-plan some 5 m long.

Notes

[1] M. Sanlaville uses this local name which is an abbreviation of *jesiret*, meaning 'island'. I do not continue to use it, in order to avoid confusion with the other islands along that coast which are also so called by the inhabitants.

[2] I am deeply grateful to M. Dunand for personally communicating this information and allowing me to examine the quartzite plaques at Byblos.

[3] Most interesting tables, showing the force of various earthquakes in antiquity, have been compiled at the Observatory at Ksara in Lebanon (roneoed copies only): *Tome IV (SEISMOLOGIE), Cahier I: Catalogue des séismes ressentis au Liban*, by J. Plassard and B. Kogoj.

[4] These figures are based on a mechanical, planimetric value of the surfaces shown on a recent, rectified aerial photograph of the Island, and under water on the measured remains. See also Technical note.

Technical note

Plans of the Island and of the underwater remains have been drawn up at the following scales: 1:200, 1:500, 1:2000, 1:2500 and 1:5000; i.e. the minimum scale for showing individual blocks, the convenient scale for the ensemble, scales dictated by the requirements of reproduction for publication and, finally, the scale which gives the relation of the Island to the land harbour.

One kilometre of underwater remains were planned in 1967. With the use of two theodolites, 107 stations were recorded at an average rate of 3 minutes per fix. Above water, the plan of the Island had to be remade; with the use of one theodolite, 157 points were fixed at an average rate of 1 minute 40 seconds each. 335 monochrome, underwater photographs helped to identify the fixes and fill in details. On land, the task was simplified by an existing aerial photograph taken at 1200 m. Printed, at our request, at 1:1000, the maximum enlargement, as well as at 1:5000, both were mechanically rectified on the basis of measurements we took on the Island.

Underwater planning with two theodolites and a vertical buoy

Sextant planning on a prepared circle-chart, though theoretically possible, was in practice out of the question because the remains were mostly 3–5 m from the shore, so that the angles they gave would have been too obtuse for accuracy. Triangulation by two theodolites proved satisfactory, but the strong currents and depths of 2–10 m made it impossible, from a boat, to hold a 10 m levelling staff at the vertical. This problem was easily overcome by using an inflatable, sausage-shaped, plastic buoy, 1·50 m long and 25 cm in diameter, with a pointed tip (a ubiquitous device invented by the well-known diver, M. Georges Barnier, of Cannes). A metric tape attached to the submerged end of this buoy allowed the diver not only to place it on the point to be fixed, but also to make an accurate note of the depth. One metre of buoy emerged above water, where 1. a swimmer verified that it was vertical; 2. the surveyors constantly followed the actions of the swimmer and buoy through their lenses; 3. the swimmer received their signals, then 4. transmitted them to the diver by pulling on the tape, so that the latter could move on to his next station.

It was the diver's duty to identify the underwater stations by means of notes and photographs, as well as to record their depths. The surveyors sighted on the pointed tip of the buoy, thus getting as good a result as they would have done from a narrow levelling staff. The main advantage of this system is that the buoy, being held on the bottom, remains at a constant level above water, the waves lapping up and down it. This operation represented four days' work at an average of 2½ diving hours per day.

Various uses of underwater photographs

Underwater photographs were taken for various purposes: first, as identifications of the points fixed by the theodolites. Had the expedition been large and time less limited, numbered concrete blocks could have been placed on the bottom. With only 16 days in the field, and only one diver and one swimmer working regularly, it devolved on the diver to choose existing 'landmarks' on the bottom and identify these by consecutive numbers (as he moved from one point to the next), written descriptions and photographs.

Second, the points thus fixed were revisited by the diver so that the details could be re-checked on the bottom. Again to save time, a great many of these measurements were made by placing certain instruments in the area to be photographed, in order that the photograph could be used to make a measured plan by means of graphic photogrammetry. To this end, two instruments were devised and used for the first time at Sidon. They are the graduated cross (with float and protractor attachment for measuring the slope), which allows an oblique photograph to be gridded and the grid transferred to a true plan (Frost, 1969: pl. VIIIb). A compass mounted on a white plastic plaque was always positioned on the bottom. Thus, the essential readings and measurements appear on the photographs themselves, so that time-consuming work can be transferred from the sea-bed to the drawing-table, where it can be tackled at leisure. A full description of these methods by the surveyor, Mr J. C. C. Williams, has been published (1969).

In the area between the islands, where the position of individual cut stones had to be recorded (as distinct from the shape of large piles of rubble), the following method proved quick and accurate. A 30 m tape was stretched along the sand at the foot of the stone-fall, from one of the points already fixed by theodolite. Offsets were taken along this tape; the compass-plaque placed in each photograph recorded minor directional changes.

Appendix

Finally, it has been drawn to our attention that calculations of volume[4] are not currently used by archaeologists, as they are by most engineers. These quite simple calculations were made, in this case, mechanically, that is to say by using an instrument called a planimeter. The instrument is placed over a plan; the outlines of, for instance, a quarry are then followed by the instrument's mobile arm. The total horizontal area automatically appears on a dial. The reading is taken, and multiplied by the known average height of the quarry. The standard formula is: (1) designation of area; (2) surface area taken by planimeter; (3) average height of deposit or excavation × surface area = volume.

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