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REPORT OF PRELIMINARY UNDERWATER INVESTIGATIONS AT SALAMIS, CYPRUS

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REPORT OF PRELIMINARY UNDERWATER INVESTIGATIONS AT SALAMIS, CYPRUS

1. Previous studies

The ruins of Salamis cover an area approximately one mile along the shore and extending half a mile inland. The history and archaeology of the site has been described in a number of publications, and has been synthesised in a single comprehensive volume by Dr Vassos Karageorghis (Thames and Hudson, 1970). Excavation continues at a number of critical points on the site, and there is a large area still unexcavated.

The remains of the harbour to the south have been known for many years, and there have always been rumours of evidence of submergence. The evidence for submergence, and the possible extent of submerged ruins, has been very much in doubt. I have personally heard from people who have dived at the site, and received totally contradictory reports. In 1971 Linder and Raban visited the site and dived at the southern end of the lagoon. In an unpublished report they identify the reef off the present shore as the ancient shoreline, and mention ruins and a roadway in the water of the sheltered lagoon opposite the "stone forum" (*sic*), i.e. at the southern end of the lagoon. Their very rough sketch-map indicates an irregular structure in the area where we later found definite proof of a road. Linder and Raban make no estimate of the magnitude of submergence.

2. Tidal and Meteorological Data

A proper assessment of a relative change of land and sea level, and interpretation of the topography of the ancient harbour and coastline, depends on the tidal range, and wind and wave directions. The Nautical Almanac states only that tidal range is 61 cm. at springs and 30 cm. at neaps. A simple tide staff marked in centimetres was placed in the lagoon for 24 hours on July 14-15th 1973, and the tidal cycle measured (Fig. 1). There is a clear semi-

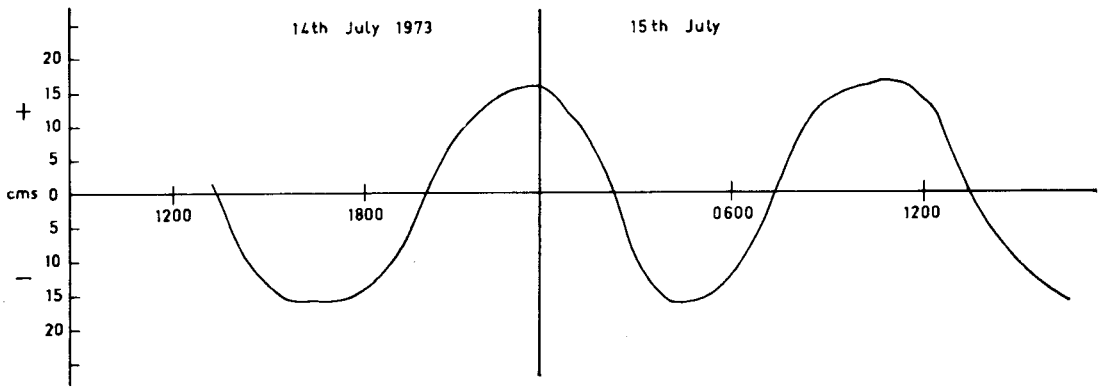


Fig. 1

diurnal tide with amplitude of 32 cm. There was full moon on July 15th, so that this measurement is accurate for the midsummer spring range.

It is desirable to have accurate wind measurements, both directions, frequency, and strength, but the admiralty pilot only gives figures for Limassol and Kyrenia, and that very out of date. Wind data would indicate the supply of sand to the shore as the result of storm waves, and hence the possible causes of erosion or deposition. Also, dominant winds determine what harbours are useful, and the best orientation of a harbour entrance. The pilot mentions that strong northerly and north-easterly winds do occur at Famagusta, and that particularly from October to March strong east-north-easterly gales can occur with heavy seas lasting up to three days (*ibid.* p. 38). In summer the winds are generally much lighter. The sea breeze starts in the morning from the south-east, and veers to south-west by the afternoon.

3. Topography and coastal change

The most remarkable feature of the coast at Salamis is the offshore reef which runs for about two miles along the coast about 100 m. from the beach. (Fig. 2). This bar is stratified beach rock, typical of an ancient shoreline, but detailed sampling and analysis would be valuable. Outside the reef the sea floor shelves gently and the bottom is sand. The shelving sandy bottom combined with the strong onshore winds would result in a continuous shoreward movement of sand. The reef is submerged at high water, and exposed at low water. Thus sand can be swept over it as well as passing through gaps. The floor of the lagoon was found to be covered in large irregular patches of sand, some thicker than others, as if dunes of sand were moving over the lagoon floor, or possibly growing and decreasing periodically. During storms when much sand is in the water, some of this would be swept onto the beach, and the onshore winds would sweep it over the city site in the form of sand dunes.

The general picture is one of continuous sand supply to the area, protecting the reef and coast from erosion, tending to infill the lagoon and harbour with sand, and supplying sand to the dunes over the city on land.

The fact that the strongest winds are from the east and north-east is compatible with a harbour entrance which is broad and open to the south. The curve of the shoreline south and south-east towards Famagusta is such as to minimise the fetch over which the wind can raise waves from those directions. However, a strong wind from the south-east is the one which would be most dangerous for the harbour.

4. Relation of the City to the Topography

The present reef is typical of the rock which forms inside a beach as the result of interaction between sand, sea water, freshwater, and sunlight. The exact process by which the rock solidifies is not understood, but there are many publications on the subject (Gifford, Stefanon, etc.). Thus at some time in the past the shoreline was almost dead straight and about 100 m. eastwards of the present shore. Beach rock usually forms up to a height of 1 m. above sea

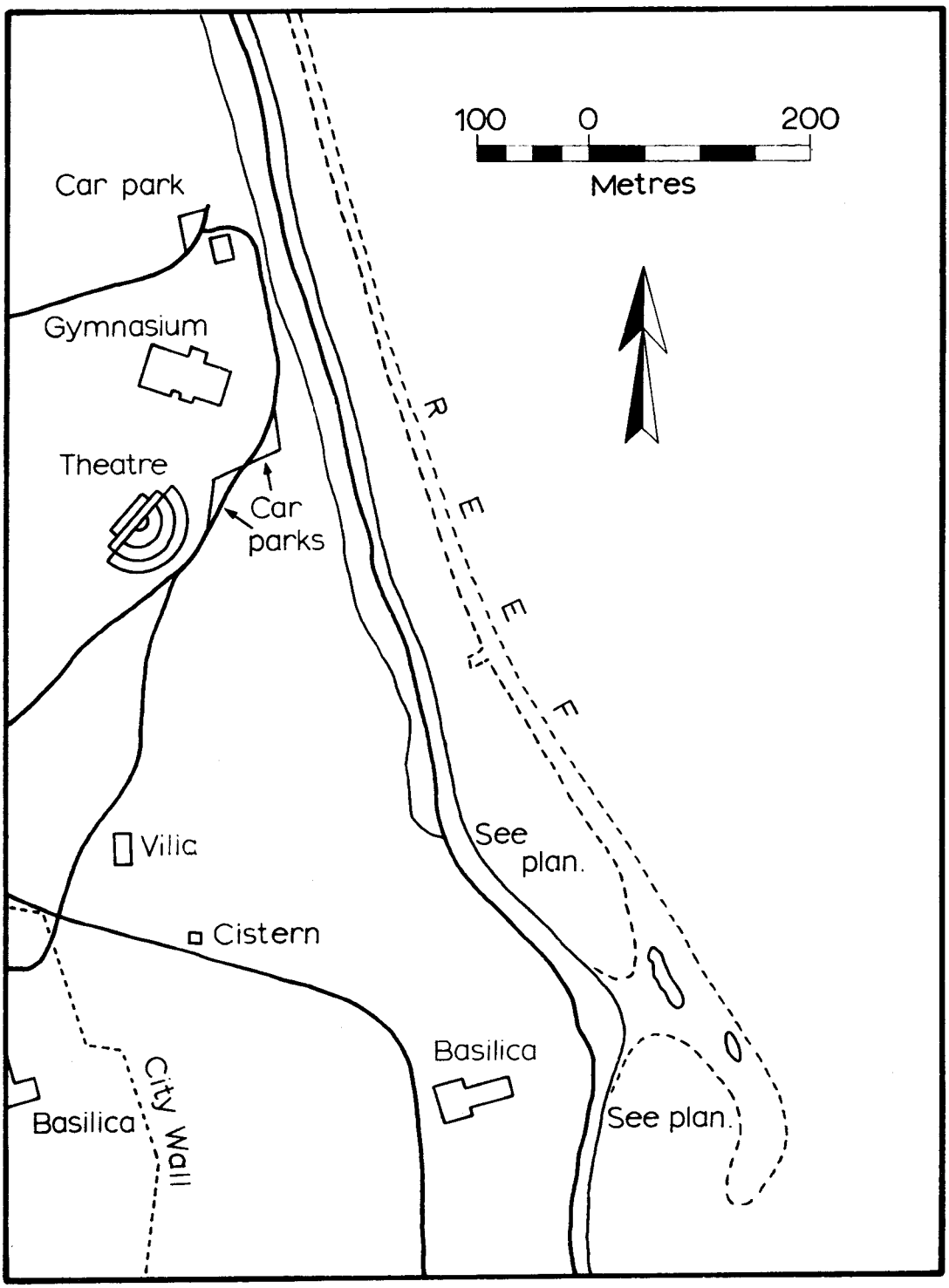

100 0 200
Metres
Car park
Gymnasium
Theatre
Car parks
R E E F
Vilic
See plan.
Cistern
Basilica
City Wall
Basilica
See plan.

Fig. 2

level, while the present reef is submerged completely by 0.5 m. at high tide. The top of the reef may have been broken off by waves, but the situation is equally compatible with submergence of about 1.5 m.

If the reef were the shoreline when the city was occupied, the coast would have been very straight, with no good harbours except for the bay to the south. It is in fact rather puzzling that the site was considered desirable for a major city, since most large sea ports are associated with an indented coastline, and several islands or bays which can be used for different purposes, or in different wind directions. Although there is no specific evidence it is just possible that there were breaks in the reef further north, and that another harbour existed. It would have been possible to draw vessels up on the shallow sand along the city sea front in summer, but this would have been too exposed to gales in winter. At the moment it appears that the basin to the south, with a diameter of about 200 m., was the only harbour. The size of this basin is comparable with that at Apollonia, Cyrenaica.

From the relative position of the harbour and the rest of the city, it follows that the major roads for transport and distribution of trade goods, produce, and ships' supplies must have radiated north and west.

5. Ruins at the southern end of the lagoon

Fig. 3 shows the area surveyed. Work was carried out by snorkeling, aided with ranging poles, drawing boards, and plastic 50 m. tape. A long swim showed that ruins continued at least half a mile northewards up the lagoon, but it was decided that a detailed survey should be made of a small area to produce specific evidence of the type of structures present.

The dominant features of the map are the two roads, one extending parallel to the shore up the length of the lagoon, the other diagonally across it. (Fig. 4). The north-south road is variable in width, but was measured in detail for block size and structure. At the northern end of the survey area it was 2.65 m. wide and bordered by ashlar blocks laid irregularly as headers and stretchers. The blocks project irregularly inward onto the road, or outwards into the surrounding rubble, as if keying the road surface into the nearby structures. The next section south is narrower, only 1.6-2.0 m. wide, of solid ashlar. This section is dislocated along its length with one part twisted relative to the next, as if shaken by an earthquake or beaten by waves. This also might be the effect of sand or earth being washed out from under the road surface.

Continuing south there is a length of well-fitted ashlar blocks, which broadens out into a triangular mass of masonry, partly broken, probably by water action. The sea floor by this road is about 1.45 m. below High Water (HW).

There is a space of 17.8 m. to the nearest point on the diagonal road. This area is covered in very large blocks which appear to have been roughly squared, but there is no continuous structural surface. The diagonal road consists of two parallel walls with a total width of 7.2 m. between their outer

edges. The blocks are all laid across the thickness of the walls, and average about 1.0 m. × 47 cm. The space between the walls is about 5.2 m., and no

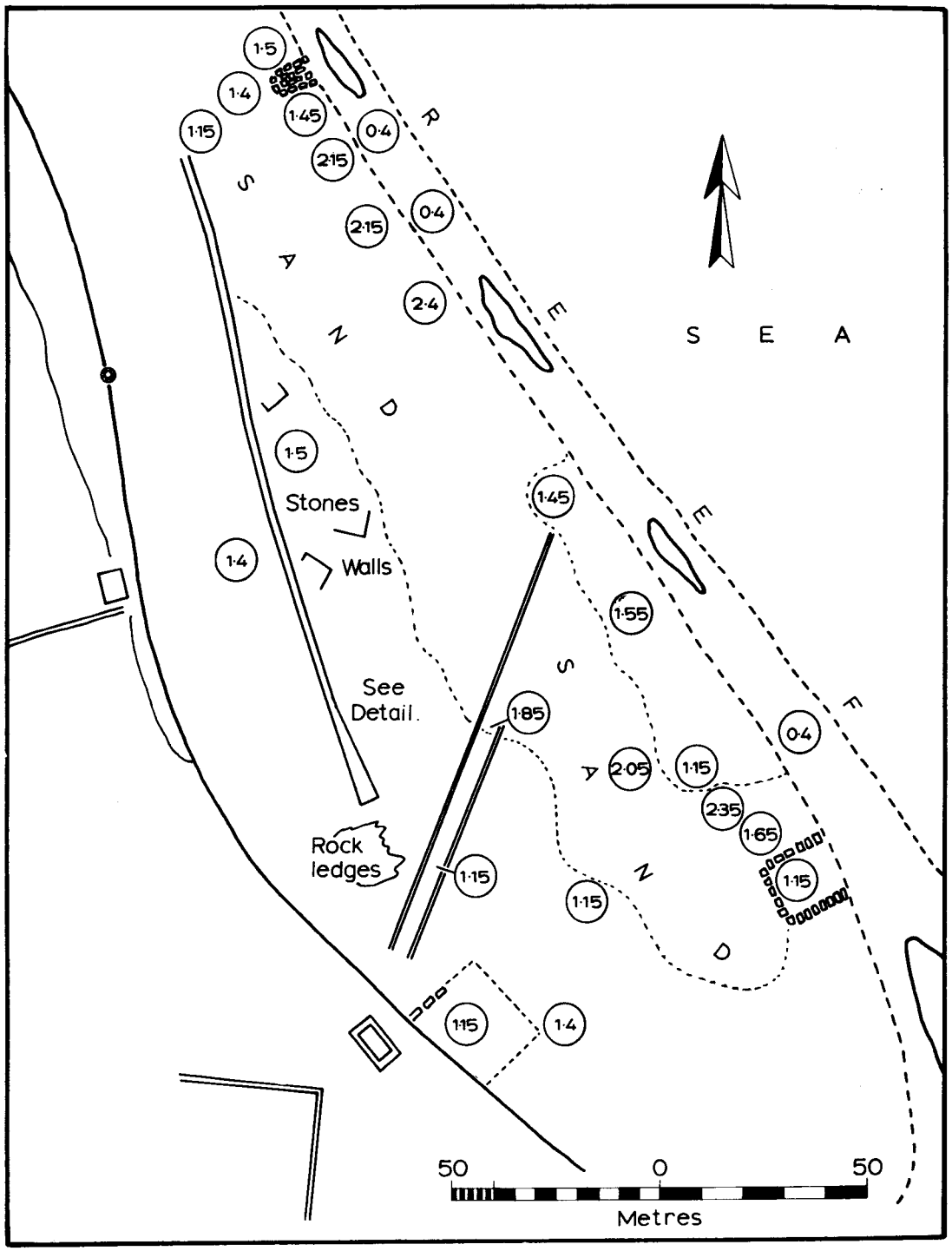


Fig. 3

surfacing material was detected, though this may have been concealed by sand and stones. The road extends for a distance of about 100 m. from the beach

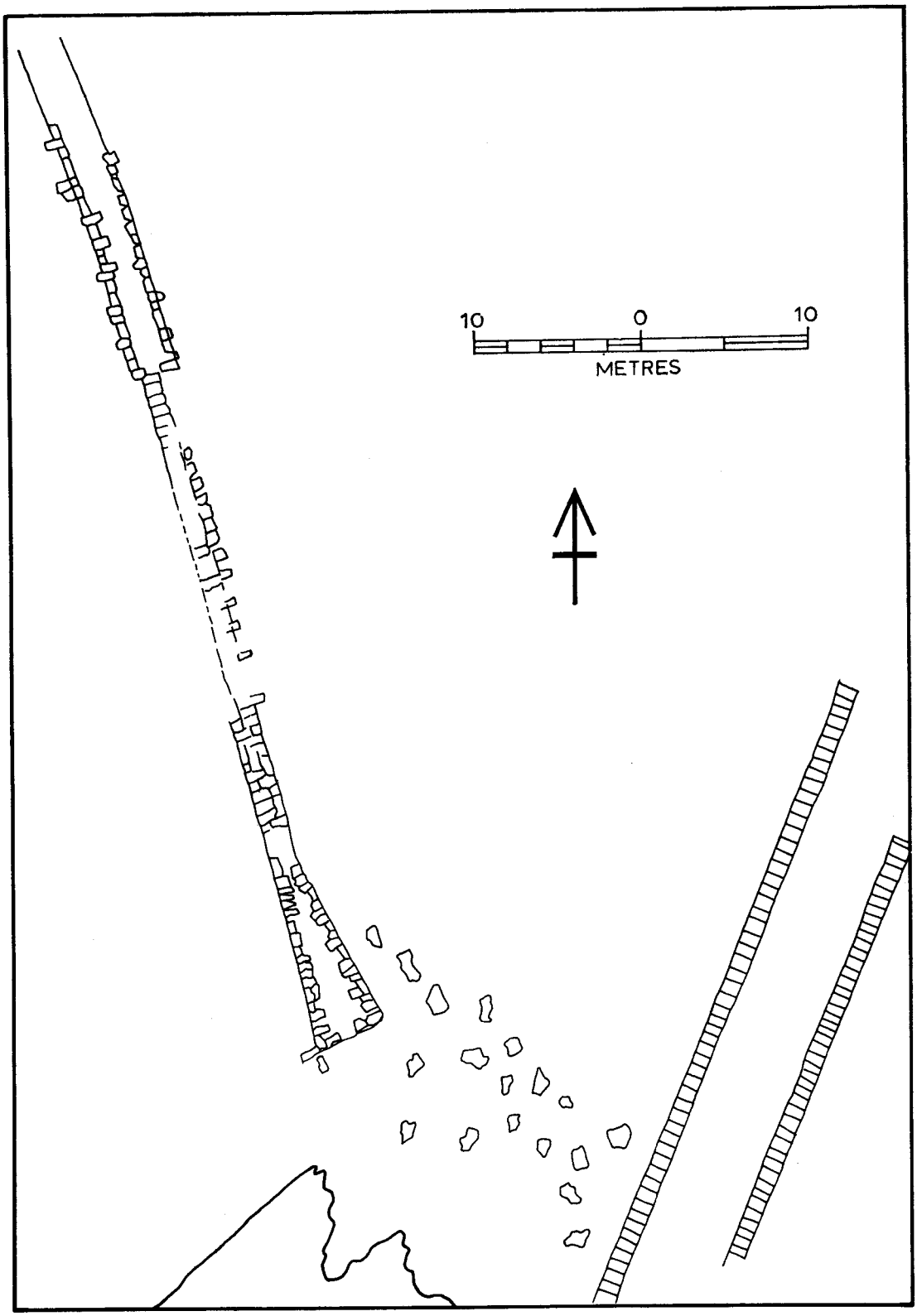


Fig. 4

across the deepest part of the lagoon, until it disappears into the confusion of stones and broken rock on the inside of the reef. At the deepest part of its traverse the road is 1.82 m. below HW.

The two roadways are the only features which were measured block by block. There are however the remains of many other structures in the lagoon. Just to the south of where the diagonal road joins the beach there is a rectangular foundation extending into the water, and several rectangular structures project back from the reef into the lagoon. The latter appear to have been solid platforms of ashlar designed to support buildings upon them. The whole area is scattered with rubble and pottery. Some typical pieces of pottery were raised, and given to the curator of the site at the main gate.

All the structures found underwater were of ashlar, or fairly well cut squared blocks set in regular courses. No mortar, concrete, or brickwork was found.

The deepest water found inside the lagoon in this area was 2.40 m. at HW, but this may not be a reliable estimate of the ground level when the site was occupied, as these deep areas were relatively restricted, and may have been scour pits, caused by eddy currents.

6. The South Harbour

Fig. 5 is a sketch of the South Harbour. The natural reef only extends

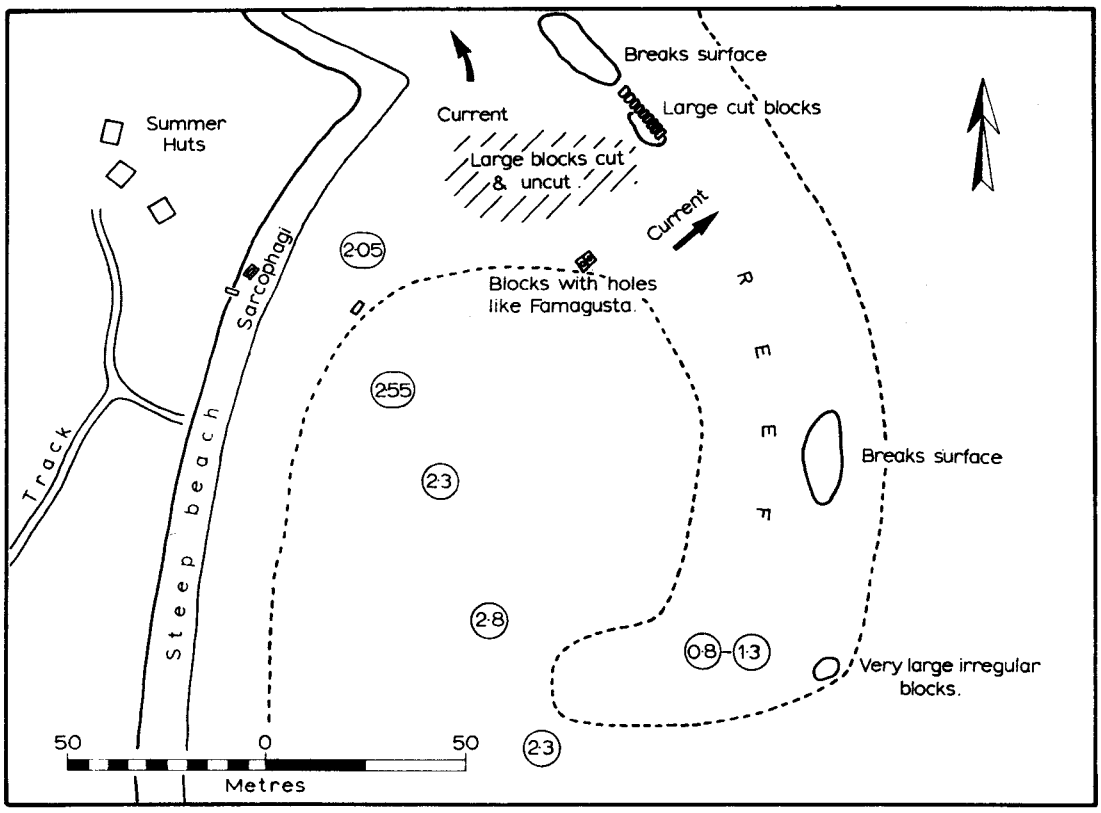


Fig. 5

a short way beyond the island to the south, and it then broadens and flattens out into a low ridge covered in stones. Through the gap between the island and the mainland shore there was a current flowing northwards at 1800 on 14th of July, when the tide was rising. It is not clear whether this current was due to the influx of tidal water, or was wind driven. Immediately south of the island a wall of massive blocks is probably the last remains of a large sea wall protecting the harbour. This wall only extends 50 metres or so above the surface, but cut and uncut blocks can be found all over the broad ridge as far as the outermost rocky projection above the water about 250 m. to the south.

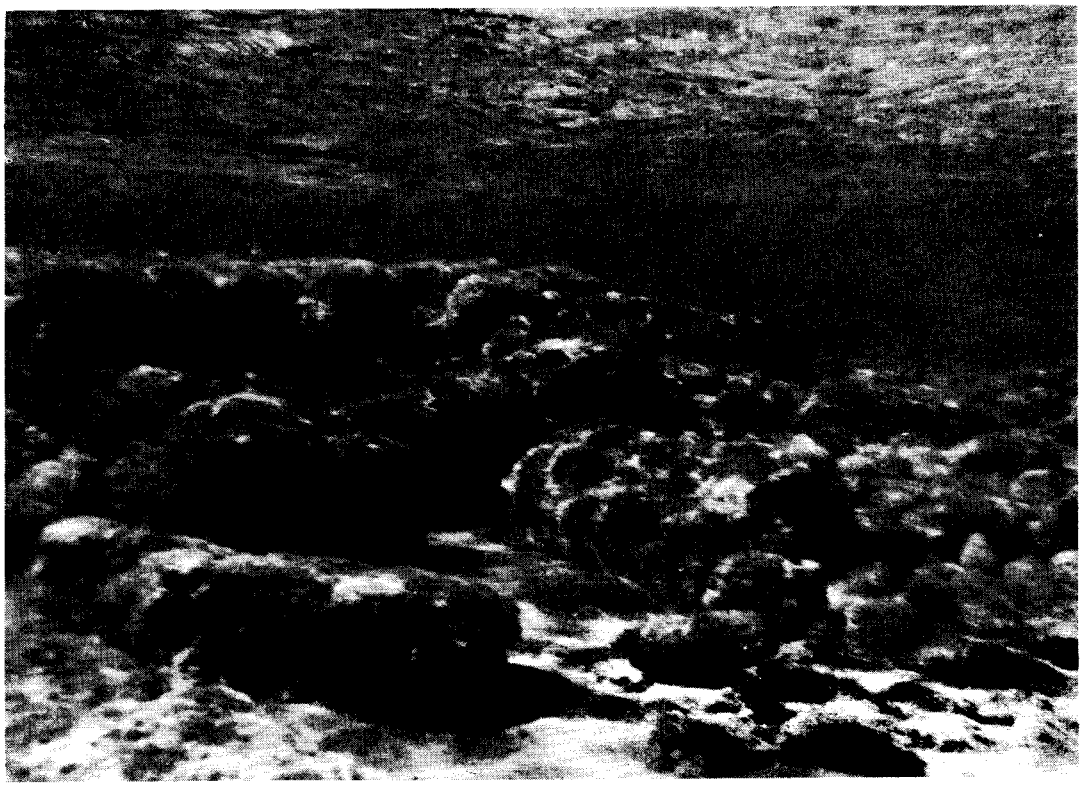
At the southern end of the ridge the water depth over the shallower areas was 0.80-1.30 m. at HW, and the end of ridge dropped steeply to 2.3 m. (HW). The end turned inland in a broad hook, partly closing the harbour mouth, but still leaving a broad entrance of nearly 200 m. width. A traverse across the basin indicated that the maxmimum depth was about 2.80 m. (HW) near the outer end of the ridge, and 2.3-3.55 m. in the centre of the basin. Around the margin of the basin irregular blocks of stone and squared cut blocks could be found on the sea floor to a depth of 2.0 m. (HW), while the main area of the floor of the basin was covered in sand. On the shore where the track comes down to the beach there were many sarcophagi being washed out onto the beach, and there are the foundations of towers and houses in the shallow water.

The ridge was clearly built up into a breakwater when the harbour was used. The presence of blocks down to a depth of 2.0 m. does not actually prove that the water level was relatively 2 m. lower, since these blocks are not in situ, and may anyway be the remains of quays built with their foundations in the water. However, taken in conjunction with the evidence from the roads in the lagoon, it is quite clear that the sea was relatively 1.8-2.0 m. lower at the time. The useful depth of the harbour would be limited by the amount of water at Low Water, which varied from 2.0-2.5 m. across the basin. If we subtract the change of level from this we are left with a depth of 0.0-0.7 m. maximum. This is plainly absurd, and it follows that the harbour must have filled considerably with sand. The accumulation of sand in the basin is consistent with the general deduction that the offshore profile and wind direction produce a steady shoreward sand movement on this coast.

No quays or jetties were found, and this combined with the rather poor protection of the harbour to the south, does not seem compatible with the main harbour of one of the largest and most important trading cities in Cyprus. This problem is completely unresolved. Further search might reveal more evidence of fortifications and harbour works in the southern basin. Alternatively, it is possible that there was another basin somewhere to the north.

7. General Conclusions

Salamis is now 1.80-2.0 m. lower relatively to the sea than it was when the harbour flourished. This submergence is commonly attributed to the earth-



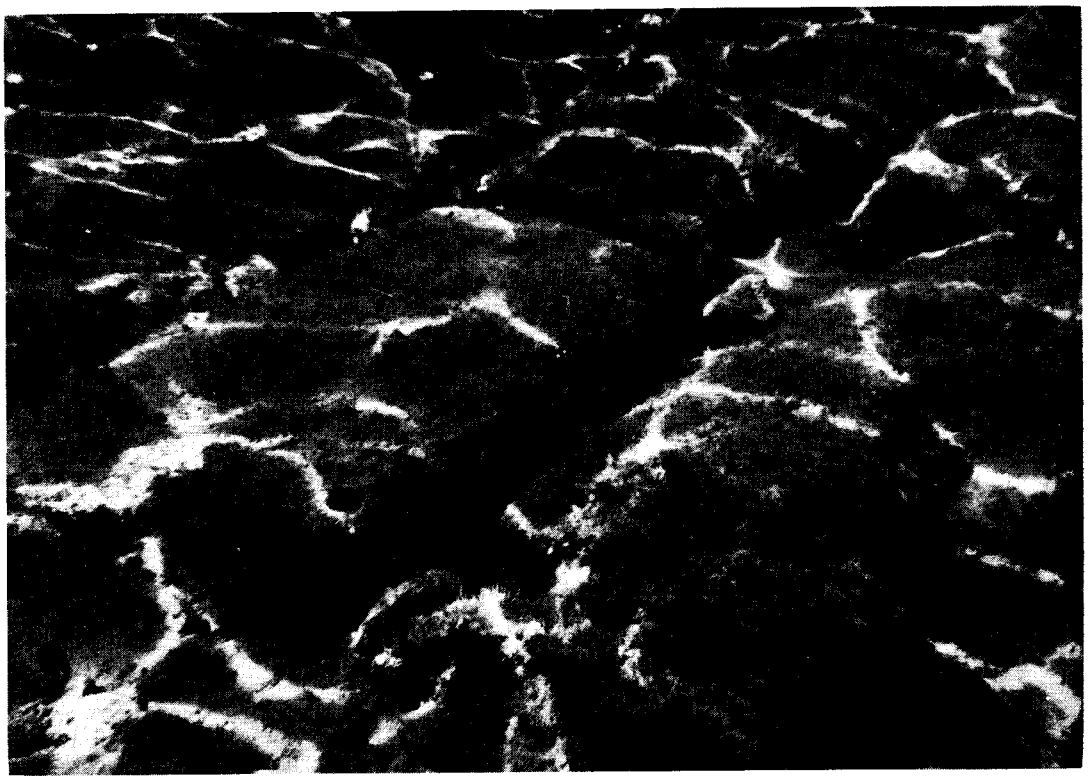


Fig. 6 (top). Fallen blocks from a platform of ashlar construction projecting back into the lagoon from the reef.

Fig. 7 (bottom). Ashlar wall of building at southern end of lagoon.

quake of 342 AD. Antonopoulos (unpublished thesis) quotes Malalas (lib XII. para. 0.415) to the effect that Salamis was partly submerged by this earthquake, and that there was no tidal wave associated with it. While this event is sufficient to account for the present observations, other later earthquakes may have increased the submergence.

Since the harbour was in one corner of the city, transport of goods from the hinterland would have been simple, probably coming in from the south

Fig. 8. Ashlar border to the road running diagonally across the lagoon. See figures 3 & 4.

west, but goods for the city itself would have been carried a considerable distance through the streets. It is possible that the long straight shoreline, with a main road along it, provided an important axis of the city.

The coastal reef is now, and was in the past, higher than the area where the roads are built, and thus we must envisage the original situation when the

road ran parallel to the shore in a depression, and separated from the sea by a sandy ridge about 2 m. high. A man walking on this road would not have been able to see the sea, and the sea would not have been visible from the ground floor windows of houses. This would have provided protection from winter storms, but would have been depressing in summer. If, as seems probable, people liked to see the sea then as much as they do now, buildings in the depression behind the coastal ridge would either have been residences of rather low value. If however the foundations were raised up so that buildings were level with the crest of the ridge, their value would probably have been greatly increased. This may be the explanation of the various large masonry platforms projecting back from the ridge.

The ridge is not absolutely continuous, and low parts or actual gaps, would have allowed direct access to the sea. One would expect a different kind of building in these areas, and these gaps may align with roads going back from the shore into the city.

8. Reccommendations

The harbour and area of ruins underwater at Salamis amply warrants a major submarine survey by a qualified team with experience of similar sites. It would be desirable to obtain aerial photographs first, either from a helicopter, or from a low flying aircraft. Suitable photographs may already exist. They should be as large scale as possible.

In any case surveying should be carried out as soon as possible, and cover the following points:-

1) Rough snorkel survey of the whole length of the lagoon, noting areas of particular interest and major structures.

2) Search in the lago on area for a possible second harbour.

3) Detailed survey of the south harbour to establish the true width of the entrance, its defensibility, and the presence of any loading quays or jetties. An echo-sounding survey should be made.

4) A detailed building by building survey of the structures in the lagoon, starting from the south and working northwards, or moving to other major structures if there are stretches with few remains.

5) Careful sampling of pottery throughout the site.

6) Detailed underwater photography.

An expedition to conduct this work would probably require 6-8 men, and 5-10 weeks on site. They should all be swimmers, and should have a good architectural or archaeological draughtsman so that the map can be drawn up as work proceeds.

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