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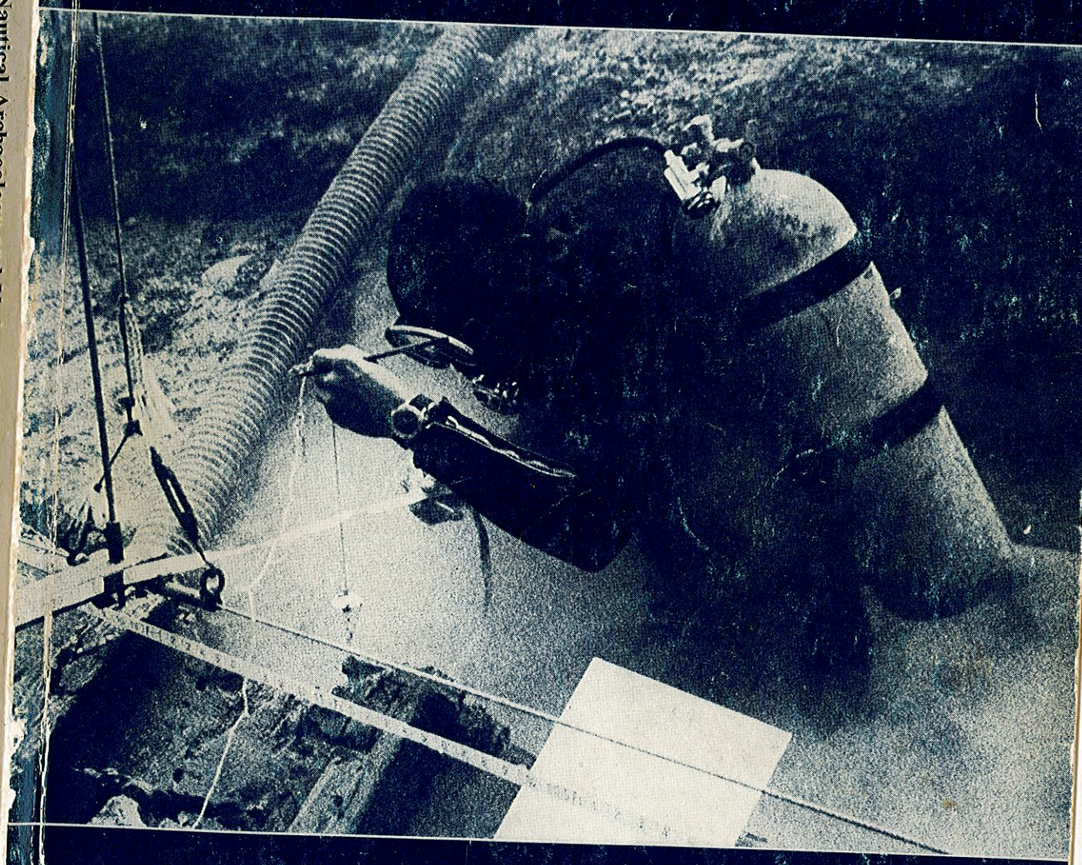

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island stronghold. On both sides of this ledge, the lake bed slopes away to a depth of 25 m. Along the ledge a causeway, in the form of a bridge, connects the fortified island with the northern lake shore near Seehausen. An extensive underwater survey revealed the main features of this bridge, which can be reconstructed approximately from a row of construction elements discovered on the lake bed. The bridge had a length of 2·2 km and a road-bed width of 3·6 m.

The simplicity of the bridge's construction was due to careful planning. Along either side of the line which the bridge was to follow, pairs of piles were rammed 1·5 m deep into the lake bed at 3-m intervals. The inner piles were vertical and were supported by the outer piles which leaned against them in such a way that their tops met above the water level. Over each pair of piles was fitted an oak beam whose ends were cut to form "eyes" at the desired width of the road. These cross-beams tied the piles together and at the same time supported the lengthwise beams over which the floor of the bridge was laid. This technique resulted in great stability. The bridge was, in effect, held together by its own weight.

While such construction—even if in comparatively modest form—was already well known from Teterow, a market town in the north of the DDR; knowledge of Slav bridge construction could be widened through further research in the Oberückersee. This could be obtained from evidence provided by the discovery of a second bridge linking the centre of the fortification with the west shore near Fergitz.

The first bridge made use of the natural ledge, permitting a simple construction. The second, however, had to cross parts of the lake 10–20 m deep over a length of 250 m. Even modern builders of permanent, stable, wooden bridges have difficulty in coping with such depths. Up to now, one had thought it unlikely, if not impossible, for the Slavs to overcome such difficulties. But it was possible to survey the layout of the bridge where it crossed the 20 m deep channel, and to take out well preserved structural elements. The construction of this bridge, which apparently stood for some time, was a considerable achievement reached by relatively simple methods. First the piles, up to 20 m long, were screwed into the clay lake-bed after having been soaked until waterlogged to lose buoyancy. Some of them, completely preserved, were found on the bottom of the lake. In this case the basic elements of support comprised groups of three piles, rather than two, placed closer together. The three single piles, again above water level, were once more bound together by the, previously mentioned, horizontal beams with large holes cut through the ends. These ran in two directions, first joining the groups of piles along the long axis of the bridge, 2·6 m apart; and secondly joining the groups together across the width of the bridge with longer beams cut with "eyes" (the distance between "eyes" being 3·6 m). This combination of beams formed a firm unit and at the same time acted as a support for the bridge surface.

The extensive building of bridges in the Oberückersee spanned a length of 2·6 km and depths of water up to 20 m. Such a technical achievement was not known until now, and it had been held by some to have been impossible.

Breite Luzien

Near Feldberg, the castle hill rises up more than 30 m above the Breite Luzien. The shape of the terrain reveals that it owes its origin partly to artificial influences. A large rampart, about 200 m long, confines a high saddle of over 2·5 ha.

Excavations in this fortress have given us a picture of about 600 to 1200 inhabitants, living in rows of houses closely packed together and protected by a city wall over 5 m high built of wood and earth, with a stone face. They gained their livelihood from agriculture and stock-farming, hunting and fishing playing only a small role. On a spur which projects into the lake for some distance to the east, separated from the castle by a shallow moat, are the remains of a sanctuary or cult place which could be seen by the inhabitants from above.

The castle seems to have been for a clan or tribe, and may be related to the immigration of Slavic tribes into the district; it had fallen into ruin already in the 8th or early 9th century.

It was expected that underwater research might bring to light remains of the fortress and its inhabitants from the bed of the Breite Luzien, whose waters wash the castle mound on two sides. A narrow pass leads a little to the north-west of the stronghold, from its northern gate, to a quiet inlet which must originally have served as the castle harbour. Besides, there are traces of a path which led from the probable cult place in the east to the lake. Divers from the Deutsche Akademie der Wissenschaften at Berlin, therefore, began their work in both places.

The bed of the shallow inlet is composed of thick layers of sediment and sunken driftwood. Eight "trenches" *c.* 0·6–0·8 m deep and equally wide were made in the lake bed with the aid of a pressure pump. These revealed a layer of wood waste and wood with traces of burning, about

0·5 m deep, together with potsherds. The layer had been deposited during the construction of the castle, its period of occupation and its final destruction by fire.

In and around these eight cuts, stratigraphically related to the castle remains, the divers found seven fish traps which had been abandoned after the destruction of the castle; those parts of the traps which had been covered with sediment were preserved. They had been made of cut pine strips, about 0·8 m long, fastened with fibres or willow twigs to a framework of willow hoops. The entrance channels on both sides of each cylindrical trap were composed of pointed pine strips; the binding between the sticks and hoops, as well as the arrangement of these channels, could often be observed and photographed *in situ* under water. In the middle of the cylinder, on at least one trap, three of the sticks had been eliminated for a distance of about 0·2 m, leaving an opening which was closed by short sticks made fast to the willow hoop. Apparently they could be opened in order to take out the captured fish. The discovery of fish traps of this period, and in so great a number is unique.

Near one trench the remains of a log canoe were hidden. This dugout had been fashioned from part of an oak log about 0·5 m in diameter and 3·5 m long. The sides of the craft had disintegrated, leaving only a large part of the bottom and the bow section preserved.

Greece

Halieis, at Porto Cheli in the Argolid

From Michael H. Jameson, Dept. of Classical Studies, University of Pennsylvania, Philadelphia, Pa. 19104.

The classical city-state of Halieis (7th–4th century BC, reoccupied in part 3rd–6th century AD) is located on the harbour of the modern village of Porto Cheli, a sheltered oval roughly 1·5 × 1 km in size. The southern and eastern margins of the harbour have been gradually submerged since antiquity so that in the northern part of the city one and, in places, two rows of buildings and a street, together with the city walls, towers, and gates are now under as much as 2 m of water; and are in effect being excavated by the encroachment of the sea. Systematic study of the remains in the sea was begun in 1965 by the University of Pennsylvania. A survey undertaken by David Owen and Frank Frost produced a plan of the submerged area within the city walls. They also excavated a room of the bath of Roman date, built above a classical gate and tower, and revealed the outlines of the tower on what is now a reef in the harbour. They used mask and snorkel and made their plan by triangulation. In 1969, Pennsylvania was joined by Indiana University. Further work by M. H. Jameson, John Wollerton and Mrs Stephen Martin showed that an apparent gap in the line of the city walls was filled by the mole for a small enclosed harbour whose entrance was dominated by two circular towers. A limited amount of excavation was undertaken by means of a pump and a Galeazzi nozzle, operated by divers using hookah equipment. Mapping and general exploration was greatly facilitated by the use of a balloon-borne camera employed by Julian and Eunice Whittlesey. In 1968 an enlarged crew returned to excavate portions of the city wall and its towers and especially the construction for opening and closing the entrance to the enclosed harbour. In addition to further use of balloon photography, portable dredges were employed for excavation. An account of the results of that and the previous seasons' work, together with a description of the methods and equipment, can be found in *Hesperia*, **38** (1969): 325–40.

In the summer of 1970 a large complex of buildings outside of the city walls, on the north-east side of the present harbour, was investigated. Two dredges, connected to a series of galvanized iron irrigation pipes, so as to carry the discharge out into the harbour, were operated from a movable platform of metal scaffolding set in about 1·5 m of water. Alfred Kann was technical supervisor. Again the Whittleseys provided balloon photography for detection and recording.

The complex proves to be a large sanctuary of the 6th and 5th century BC with its origins probably in the 7th century (it is not yet clear whether it survived into the 4th century BC). The oldest and most interesting building is a long narrow shrine of which less than a fifth was excavated this season. Its construction is distinctive, and violent destruction around the middle of the 5th century has preserved a rich deposit, some 0·13 m deep above the floor. The contents include much votive pottery, a hoard of 18 silver coins of Aegina, and marble statuary. A stoa immediately to the east is later in date. To the south are the foundations of a monumental altar, possibly for a classical temple, yet to be located, a successor to the archaic shrine. A hostel or bath complex lay along the east side of the area. On the south is the starting line of a race course for athletic competition, flanked by con-

structions on both sides, which will extend some 180 m to the south. Exploration and excavation will be continued in 1971. A report on the 1970 season will appear in *Archaiologikon Deltion: Chronika*.

Pelagos, Northern Sporades

From G. F. Bass, Pennsylvania University Museum, 33rd and Spruce Streets, Philadelphia, Pa. 19104.

In 1968, G. F. Bass and L. T. Joline inspected and photographed a Byzantine shipwreck at Pelagos for the Greek Department of Antiquities. The wreck had been partially looted the previous summer by a German diver who had raised over 100 glazed plates, thought at the time to be of the 13th century. The illegal activity had been stopped by the local authorities, and over 50 of the plates had been confiscated.

This, almost certainly, is the same wreck which was announced as discovered in 1970 off Halonnesos Island, a large island not far from Pelagos. According to the New York *Times* (7 November 1970), Nikolaos Yialouris, director of antiquities, stated that the ship was 66 ft (20 m) long and that in 1970 about 1500 plates were raised from it; the glazed wares, decorated with animal and geometric designs, indicate now that the ship sank around AD 1150. The excavation was undertaken by the Greek Department of Antiquities, using Peter Throckmorton's research ship, *Stormie Seas*, as a headquarters; Mr Throckmorton served as technical adviser for the project. Further diving on the site, at depths between 100 and 135 ft (30–41 m) is planned for the future.

Porto Longo, Sapienza Island

In 1969 and 1970, Peter Throckmorton directed a survey of the harbour using sonar and a proton-magnetometer. Collaborating with him were Harold Edgerton of M.I.T., E. T. Hall of the Research Laboratory for Archaeology, Oxford, and Fred Feyling; Dr Spiridon Marinatos was overall director of the project. After a topographical survey of the harbour had been made in 1969, sonar located a number of anomalies; exploratory trenches at these points indicate a number of wrecks beneath the sediment, including those of a 19th century Greek ship, a Byzantine ship, and H.M.S. *Columbine*. The survey, for the Greek Antiquities Service, was a continuation of an earlier project in which, in 1963, Mr Throckmorton had studied the processes of dissolution in wooden wrecks, using the *Heraclea* (sunk in 1940) and an unidentified Austrian brig (sunk in 1860) as examples.

And see D. Frey, p. 170.

Throckmorton, P., 1970, More lost ships, *Expedition*, **13**(1): 35–40.
Throckmorton, P., 1964, Ships wrecked in the Aegean Sea, *Archaeology*, **17**: 250–256, for the earlier work.
Throckmorton, P., 1969, *Shipwrecks and archaeology*. Boston/Toronto.

Hungary

From Agnes Salamon, Archaeological Institute of the Hungarian Academy of Sciences, 49 Uri Street, Budapest 1, Hungary.

Actual underwater archaeological research has not yet been undertaken in Hungary, largely because visibility in the rivers is often restricted to less than 1 m. Very frequently, however, objects of all periods, including many ancient artefacts, are raised from the Danube by dredgers. Also, we know of many Roman settlements on the shores of the Danube which are already partially covered with water, especially because of the changing beds of the river and Lake Belaton. Such settlements are, for example, Fenéktuszta and Örvenyés. We also know of Roman bridge foundations in the Danube, clearly visible when the water is low; one of these is at Nógrádveröcénél.

Israel

From Elisha Linder, Undersea Exploration Society of Israel, 21, Dereh H. Golani, P.O.B. 699, Haifa.

The Mediterranean

As part of the preparations for publication of the 10th Anniversary volume of the Undersea Exploration Society (which will include summaries of the most important projects carried out by us) we mapped and recorded anew a number of harbour installations of Akko and Athlit, the former from the Roman period, and the latter a harbour from Phoenician-Hellenistic times. A

series of underwater photographs, exact and detailed drawings of architectural remains, and trial excavations for ceramic stratigraphy have been carried out.

During the autumn (the season with the best visibility along our Mediterranean coast) a great number of our members were busy surveying along the coast. Working in teams of six to ten, divers at a given location covered more than a dozen ancient sites previously studied and now resurveyed. During these operations, the following new discoveries were made:

i. A number of swords, an anchor and copper utensils from a Crusader wreck in shallow water, though nothing of the ship could be found.

ii. Remains of a 17th century merchantman which carried a cargo of metal scrap which included lead, silver and brass bars, pieces from Roman sculpture, Hellenistic silver coins, copper household utensils and well preserved 15th century cannon.

iii. Relics from a 4th century BC wreck which included silver coins and pottery, washed ashore and found in shallow waters.

iv. A submerged Chalcolithic site (4th millennium BC).

The Sea of Galilee

During our recent surveys of the coast of the Sea of Galilee, two ancient anchorages were discovered, in Kursi (the site of the miracle of the pigs) on the eastern coast and at Tabgha on the northern shore. These man-made harbour installations were measured, photographed and mapped in detail.

The Red Sea

We are in a final stage of preparations for a joint Israeli-American expedition which will take place in January-February 1971 in the northern part of the Gulf of Eilat. This is the second phase of an earlier survey carried out by us in 1968, in co-operation with a British group headed by A. Flinder. We shall make a sonar/magnetometer survey around the "Coral Island" (perhaps King Solomon's Red Sea harbour) in search for ancient wrecks buried under the heavy silt which accumulated during the centuries in the narrow strait between the island and the mainland.

We are now preparing final reports on various sites explored in 1970 which will be incorporated in the forthcoming anniversary volume of our Society, to be published in 1971.

Italy

Straits of Messina (at Porticello)

From David I. Owen, The University Museum, 33rd and Spruce Sts., Philadelphia, Pa. 19104.

The University Museum-Geographical Society of Philadelphia Expedition undertook the investigation of the site of a looted 5th century BC shipwreck within the Straits of Messina at the village of Porticello. The wreck lay on a gently sloping bottom 33–37 m deep, about 225 m from the mainland shore. With the help of a three-man US Navy diving team we conducted a metal-detector survey of the 600-m² site. String corridors were laid out over the wreck and divers with the detector followed these lanes, marking all contacts with wooden stakes. The contacts were later excavated by hand or with the help of a portable air lift. Triangulation of finds was done from a series of fixed points established throughout the wreck site. The survey-excavation continued for four weeks.

Excavated finds included eight amphora types (Carthaginian, West Greek, and Mainland Greek), two black glazed, two-handled cups (bolsals), fragments of cooking ware, half a loaf-shaped lead ingot, silver nuggets and sections of pancake silver ingots, a wooden bowl, a wooden cleat, a wooden fishing reel, a wood-handled iron-tipped awl, bronze anchor fluke tip shields, lead parts of anchors, scattered fragments of the hull including mortise-and-tenon joints, large copper clenched and straight nails, and lead sheathing.

Finds from the ship recovered from looters included fragments of two life-size bronze statues of the Classical period, one stamped loaf-shaped lead ingot, two black glazed lamps, a pitcher, a cooking pot, and a terracotta mortar, along with other miscellaneous finds.

Finds from the wreck lost, sold, or destroyed, included at least three lead anchor stocks (two inscribed), the largest of which weighed about 1000 kg; 15–20 loaf-shaped lead ingots; 100–200 amphoras of a variety of types; many pitchers, animal-shaped rhytons and numerous black glazed cups, bowls and plates. One bronze head was later examined by a museum in Switzerland.

On the basis of the finds we have dated the ship to the last quarter of the 5th century BC. The bronze statues probably predate the shipwreck by as much as 50 to 75 years. No further excavation of the site is planned, although we will return in the summer of 1971 to complete the study and publication of the finds.