Underwater Excavations at the Etruscan Port of Populonia

Professor Nino Lamboglia *in memoriam*

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This article and the following companion article by John Peter Oleson are concerned with the results of excavation, survey, and research at two ancient ports on the Tuscan coast of Italy. The work discussed is part of a larger scale study of harbors on this coast and has been sponsored since 1965 by the American Academy at Rome. The first article is a report on Populonia and is presented in three sections: Anna Marguerite McCann discusses the Project and the excavations, Joanne Bourgeois provides a description of the geologic setting, and Elizabeth Lyding Will comments on amphoras and trading activity in Roman times.

Evidence for the location of the ancient port, breakwater, and anchorage area of the Etruscan city of Populonia is presented. From both archaeological remains and geological evidence a rise in mean sea level at Populonia of up to 2.5 m. since Etruscan times is indicated as well as a recession of the coastline of 80 to 120 m. Possible evidence for an ancient ship (ore barge?) was found in an area yielding worked logs with a radiocarbon date as early as 840 B.C. Pottery found in the harbor indicates the span of the commerical life of Populonia from the 6th century B.C. through the 3rd century A.C., with the majority of finds from the 4th through the 2nd centuries B.C. The large series of "Greco-Italic" amphoras from this period have special significance as they are among the earliest thus far found in Italy.

1. The Project and the Excavations

by ANNA MARGUERITE MCCANN

The project to survey and study the ancient harbors along the Tuscan coastline of Italy was begun by the author in 1965 under the auspices of the American Academy in Rome. This article (including the reports by J. Bourgeois and E. L. Will, and the accompanying article by J. P. Oleson) present the results of this research project in which archaeologists and scientists have joined in both the excavation and publication of the material. In a study of ancient harbors where recovering the line of the ancient seacoast is an essential aspect, geological data has proved essential to the archaeological interpretation, as these joint articles reveal. Moreover, the expertise of E. L. Will on ancient amphoras has been invaluable in indicating the particular significance of this large body of port material. In an underwater survey where the aims, as here, were to cover a large area and obtain evidence for the location and use of the harbor itself, specific find spots for material recovered were not always obtained. For the two amphoras E. L. Will has selected for study, P70-67 comes from the presumed ancient channel area of the harbor and was found between points U16 and U19 on the grid survey map (FIG. 4). Amphora P70-84 was recovered in the SE area of the gulf, off the present pine

Figure 1. Aerial photograph of Populonia (Golfo di Baratti). North is at upper left. Photo: kindness of Gen. G. Schmiedt, Florence, Istituto geografico militare.

grove in square 5 on the map published as Figure 3. J. Oleson, as assistant archaeologist and diver, was in charge of the underwater work at both Populonia and Pyrgi in the summer of 1974. The results reported below are largely due to his efforts and are drawn from his report. To a fine team of scholars from various fields of study, I owe my grateful thanks. Further study of the pottery is projected by F. Pallarés and E. L. Will, the latter of whom is continuing a study of the amphoras as a whole. To the late Professor Nino Lamboglia we all gratefully dedicate our efforts here. Without his aid and expertise in this field of underwater archaeology to which he contributed so much, our work in 1974 would not have been possible.

Historical Background

Populonia is the only one of the Etruscan cities founded directly on the seacoast of ancient Etruria[1] and therefore selected for special study in our survey of ancient harbors outlined above. If the Etruscans were engaged in such extensive seafaring as the ancient sources indicate,[2] it seemed logical that Populonia would yield the evidence. Populonia is located ca. 140

1. Strabo v. 2.6; Pliny *nat. hist.* iii. 8.

2. For their reputation as sea-pirates see Strabo v. 2.2; v. 3.5; vi. 2.2. For the Etruscan naval defeat of the Phocaeans at Alalia in Corsica between 540 and 535 B.C. see Diodorus v. 13 and Herodotus i. 166. For the naval defeat of the Etruscans at Cumae in 474 B.C. by the Syracusans and Cumaeans see Pindar *pyth.* i. 71; Diodorus xi. 51. For those who accept Herodotus i. 94 that the Etruscans originally came by sea from Asia Minor, the evidence of the Etruscans as a sea power is not surprising. For a summary of these arguments and other theories see H. H. Scullard, *The Etruscan Cities and Rome* (London 1967) 43-57 or L. Banti, *Etruscan Cities and Their Culture* (Berkeley and Los Angeles 1973) 208-211 and 303 for bibliography.

miles north of Rome and was famous in antiquity as the center for the working of iron ore brought by ship from the mines of Elba.[1] It is likely that in Populonia's wide gulf, with its shoreline of over 1.5 miles, there were facilities for both protection and unloading (FIG. 1). In fact, the quantity of ore smelted there must have been immense to judge from the slag still remaining in the banks of her present shore. It has been estimated that about 10 million tons of ore were transported and worked each year during the most active period of Populonia's industrial life from the late 5th to the 1st centuries B.C.[4]

Previous archaeological study of Populonia has been concentrated on the excavation of the rich tombs that dot her shore.[5] The ancient city on the hill lies still unexcavated. Material found from the tombs may go back as early as 1000 B.C., representing some of the earliest non-Italic finds in Italy and has been used as evidence for settlement by an Aegean people, possible forerunners of the Etruscans who emerge at Populonia in the beginning of the 7th century B.C. following an earlier Villanovan occupation of the site.[6] Their culture continues without interruption into Roman times and it is not until early in the 1st century B.C. that Populonia becomes a *municipium* of Rome, two centuries later than most of the other Etruscan cities.[7] But by early imperial times the ancient citadel on the hill lay deserted, except for the temples, and life centered around the port town which, according to Strabo, had a small harbor and two docks at the base of the mountain.[8] By the 5th century A.C. when the praefect Rutilius Namatianus visited the city (in 416 A.C.) on his way home to Gaul, even the port town was deserted.[9]

The height of Populonia's commercial life was thus in the late Classical and Hellenistic periods when most of the cities in southern Etruria were on the decline. Her continued prosperity was undoubtedly due to the life of her port and the working of the iron ore which took place there. Her wealth during these years is reflected in her gold and silver coinage which is the oldest and richest in Etruria.[10] While we know of no great art manufactured in this predominantly industrial city, ships could easily bring imported work to her shores; the famous "Piombino Boy", for example, was found

3. Strabo v. 2.6; Diodorus v. 13; Livy xxviii. 45; Servius *comm. ad Verg. Aen.* x. 174.

4. The working of iron at Populonia apparently did not begin on a large scale until the end of the 5th century B.C. Her earlier wealth, reflected in the rich bronze finds from her tombs of the 7th and 6th centuries B.C., was based on the exploitation of copper from mines in her own hinterland; see Aristotle *de mir. ausc.* 93. For a history of Populonia's mineral industry see A. Minto, "L'antica industrie minerarie in Etruria ed il porto di Populonia," *StEtr* 23 (1954) 291-319. On the ancient smelting of iron in general see T. A. Rickard, "The Primitive Smelting of Iron," *AJA* 43 (1939) 85-101. See also below, Section 3 by J. Bourgeois.

5. A. Minto, *Populonia. La necropoli arcaica* (Florence 1922); idem, "Le ultime scoperte archeologiche di Populonia (1927-1931)," *MonAnt* 34 (1931) 289-420; idem, *Populonia* (Florence 1943) with earlier bibliography; A. Åkerström, "Studien über die etruskischen Gräber," *Acta Instituti Romani Regni Sueciae* 3, 1 (1934) 139-159; A. de Agostino, "Populonia (Livorno). Tomba etrusca a camera scoperta nella zona 'Podere S. Cerbone'," *NSc* (1953) 7-9; idem, "Nuovi contributi all 'archeologia di Populonia," *StEtr* 34 (1955-1956) 255-268; M. Demus-Quatember, *Etruskische Gräbarchitektur* (Baden-Baden 1958) 17; A. de Agostino, "Populonia (Livorno). Scoperte archeologiche nella necropoli, negli anni 1957-1960," *NSc* 15 (1961) 63-102; idem, *Populonia. La città e la necropoli* (Rome 1965).

For a study of the archaeological zone as a whole see idem, *Populonia. La zona archeologica e il museo* (Rome 1963). For a study of the fortification walls see idem, *"Forma Etruriae.* Contributi per la carta archeologica. Etruria Toscana. La cinta fortificata di Populonia," *StEtr* 30 (1962) 275-282. For further bibliography on Populonia see "Populonia," *RE* XXII, 1 (1954) 91-100, (G. Radke); P. Bocci, "Populonia," *EAA* 6 (1965) 378-380; Istituto geografico militare, *Atlante aerofotografico delle sedi umane in Italia, 2. Le sedi antiche scomparse* (Florence 1970) pl. lv (Cr. Schmiedt).

6. See Scullard, op. cit. (in note 2) 41-42 with bibliography.

7. Minto, *Populonia*, op. cit. (in note 5) 279-280.

8. Strabo v. 2.6.

9. *De reditu suo* 1.401.

10. Because of a lack of evidence, there is still a good deal of uncertainty concerning the mints and chronology of Etruscan coinage. The gold and silver coins of Etruria are peculiar for they usually have a smooth reverse. The only analogy for this feature are archaic coins from Cyprus (G. K. Jenkins, *Ancient Greek Coins* [London 1972] 202-203). The coinage of Populonia, however, may be distinguished metrologically from that of most of the other Etruscan cities by its use of the Syracusan litra system: G. K. Jenkins, "Recent Acquisitions of Greek Coins by the British Museum," *NC* 19 (1959) 23-45; *Sylloge Nummorum Graecorum: The Collection of the American Numismatic Society, 1. Etruria-Calabria*, (New York 1969) pls. I-II. The one exception is the neighboring city of Vetulonia which also used the Syracusan litra system, making for confusion in the attribution of some of the silver coinage: G. Castellani, "Monete trovate nel territorio dell'antica Vetulonia," *StEtr* 5 (1931) 587-591. The gold issues have usually been considered earlier than the silver and the didrachms with the mark of value, XX (20 units), considered later than those marked with a single X (10 units). Jenkins believes the coins with the Gorgon's head cannot be before the late fifth century and other scholars date some as late as 225-200 B.C.; C. M. Kraay and M. Hirmer, *Greek Coins*, London 1966, pl. 111, nu. 327. In a recent study by Robert F. Sutton, entitled, "The Populonia Coinage and the Second Punic War", shortly to be published in the *Atti del V convegno internazionale di studi numismatici. Studi introduttivi alla monetazione etrusca* as a supplement in the *Annali. Istituto italiano di numismatica*, new evidence is presented for the late 3rd century B.C. for both the gold and silver coinage of Populonia. He argues that the series was struck on the same standard as the Roman denarius and issued simultaneously with the earliest denarii, probably between 214 and 211 B.C., to pay for Etruscan expenditures during the second Punic war.

Figure 2. Aerial view of breakwater at Populonia. N is at top. Photo: J. Whittlesey.

off the SW point of the harbor in the late 19th century.[11] Populonia apparently remained active in the iron trade until the 2nd century A.C. when evidence that her control had passed over the Alps to Carinthia is found in her importation of axes from the region of Klagenfurt in Austria, a good indication that her own workshops were deserted.[12]

11. For a date in the 5th century B.C. and arguments that the statue was made in Magna Graeca see R. Lullies and M. Hirmer, *Greek Sculpture* (New York 1960) pls. 92-95; J. Charbonneaux, R. Martin, F. Villard, *Classical Greek Art (480-330 B.C.)* (New York 1972) 102-104, fig. 110. For evidence indicating a date in the 1st century B.C., see B.S. Ridgway, "The Bronze Apollo from Piombino," *Antike Plastik* 7 (1967) 43-75, pls. XXIV-XXIV. This writer finds the latter argument more convincing.

12. R. Egger, "Die Stadt auf dem Magdalensberg, ein Grosshandelsplatz," *Denkschr. Ost. Akad., phil.-hist. Kl.*, 79 (1961) 8, note 30, pl. II,30.

Survey and Excavation

There were several limited investigations of the underwater area before 1970. In 1960 the Centro Sperimentale di Archeologia Sottomarina explored an area of the gulf[13] and in the same year A. Olschki excavated with an air-lift in the SE area of the gulf ca. 120 m. out from the shore.[14] He reported finding enormous pottery jars (perhaps the Latin *dolia*?) which he suggested belonged to a cargo of a sunken ship. He also described the breakwater (FIG. 2) formed from locally cut blocks of *Macigno* sandstone and *panchina* (beachrock) laid upon a bedrock foundation of *pan-*

13. "Prime indagini su Populonia sommersa," *Forma Maris Antiqui* 3 (1960) 358-359.

14. A. Olschki, G. Marinelli, "Ricerche archeologiche subacquee nel Golfo di Baratti," *Atti del II Congresso Internazionale di Archeologia Sottomarina* (1958) 117-123.

china which extends northward from the southern point of the gulf. He suggested, as does Cardarelli in his most recent study of the maritime activity of Populonia,[15] that the ancient inhabitants chose the port site partly for the natural protection offered them to the south, which they in turn artificially reinforced. In 1969 the English oceanographer N. Flemming,[16] reporting information given by Blaber notes the presence of round structures underwater lying on top of the mole, structures which we did not see. All these investigators, as well as General Giulio Schmiedt,[17] have noted evidence for a decided change in sea level since ancient times. Flemming suggested that the sea level has risen as much as 2 m. Geologists who have studied this coastline have noted changes in sea level in the Quaternary period resulting from eustatic fluctuations.[18]

With all this in mind, and also seeking possible predecessors in the Etruscan world for the Roman port at Cosa,[19] the first of the ancient harbors surveyed in the Tuscan port project, we began work at Populonia with a small American diving team in the summer of 1970.[20] Our goals were, first, to examine and define the presumed area of the ancient port below the cliffs on the SW (FIG. 2) and map any remains found; secondly, to obtain datable material from this area to document the harbor's construction and use; finally, to survey as much of the remaining gulf as possible with the hope of also defining the line of the original ancient coast. We continued to pursue these goals in 1974,[21] collaborating with the Italian team from the Centro Sperimentale di Archeologia Sottomarina directed by the late Professor Nino Lamboglia and assisted by Dr. Francesca Pallarés.[22] The results of both expeditions are shown on a new map of the underwater area (FIG. 3).

In 1970 after a systematic underwater search of the gulf area for a distance of ca. 250 m. to 300 m. out from shore (shaded areas on map, FIG. 3), it was decided to concentrate in the area of the present small fishing harbor where natural features offer the best protection for anchorage in the gulf. This natural protection of the land on the west is strengthened today by a wide breakwater made of uncut rock which serves to break gradually the force of the waves rolling in from the NW. The question was whether or not below this modern protection could be found an ancient one. Because of the dense growth of weed over the main area to be explored, after baselines were set up on land, a 15 m. grid was laid out measuring 210 m. (E-W) by 270 m. (N-S) (FIG. 4). By using movable 15 m. lines with attached floats and weights (cans filled with concrete), a diver working with a skin diver on the surface to aid in moving the grid and keeping the line taut was able systematically to record bottom conditions, depths, rocks and potsherds. Where visiblity was poor a 1.5 m.

15. R. Cardarelli, "De ora maritima Populoniensi," *StEtr* 31 (1963) 502-531, especially 508, note 6.

16. N. C. Flemming, "Archaeological Evidence for Eustatic Change of Sea Level and Earth Movements in the Western Mediterranean During the Last 2,000 Years," *Geological Society of America, Special Paper* 109 (1969) 29-30.

17. G. Schmiedt, *Il livello antico del mar Tirreno* (Florence 1972) 17-18.

18. See the section below by J. Bourgeois.

19. A. M. McCann, "Excavations at the Roman Port of Cosa, 1968," *AJA* (1969) 241-42; idem, "The Ancient Port of Cosa," *Archaeology* (1970) 200-211; idem, "Excavations at the Roman Port of Cosa, 1972," *AJA* (1973) 220; idem, *International Journal of Nautical Archaeology* 2 (1973) 199-200; idem, "Excavations at the Roman Port of Cosa," *Actes du IVe International Congrès d'archéologie sous-marine* (awaiting publication).

20. A. M. McCann, "Survey of the Etruscan Port at Populonia," *Muse [Annual of the Museum of Art and Archaeology, University of Missouri, Columbia]* 5 (1971) 20-22. The team was under the direction of the author and financed by the University of Missouri and private donors. The staff included Dr. John Oleson (University of Victoria), archaeologist; Dr. Robert Hohlfelder (University of Colorado), chief diver; Jay Warren (Tulsa, Oklahoma), architect; and Dennis Crull (Columbia, Missouri), engineer.

21. A. M. McCann, J. Oleson, "Underwater Excavations at the Etruscan Ports of Populonia and Pyrgi," *JFA* 1 (1974) 398-402; D. J. Hamblin, *The Etruscans* (New York, Time-Life 1975) 147-153; A. M. McCann, J. Oleson, "Le ricerche della missione italo-americana (1974) nell'antico porto di Populonia (Golfo di Baratti) e nelle acque di Pirgi," to appear in *Atti del V Congresso Internazionale di Archeologia Sottomarina* (Lipari 1976).

22. The American team was directed by the author and assisted by Dr. John Oleson (University of Victoria). Other members were: Martha Oleson (Victoria, B.C.), cataloguer; Jay Warren (Tulsa, Oklahoma), architect; John Stubbs (Louisiana State University), architect; Lloyd Austin (University of California), chief diver; Robert Loew (San Jose, California), engineer; Christopher Swann (Santa Barbara, California), photographer; Richard Preston (Pomona College), diver; George Lauder (Harvard University), diver; Joanne Bourgeois (University of Wisconsin), geologist; Robert Taggart (New York), business manager; Mr. and Mrs. J. Whittlesey (Wilton, Conn.) and W. Myers (Michigan State University), aerial photography; Professor Lionel Casson (New York University), archaeological consultant; and Dr. Elaine Gazda (University of Michigan), study of wall construction and building techniques.

The Italian team was directed by Professor Nino Lamboglia (Istituto Internazionale di Studi Liguri), assisted by Dr. Francesca Pallarés. Other members included: Renzo Ferrandi (Albenga), chief diver; E. Liberto (Grado), assistant diver; A. Signorini (Viareggio), diver; Capt. A. D'Acquisto (Savona), Captain of the "Cymulus"; M. De Angelis (Rome), assistant archaeologist; M. Borzone (La Spezia), assistant archaeologist.

The project was financed by the Atlantic Foundation to whom we all owe our grateful thanks.

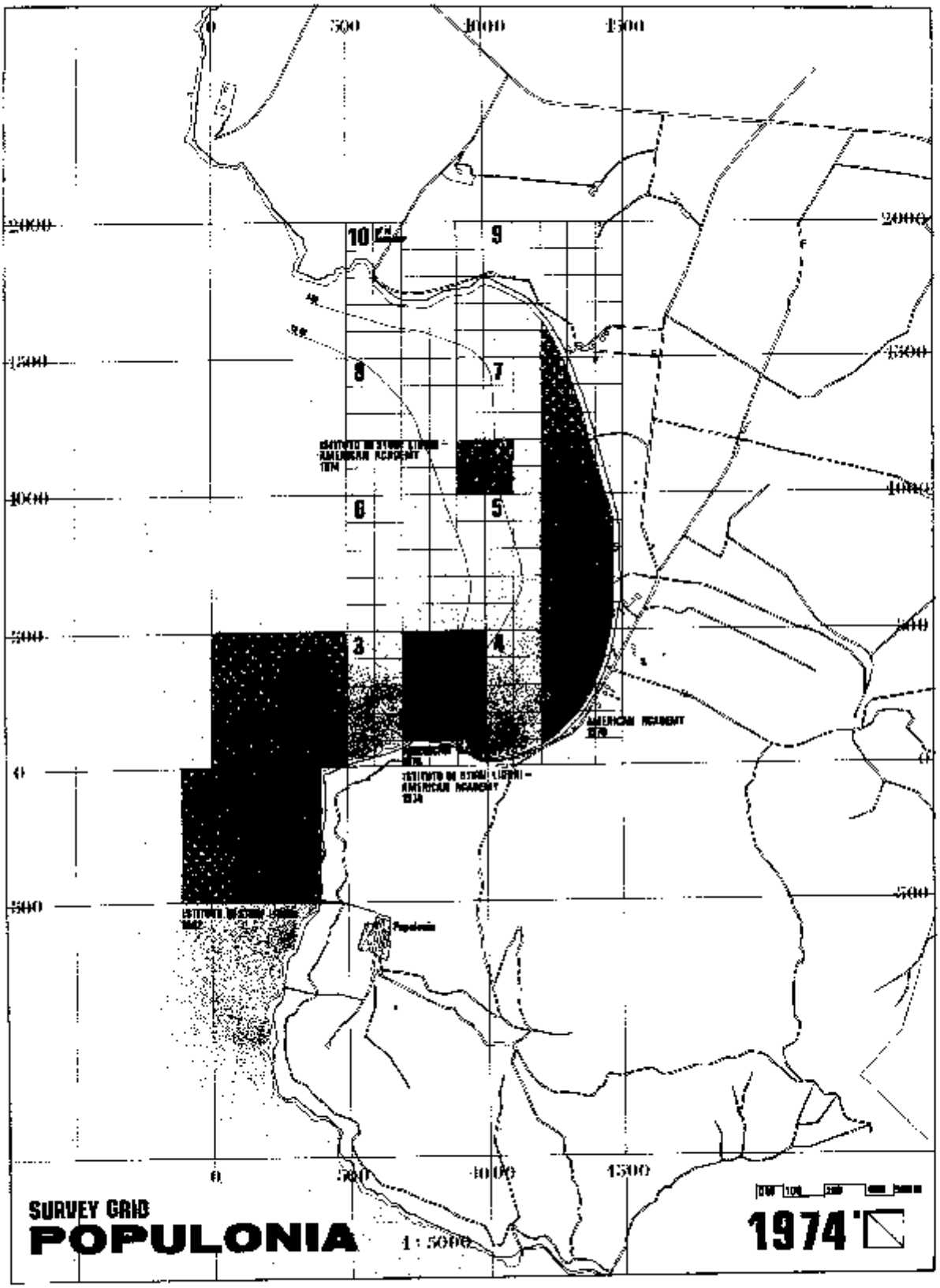

Figure 3. Map of the gulf of Populonia with grid. Shaded zones indicate areas which both Italian and American teams have searched underwater. C 1, C 2, C 3: caisson trenches; U 16: area of worked wooden logs and spar. Small numerals: 1, remains of ancient smelting furnace in beach cliff; 2, line of underwater Necropolis Shore Trench; 3, line of wall of headrock, underwater; 4, area of cinerary urn and tufa blocks; 5, remains of early pre-Etruscan necropolis; 6, remains of modern boat; 7, remains of second modern boat; 8, Etruscan necropolis. Plan: J. Warren.

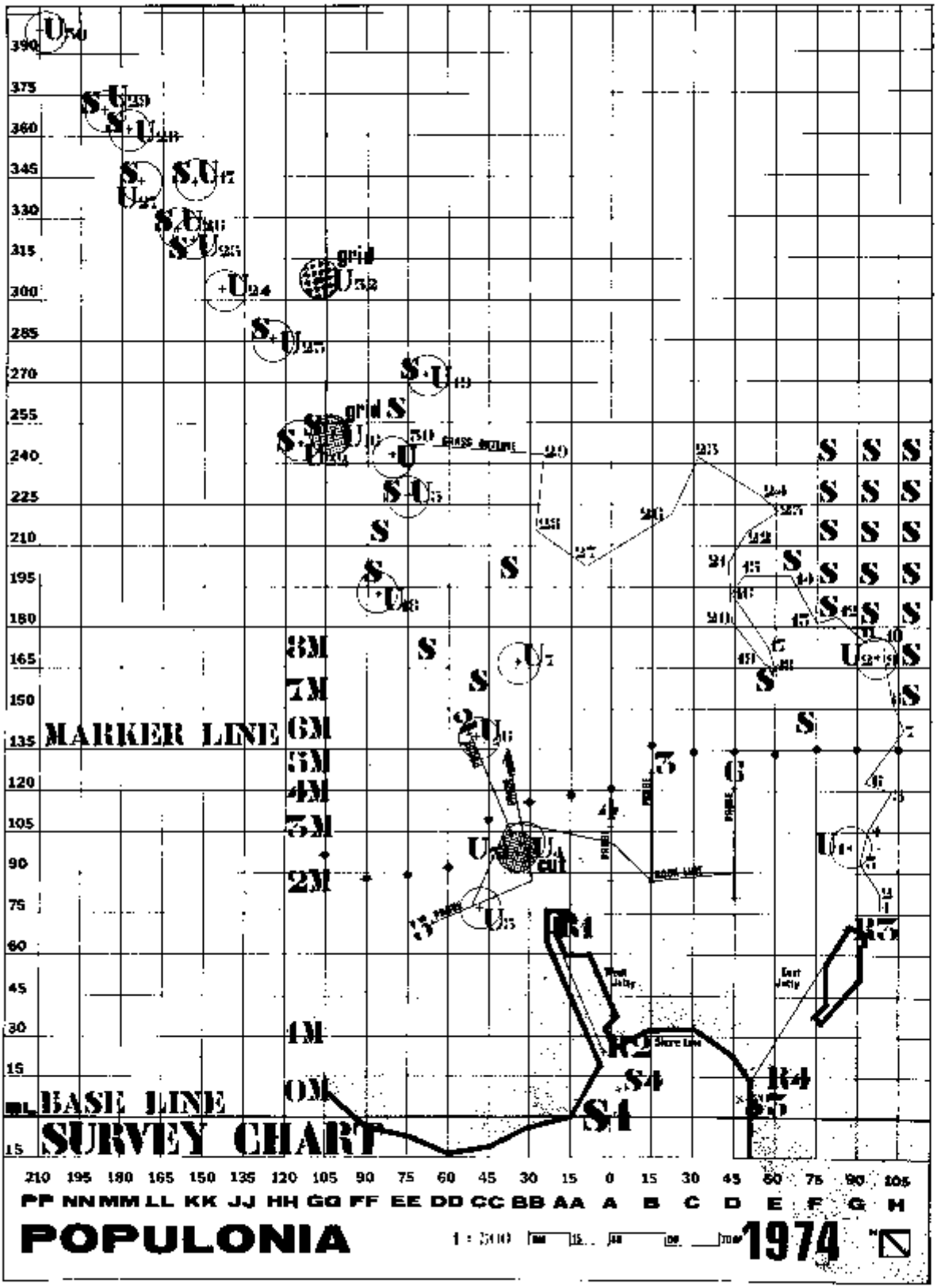

Figure 4. Grid map of area searched in 1970 and 1974, extending N-S from breakwater, R 1, 2, 3, 4. S indicates areas where ancient pottery was found. U indicates underwater points of special interest. U 16, area of wooden logs; U 32, area where floor timber from ship was recovered; U 31, cut made through breakwater in 1974. Probes 1-6, line of under-rock to depth of 2.30 m. Map: J. Warren

Figure 5. Cut made in channel area of harbor at Populonia by modern dredges. Photo: A. M. McCann.

probing rod was used at 5 m. intervals. After the initial search along the main line had been completed, the diver worked on either side of the line. He determined locations by attaching to the line a 10 meter tape with a sliding ring and swimming perpendicularly away from the main line. He checked his position with a compass at each grid point. Individual points of interest underwater were mapped by utilizing two theodolite stations on shore with a diver and float or rubber zodiac boat in the water. This movable grid method of survey proved a successful one for a small team with limited time in the particular conditions given at Populonia, namely, poor visibility, shallow water in which a skin diver could be used and the hazard of small boat traffic overhead. The grid and surveying techniques used here were designed by J. Warren and carried out underwater by R. Hohlfelder, both of whom must be credited for its success.

The charted depth contours of the harbor obtained from the grid survey indicate that the deepest area lay just to the west of the present western jetty, suggesting that this structure may have existed for some centuries. Evidence in support of this hypothesis was also found by further probes through the weed and sand pockets with a water-jet probing device which recorded rock down to a maximum depth of 2.30 m. below the present ocean floor. A line of rock was found extending directly north from shore along the line of the western modern jetty for a distance of ca. 100 m. and extending eastward for ca. 90 m. (FIG. 4, probes 1-6). It seems very likely that this line of rock defines the ancient breakwater, especially since the depth of the presumed ancient rock corresponds with the level of ancient sherds found in other areas of the harbor which have been revealed by dredging in modern times (FIG. 5). An ancient sherd layer in these dredged banks was found between 2 m. and 2.5 m. below the present ocean floor. Extensive sherds were also traced to the north and east of the breakwater area, establishing the zone of the channel of the ancient anchorage (FIG. 4; "S" indicates areas where ancient pottery was found).

We had hoped to confirm this evidence for an ancient breakwater beneath the modern one by excavation in 1974. Attempts were made in two places (Points A and C) to dredge a trench across the line of the present breakwater but the thick layer of weed (about 1.2 m.) known as *poseidonia* above the ancient bottom level made excavation impossible. At point "C", however, there was a deep sandy pocket with steep sides which made it possible to excavate a section just west of the western side of the present breakwater. This section revealed a layer of smooth rocks and boulders mixed with a few Roman amphora sherds and tile fragments below the layer of rocks at a depth of ca. 1.3-1.8 m. (FIG. 6). Since it was not possible to excavate a trench across the breakwater itself, the problem of its form and date remain to be resolved in the future. Excavation on land across the line of the breakwater where modern fill has covered the structure is suggested as well as further underwater excavation with heavier equipment. It seems logical that from the beginning the Etruscans would also have sought protection at this natural point, particularly for the ore barges which must have unloaded on her shores. Moreover, the form of the presumed ancient jetty with its broad platform of rocks is similar to that of the Roman port at Cosa.[23] This type of breakwater, designed especially to break the force of the waves gradually, is very unlike the narrow breakwaters developed in the Greek world which break the brute force of the waves all at once.[24] Thus, it may be that

23. See McCann, *Archaeology*, op. cit. (in note 19) fig. on p. 201.

24. Compare, for example, the Hellenistic port of Sidon, A. Poidebard, J. Lauffray, *Sidon. Aménagements antiques du port de Saida* (Beirut 1951) plans I, II.

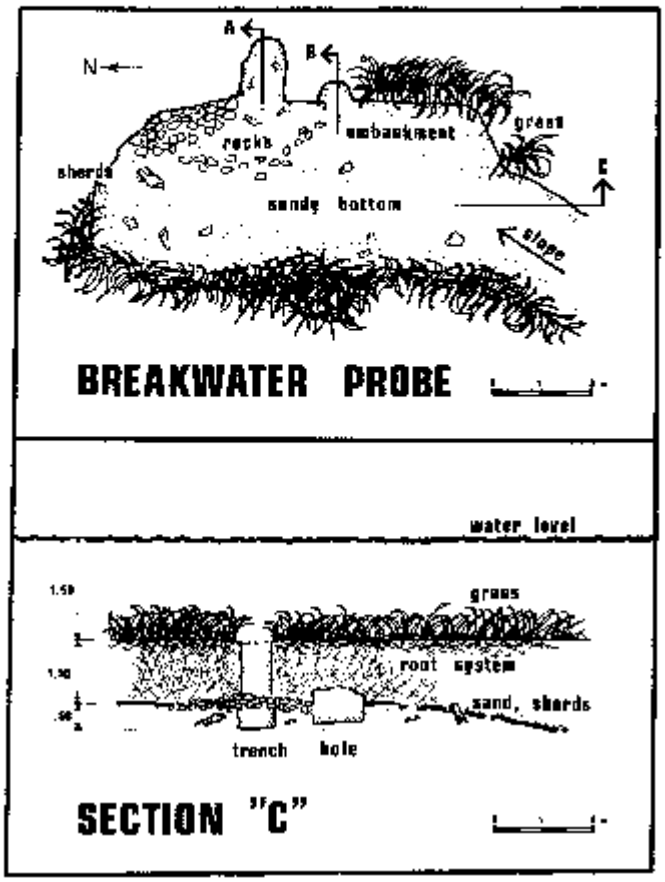

Figure 6. Plan and section of probe into breakwater at Populonia. Plan: J. Stubbs.

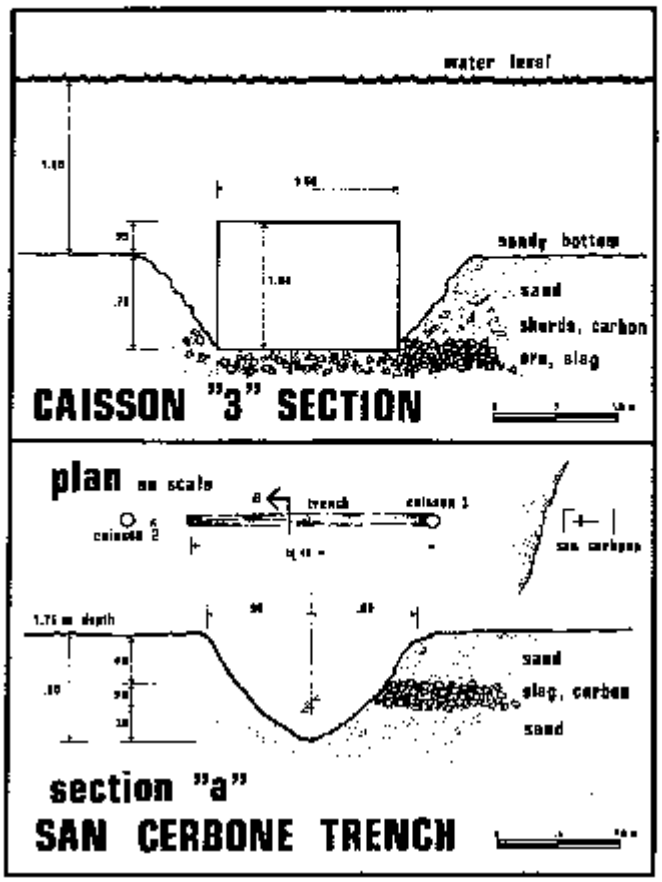

Figure 7. Above, sections of Caisson 3 test. Below, plan and section "A" of San Cerbone trench (Caissons 2 & 3) showing depth of indurated slag level. Sections: J. Stubbs.

early Roman harbor engineers, such as those at Cosa, drew upon a native Italic heritage in this practical solution to the problem of harbor protection which is still used effectively today for the modern anchorage at Populonia.

We were more successful in defining the ancient coastline along the SE shore of the bay in 1974. For this study, both soundings and trenches were made in the gulf with dredges alone and also within steel caissons to examine stratified deposits (FIGS. 7, 8, 9). Also core samples were taken along the beach by J. Bourgeois and R. Taggart. It is obvious from the steep banks surrounding the bay, in which can be seen ancient strata containing remains of Etruscan tombs and smelting furnaces, that both erosion and probably a change in sea level have occurred. In order to define the extent of this change, excavations were made underwater at four points to the north and SW of the chapel of San Cerbone. First, the dredge, powered from the Italian boat, the "Cycnulus", was used to dig a trench perpendicular to the shore along the line between squares 4 and 5 (FIG. 3), beginning about 100 m. out from shore in front of the necropolis area. This trench, which reached a depth of about 2 m. and ultimately extended 30 m. in toward the present beach, exposed a series of loose strata containing iron ore mixed with pebbles, slag, and sherds alternating with layers of sterile, white sand. There is no indication from the stratigraphy that this area of the gulf was dry land in antiquity (FIG. 10). Several pieces of black glaze ware recovered in the trench probably stem from tombs eroded by the sea farther in towards the shore.

Secondly, at a point ca. 150 m. from the beach, SW of the chapel of San Cerbone a caisson (FIG. 3, C1) was sunk in 2.3 m. of water near a pile of rocks in the area where Olschki in 1960 had found a series of large *dolia*. They would appear to have belonged to a granary or oil magazine once located on dry land rather than a cargo from a sunken ship as he suggested. The caisson revealed a layer of iron ore, slag and carbonized wood 0.4 m. below the rocks and surface sand, above a layer of grey sand. This layer of loose slag was probably formed near the ancient shoreline.

Figure 8. Steel caisson being moved into place underwater. Photo: A. M. McCann.

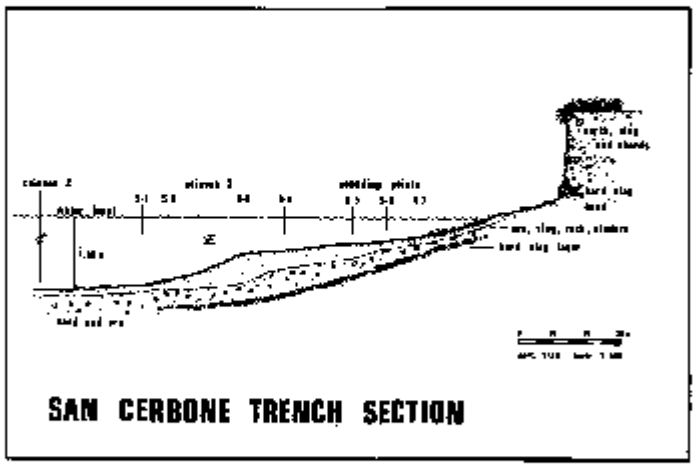

Figure 9. San Cerbone trench. Section from shoreline at San Cerbone chapel to underwater Caisson 2, showing extension of hard indurated slag layer. Section, J. Stubbs.

A second caisson (FIG. 3, C2) was located to the NE of Caisson 1, 220 m. from shore directly in line with the chapel of San Cerbone at a depth of 2.1 m. Excavation revealed a loose layer of iron ore and slag 0.2 m. thick, 0.4 m. below the sandy present sea floor, above a uniform layer of grey sand with occasional pieces of ore. The caisson was excavated to a depth of 1.6 m. and it is improbable that any of these layers indicate dry land in ancient times.

Firm evidence of the ancient Etruscan shoreline was obtained, however, from Caisson 3 sunk 80 m. from shore in a line with Caisson 2 and the chapel of San Cerbone at a depth of 1.5 m. The section of the bottom obtained here showed 0.5 m. of white sand above 0.5 m. of loose slag, sherds and scattered ore, above an indurated slag layer of iron-oxide (FIG. 7). It is this layer, at a depth of 2.5 m. below present sea level, which is the critical one for it represents the Etruscan level which may also be observed on land at the base of the beach cliffs approximately 1 m. above the present sea level (FIG. 11). Such cemented slag layers are formed in the vadose zone, that is above the zone of saturation. This hardened slag layer was further traced by excavating the San Cerbone trench between Caissons 2 and 3 to a point 13 m. seaward of Caisson 3 where it became a loose layer of slag and ore similar to that found in the other trenches (FIG. 9). This point probably represents the line of the ancient coast when the smelting furnaces were in use, chiefly from the 4th to the 1st centuries B.C. Similar soundings and trenches should be made at other points in the bay in the future to complete the line of the ancient shore.

Further evidence for this change in mean sea level was the discovery of remains of two other structures underwater. A cinerary urn was found ca. 30 m. out from shore at a depth of ca. 1.5 m., cemented into beachrock and surrounded by 20 visible large tufa blocks (FIG. 3, small no. 4; FIGS. 12, 13). The latter are probably from the base of a circular Etruscan tomb similar to those on the shore, indicating that the ancient necropolis must have extended out at least to this point in the gulf. Furthermore, the cementation of the cinerary urn in beachrock at a depth of 1.5 m. is evidence for a post-Etruscan sea level 1.5 m. below the present one, since beachrock is formed in the intertidal zone, that is at sea level.[25] Nearer the shore and running parallel to it along the east coast between the carpenter's house and the chapel of San Cerbone, blocks of *panchina* (beachrock) forming the line of a wall were found at a depth of ca. 0.3 m. at a distance of ca. 7 m. out from the beach (FIG 3, small no. 3). Although there are gaps, the uniform series of blocks follows a single line for about 86 m.

25. See Section below by J. Bourgeois.

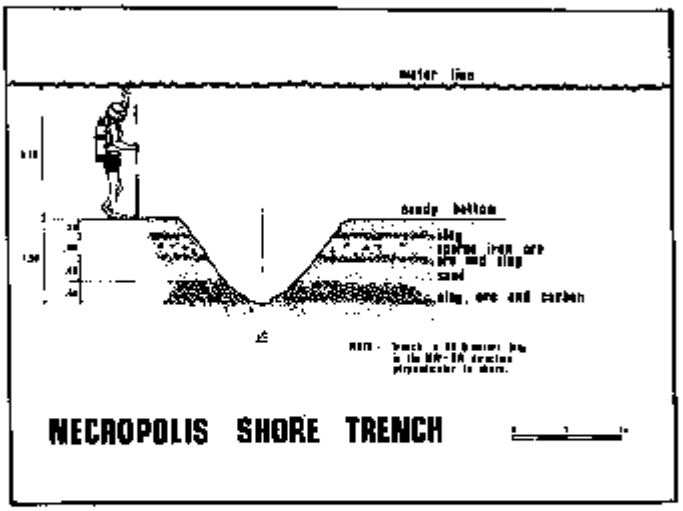

Figure 10. Trench made underwater in front of necropolis on shore showing loose slag layers alternating with white sand. Section: J. Stubbs.

Figure 11. Beach cliffs at Populonia, showing slag layer at base. Photo: A. M. McCann.

Since the blocks form only one course, and are bedded directly in the sand, it is questionable whether they originally formed a wall of any height, unless the upper blocks were removed at some later time. It may be that a line of single blocks was laid to protect the eroding shoreline behind either in ancient or even more recent times. General Giulio Schmiedt suggests that the blocks are related to an ancient port building.[26]

All this evidence underwater coupled with the visible evidence on land from the beach cliffs where tombs and ancient furnaces for the smelting of ore can be seen provide proof for an extensive retreat of the coastline of

26. Schmiedt, op. cit. (in note 17) 18. On our map, FIG. 3, small number 3.

Figure 12. Marble cinerary urn underwater. Photo: A. M. McCann.

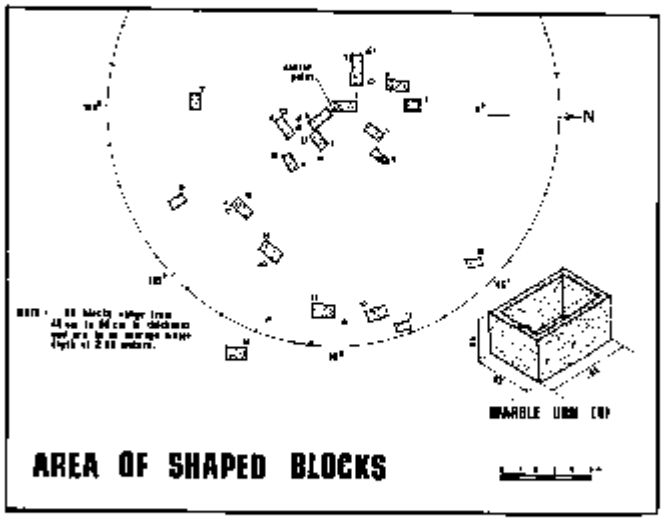

Figure 13. Plan of area of cinerary urn with surrounding tufa blocks. Plan: J. Stubbs.

Figure 14. Cut logs and spar at underwater point U 16. Photo: A. M. McCann.

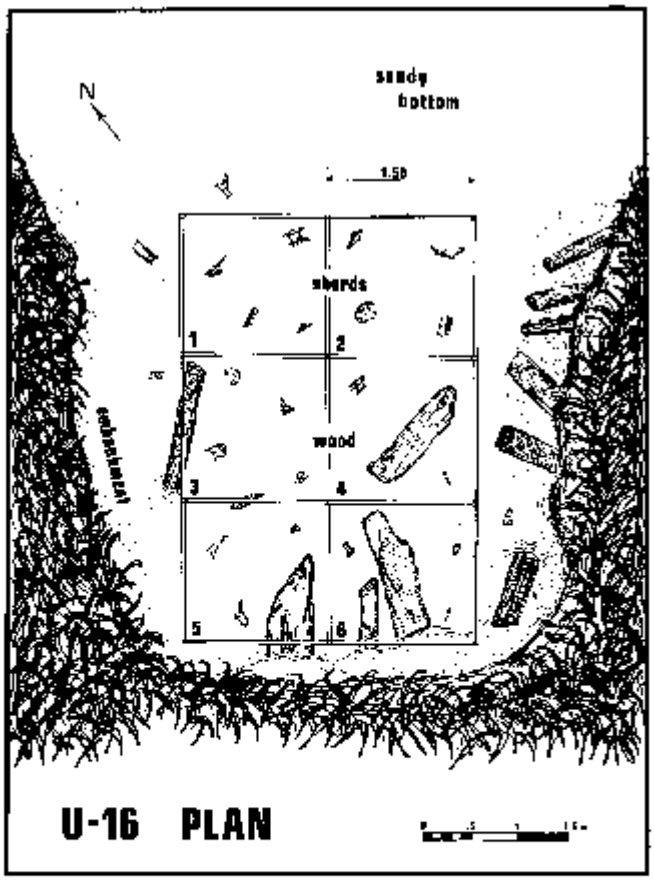

Figure 15. Grid plan of area of U 16 with wooden logs and spar. Plan: J. Stubbs.

Populonia since Etruscan times. Evidence obtained from the caissons indicates a recession of the coastline of at least 80 m. and if Olschki's earlier finds in the gulf may be interpreted as material from a land structure, which seems likely, the ancient shoreline may even have extended as far as 120 m. into the present gulf. A rise in sea level at Populonia of up to 2.5 m. since Etruscan times is also indicated.

In the underwater survey of the channel area of the harbor, at a depth of ca. 18.0 m., six worked and smoothed logs, some with their bark intact, and a rounded spar were found with other fragments of worked wood (FIG. 14). More wood extends under the troublesome *poseidonia* weed. Using the system previously employed by our Italian colleagues in their excavation underwater,[27] a grid of six 1.50 m. squares was laid out with iron pipes over the area (FIG. 15) and systematic excavation was then carried out with a large dredge powered from the "Cycnulus." This area had been located in 1970 and radiocarbon dates from two separate timbers indicate a date as early as 840 B.C.[28] The remains could be from a barge used in the transportation of iron ore from the island of Elba. If so, such a discovery would be unique; the area is worthy of further excavation with heavier equipment to cut through the *poseidonia* weed.

Pottery found with the wood includes a fragment of a late 6th century Etruscan *oinochoe* of *bucchero pesante*[29] (FIG. 16), and fragments of Attic red-figured ware. One example illustrated here (FIG. 17) is from the center tondo of a *kylix*. The use of incision to outline the design as well as the reserved circle around the tondo securely date it before 500 B.C.[30]

27. See, for example, N. Lamboglia, "La nave romana di Spargi (La Maddalena)," *Actes du IIe Congrès International d'Archéologie Sous-marine* (1958) 143-166.

28. ^{14}C analysis was made by the University of Pennsylvania. MASCA correction dates are: 816 B.C. for the sample from 1970; 840-820 B.C., for the sample from 1974.

29. For bibliography on *bucchero pesante* see D. Lollini, "Bucchero," *EAA* 2 (1959) 203-210. For other *oinochoe* of similar date see the famous example from Casuccini Collection in Palermo, Museo Nazionale, V. Tusa, *ArchCl* 8 (1956) 147-152, pls. XXXV-XXXVIII, dated ca. 550 B.C., and an unpublished *oinochoe* in the Metropolitan Museum of Art, New York, Acc. no. 96.9.135. The Populonia fragment, however, lacks the molded wheel design on the handle and is smaller in size (D. of mouth, 0.11 m.; M. P. H., 0.06 m.).

30. Compare, for example, a *kylix* by Douris, placed by Beazley in the artist's early middle period: Louvre G 118 (J. D. Beazley, *Attic Red-figure Vase-painters* [London 1963, rev. ed.] 430,35). An athlete with his sponge forms the center decoration on the Louvre cup, a possible identification for the fragmentary design remaining on the Populonia piece. I am grateful to D. von Bothmer for discussing this fragment with me and offering the above suggestions.

Figure 16. Mouth of *olinochoe* of *bucchero pesante* (P74-374), late 6th century B.C. D. of mouth, 0.11 m.; M. H. of fragment, 0.06 m. Photo: A. M. McCann.

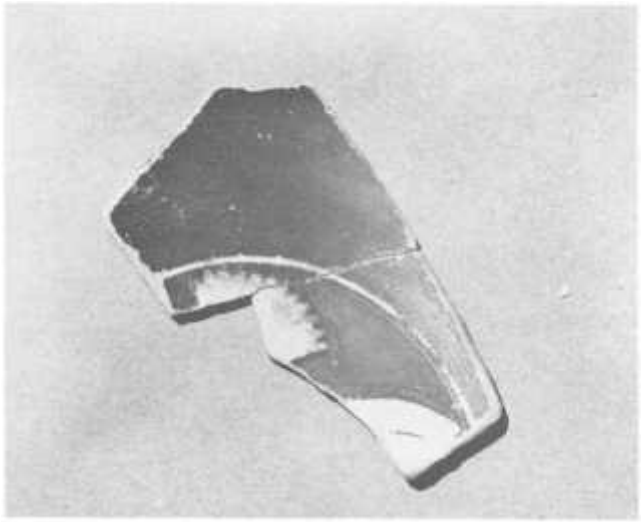

Figure 17. Fragment of center tondo, Attic red-figured *kylix*, ca. 500 B.C. (P74-616). Fragment: 0.07 m. x 0.03 m. Photo: A. M. McCann.

Finds from the other areas of the harbor reflect the history of the commercial life of Populonia which enjoyed its florescence only after 400 B.C. Amphora fragments make up the majority of the material found and the series goes back to the late 4th or early 3rd centuries B.C. and runs through the 3rd century A.C.[31] The majority of sherds are from the 2nd century B.C., before the bulk of Roman trade began, and represents one of the earliest series of "Greco-Italic" amphoras thus far found in Italy. The finer ware pottery found in the harbor channel and anchorage area[32] also largely comes from the 4th-2nd centuries B.C. Two selected examples are illustrated here: the base of a black-glazed *oinochoe*, a typical Etruscan form of the 4th-3rd centuries B.C. (FIG. 18);[33] the base of a small column krater of Campana ware, corresponding to Lamboglia's Form 40, variant D, of Attic derivation, which dates to the second half of the 4th and early 3rd centuries B.C. (FIG. 19).[34] These two finds reveal through their pottery styles a period when Etruscan originality flourished alongside the adaptation of Greek forms and reflect on a small

Figure 18. Black-glazed Etruscan *oinochoe*, 4th-3rd centuries B.C. (P70-49). Photo: A. M. McCann.

31. See section below by E. L. Will.

32. See FIG. 4. "S" indicates areas where sherds were found, defining the probable location of the channel and anchorage area of the ancient harbor.

33. Compare Minto, *Populonia* op. cit. (in note 5) pl. LXI, nos. 5, 6.

34. N. Lamboglia, "Per una classificazione preliminare della ceramica campana," *Atti del I Congresso Internazionale di Studi Ligure 1950* (1952) 186-87.

Figure 19. Small column krater of Campana ware. Photo: A. M. McCann.

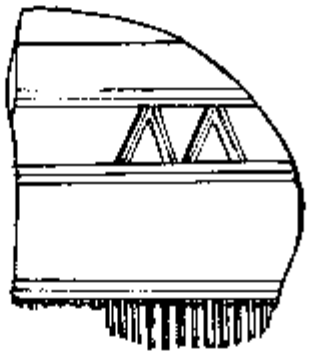

Figure 20. Fragment of wooden comb (P74-615) 0.048 m. x 0.053 m. Width of decorative bands: 0.01 m. and 0.015 m. Drawing: R. Preston.

Figure 21. Lead ingot of Emperor Nero from harbor of Populonia. Photo: A. M. McCann.

scale the lively and varied trade which must have taken place in this later Etruscan port.

Other artifacts of special interest are a fragment of a small wooden comb from the area of U16 with incised decoration (FIG. 20)[35] and a lead ingot bearing the titles of the emperor Nero in the form used after 65 A.C. (FIG. 21):[36] IMP NER(O) CLAUD(IUS) CAES(AR) AUG GE(RMANICUS) E G. This later find from the SE area of the gulf, recovered by a local sports diver, Piero Allori, and in the Pensione Marisa (Baratti), along with other objects of Roman date, indicates the continued activity of the port in Roman imperial times.

In conclusion, the combined efforts of the American and Italian teams have brought forth secure evidence for the location of the Etruscan harbor and anchorage area at Populonia. A change in mean sea level up to 2.50 m. since Etruscan times has been indicated both from the archaeological remains and the geological evidence. The establishment of an ancient breakwater seems probable but further excavation in this area, as well as the area of the cut wooden logs at point U16 on our map (FIG. 4), is worthy of further investigation. It is hoped that collaborative archaeological teams can work together more in the future to unfold our common ancient maritime heritage.

Geographic and Geologic Setting

by JOANNE BOURGEOIS

The harbor site of Populonia is flanked by bedrock cliffs and underlain by various marine and non-marine sediments. Iron ore from Elba was introduced to the site by the Etruscans and may, therefore, be used as a time marker. Evidence from coring, excavation, and underwater exploration indicates that (1) the sea has transgressed at least 80-120 m. since Etruscan times, and (2) sea level has risen 2.0-2.5 m. since Etruscan times. Major pieces of evidence for these changes include a modern sea cliff cut into the Etruscan level, an indurated slag layer found 2.5 m. below present sea level, and Etruscan structures naturally cemented in bedrock 1.5 m. below present sea level.

Introduction

The harbor of the Etruscan city of Populonia, located in the Gulf of Baratti, was a small, natural, well-

35. A similar comb was found on a recently discovered wreck at Marseilles, reported by Jean-Marc Gassend at the fifth International Congress of Underwater Archaeology at Lipari, June, 1976.

36. See J. E. Sandys, *Latin Epigraphy* (Cambridge 1927, rev. ed., S. G. Campbell) 237; cf. J. C. Egbert, *Introduction to the Study of Latin Inscriptions* (New York 1923, rev. ed.) 127.

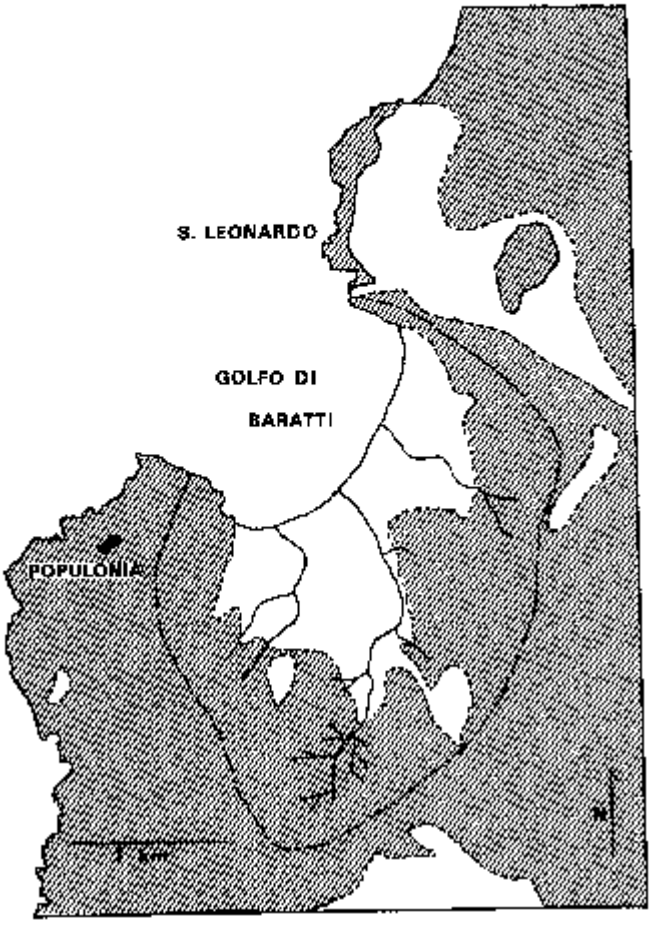

Figure 22. Generalized geology of the Gulf of Baratti (Gulf of Populonia). The white areas are alluvium and other unconsolidated sediments of Quaternary age (see Fig. 23 for more detail). The shaded areas are bedrock, consisting primarily of Macigno (Oligocene sandstones and siltstones), but also including some lenses of Eocene limestones (undifferentiated on map). This limestone makes up the bedrock outcrop along the east side of the gulf. Topography is not noted, but the areas underlain by bedrock have high relief; the Quaternary sediments underlie a gently rolling plain. The drainage basin of the gulf is outlined by a dash-dot line; streams are also noted.

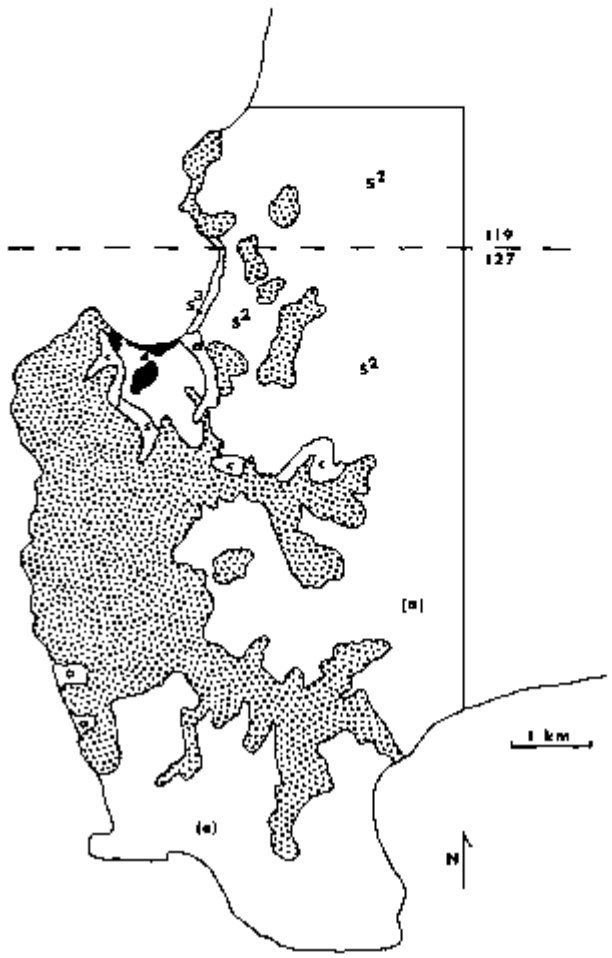

Figure 23. Geology of the Promontorio di Piombino, based on Carti Geol. d'Italia, Folii 119 (1969) and 127 (1968), showing differentiation of the varied Quaternary deposits surrounding the Gulf of Baratti; shaded areas are bedrock. In the southern half of the promontory the Quaternary deposits ("a" in parentheses) are not differentiated. a: alluvium; c: colluvium; s: older (Tyrrhenian?) beach sand and dunes, s²: Holocene sand dunes; s¹: modern coastal sands; black areas: slag heaps.

protected embayment on the north side of the Promontorio di Piombino. The sides of the gulf are flanked by rocky cliffs, composed on the west side of slightly deformed sandstones and siltstones of the Oligocene-age Macigno and on the east side by Eocene calcilutite (FIG. 22; for geologic time scale, see FIG. 25).[37] At the head of the gulf, the bedrock has been buried by sand, gravel, and alluvium of varied origin (FIG. 23): Quaternary marine terraces, ancient dunes, colluvium, alluvium, and slag heaps from the smelting of iron, both by the Etruscans and by the 20th-century Italians.

The source of the iron smelted by the Etruscans was Elba, a geologically complex island containing rich iron ores.[38] These ores, known as skarn, crop out extensively on the east end of Elba (FIG. 24), where complexly deformed Mesozoic rocks have been intruded by Late Tertiary igneous rocks, which crop out on the western

37. G. Gasperi, "Geologica del Promontorio di Piombino (Livorno)," *MemGeolSocIt* 7 (1968) 11-28; V. Bortolotti, P. Passerini and M. Sagri, "The Miogeosynclinal Sequences," *Sedimentary Geology* (Special Issue) 4(3/4) (1970), ed., G. Sestini, 341-444.

38. G. Marinelli, "Le intrusioni terziarie dell'Isola d'Elba," *AttiSocTosciSciNat, Series A* 66 (1959) 50-253; Carta Geologica d'Italia Folio 126 (1969); V. Bortolotti and P. Passerini, "Magmatic Activity," *Sedimentary Geology* (Special Issue) 4(3/4) (1970), ed. G. Sestini, 599-624.

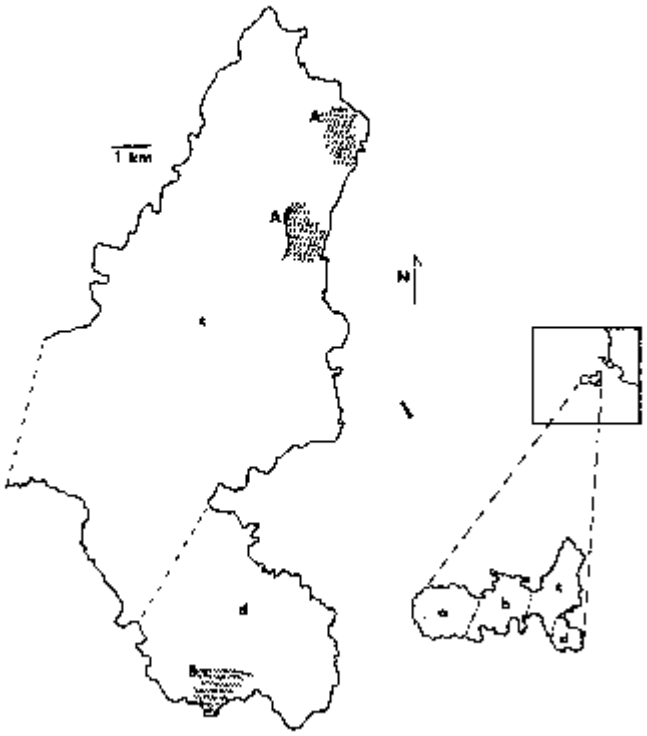

Figure 24. Map of the eastern half of Elba, from Carta Geol. d'Italia, Folio 126 (1969), showing only the largest mineralized zones of two types. A: veins and masses of hematite and pyrite emplaced in Triassic schist (Verrucano); B: skarn with masses and lenses of magnetite, hematite and pyrite emplaced in Triassic calcareous rocks. Small map shows regional geology of Elba. a: massive biotite-granodiorite intrusive; b: zone of extensive dikes; c and d: complexly deformed rocks with extensive mineralization. Inset shows location of Elba with respect to Populonia (arrow).

half of the island. The resultant, very rich iron ores include veins, lenses, and masses of pyrite (FeS_2), magnetite (Fe_3O_4), and hematite (Fe_2O_3) in its metallic form (specularite). It is estimated that the Etruscans removed approximately 10 million tons of ore a year from Elba and smelted it on the shores of the Gulf of Baratti; the resultant slag was resmelted early in the 20th century.[39]

This intense activity has disturbed much of the naturally-deposited sediment in the gulf area. The introduction of iron to an area where there is no local source, however, provides an excellent time marker. A 1-3 m. high beach cliff at the head of the gulf indicates that the coastline has retreated, and the erosion of the Etruscan level at the base of the cliff has produced extremely iron-rich sediments.

39. See sections above by A.M. McCann.

Quaternary History

The Quaternary Period (see FIG. 25)[40] is noted for worldwide (eustatic) fluctuations of sea level, brought about by the repeated advance and retreat of continental ice sheets.[41] These sea-level oscillations are well represented in Italy by marine terraces — shallow-marine sediments deposited during periods of high sea level and now exposed along the coast of Italy; thus the terms used in the Mediterranean area to delineate these high stands of sea level are derived from areas of Italy (see FIG. 25). At Populonia we are concerned primarily with the Holocene (=Recent, i.e. the last 10,000 years) rise of sea level (FIG. 26),[42] but Figure 27a[43] depicts the maximum extension of Quaternary seas around Populonia, and Gasperi[44] noted Tyrrhenian and possibly Sicilian marine terraces in the Populonia area.

The Holocene rise in sea level began about 10,000 years ago. There are varied opinions as to the nature of this rise, i.e. whether it was a smooth, steady rise or a fluctuating rise (FIG. 26). Numerous and varied studies — geomorphological, geochemical, paleontological, archaeological, etc. — have been conducted to determine the nature of this curve. Flemming[45] surveyed ancient harbor sites in the western Mediterranean, averaged the results, and concluded that there has been no change since the beginning of the modern era in sea level as a result of eustasy (melting ice), only changes due to tectonism (local earth movements). On the other hand, Pongratz[46] surveyed Roman fish tanks and other

40. R. W. Fairbridge, "Quaternary Sedimentation in the Mediterranean Region Controlled by Tectonics, Paleoclimates and Sea Level," D. J. Stanley, ed., *The Mediterranean Sea* (Dowden, Hutchinson & Ross, Stroudsburg, Pa. 1972) 99-113.

41. For example, an increase in ice volume would be matched by a decrease in ocean-water volume and hence a lowering of sea level; usually this lowering is accompanied by a regression, or seaward movement of the coastline, but other mechanisms may also cause regressions and transgressions. See J. C. Kraft, R. B. Biggs and S. D. Halsey, "Morphology and Vertical Sedimentary Sequence Models in Holocene Transgressive Barrier Systems," D. R. Coates, ed., *Coastal Geomorphology* (SUNY Binghamton 1973) 321-54.

42. R. W. Fairbridge, "Quaternary Shoreline Problems at INQUA, 1969," *Quaternaria* 15 (1971) 1-18.

43. G. Merciai, *Mutamenti Avvenuti nella Configurazione del Litorale tra Pisa e Orbetello dal Pliocene in Poi* (Stab. Tipografico Succ. FF. Nistri, Pisa 1910) 1-148.

44. G. Gasperi, op. cit. (in note 37).

45. N. C. Flemming, "Archaeological Evidence for Eustatic Change of Sea Level and Earth Movements in the Western Mediterranean during the Last 2,000 years," *GeolSocAmSpecPap* 109 (1969) 1-125.

46. Erica Pongratz, "Historische Bauwerke als Indikatoren für Küstenmorphologische Veränderungen (Abrasion und Meeresspiegelschwankungen) in Latium — Feldbegehung und Luftbildauswertung," *MünchGeographAbhandl* 4 (1972) 1-144.

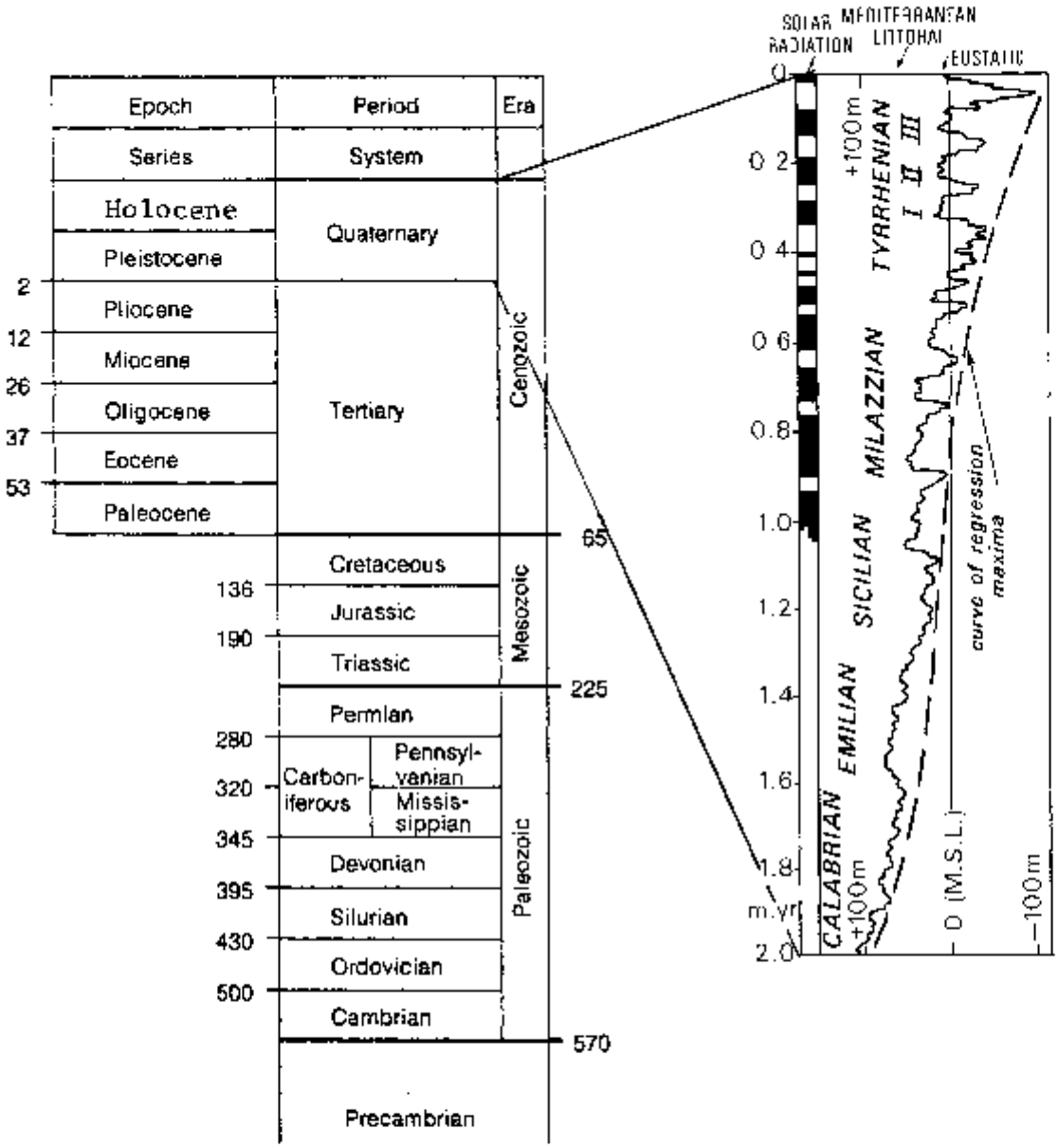

Figure 25. The geologic time scale (left) and the Mediterranean subdivisions of the Quaternary (right). Dates are in millions of years. Curve shows gradual lowering of sea level in the Quaternary, with large fluctuations (Calabrian, Emilian, etc.) tied to major advances and retreats of continental ice sheets; minor fluctuations are schematic (from Fairbridge, op. cit. in note 40).

wall structures on the coast of Latium and concluded that there has been a 1 m. eustatic rise in sea level since the turn of the era. All the curves in Figure 26 do record a lower sea level around 2000 B.P., so that a eustatic change in sea level since Etruscan-early Roman times is acceptable to many investigators of sea-level changes. The evidence at Populonia for a change in sea level will be examined presently.

Changes in coastal configuration need not be caused by a change in sea level.[47] They may also be brought about by sedimentation and erosion. Merciai[48] reviewed maps of and references to shoreline changes on the Promontorio di Piombino (FIG. 27b). The Gulf of Baratti is very small compared to the Gulf of Piombino, and no historical changes there were noted by Merciai.

47. J. C. Kraft et al., op. cit. (in note 41).

48. G. Merciai, op. cit. (in note 43).

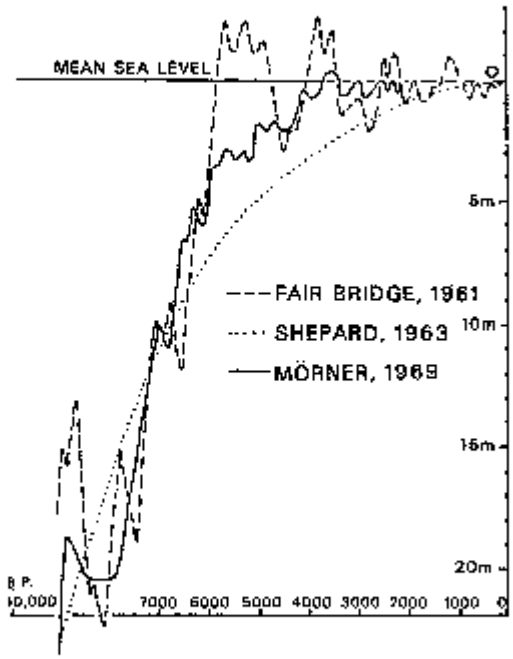

Figure 26. The post-glacial rise in sea level, as suggested by three different studies (from Fairbridge, op. cit. in note 42). Note that the rise in all cases is very rapid until about 5000 B.P. and then slows down and possibly fluctuates.

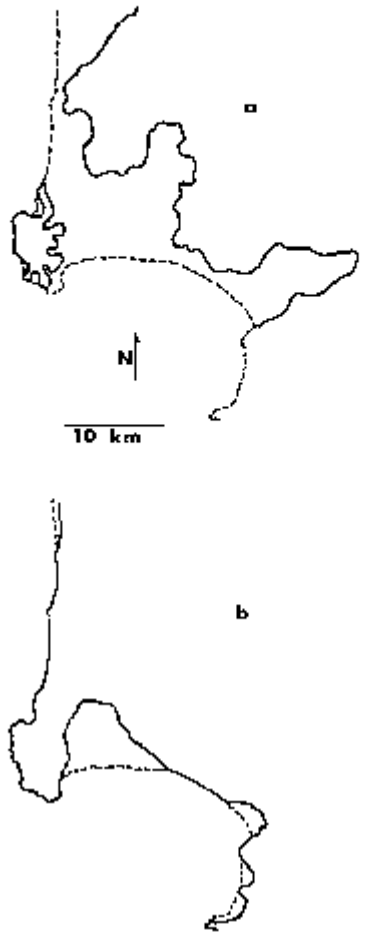

Figure 27. a: Maximum extension of the Quaternary sea at the Promontorio di Piombino (solid line). b: Coastal changes in historical time. Dotted line on both maps represents the modern coastline (after Mercial, op. cit. in note 43).

It is apparent, however, that the coastline has retreated, i.e. the sea has transgressed, since Etruscan times.

The Modern Site

As mentioned above, the present Gulf of Baratti is flanked by bedrock on its sides and by varied Quaternary deposits, cropping out in a 1-3 m. beach cliff, at the head of the gulf.[49] The major components of this Quaternary sequence exposed above sea level are eolian sand (especially on the east side of the harbor), coastal marine sediments, and slag. The drainage basin of the gulf is not very large nor very active (FIG. 22), so that river-deposited sediments are not a major component. Important natural components of the Quaternary sequence are quartz, some silt and lithic fragments — primarily sandstone, with some limestone, and rare granite (probably anthropogenic, from Elba). The slag is composed of fragments of the Triassic Verrucano schist (the formation on Elba most abundantly inseminated with iron ore), and magnetite and specular hematite and their alteration products — earthy hematite (red) and limonite (yellow-brown); any pyrite imported by the Etruscans would have been completely altered to iron oxides by the present. The Etruscan level is an iron-oxide cemented zone at the base of the beach cliff, approximately 1 m. above present sea level.

The surficial beach sands along the shore are very rich in iron oxides, remnants of the Etruscan industry, concentrated by waves as the cliff has retreated. Much of the sand consists of nearly 50% iron minerals, approximately equal proportions of magnetite and hematite. Concentrations of greater than 90% iron minerals occur on and close to the surface. The light (in color and in density) fragments are primarily quartz, with minor lithic fragments, probably derived from the slag. A trench section cut in the beach revealed 15-20 cm. of alternating brown (fewer heavy minerals) and black sand overlying 30-40 cm. of black sand. Beneath this iron-rich layer, the sand was nearly devoid of heavy minerals (none detected), with no magnetite or hematite in evidence. A 1.5 m. long core taken in this sand

49. G. Gasperi, op. cit. (in note 37).

revealed nearly homogeneous (apparently unbedded), iron-free, fine-grained sand; the lowest 20 cm. was medium-grained sand of the same composition. It is apparent that this sand has not been disturbed since the Etruscan iron industry began, and it is suggested that it represents offshore (Tyrrhenian age?) deposits; only a few small shell fragments were found, however.

Offshore, silty sand and numerous rocks, including slag and iron ore, make up the gulf floor. Caisson excavation indicated that the indurated slag layer (the Etruscan level) extended 80 m. offshore, where it occurs at a depth of 2.5 m. below present sea level. It is found beneath 0.5 m. of loose slag, which in turn is covered by 0.5 m. of sand. This loose slag zone extends farther out, to over 200 m. from shore, where it occurs at a depth of 2.5-2.7 m. below present sea level.

A cinerary urn and numerous cut blocks of tufa, presumably part of an Etruscan tomb, are found 30 m. offshore in 1.5 m. of water. These blocks are cemented into a layer of beachrock. Other structures have been found 120 m. offshore.[50]

Changes Since Etruscan Times.

The configuration of the bedrock flanks of the Gulf of Baratti has almost certainly not changed appreciably in the Quaternary Period. There is abundant evidence, however, that the coastline at the head of the gulf has retreated; as mentioned earlier the beach cliff cutting into the Etruscan level provides graphic evidence for this retreat. Large Etruscan artifacts, immoveable except by extreme wave conditions unlikely to occur in this protected harbor, are found 30 m. and 120 m. from shore. The indurated slag layer extends at least 80 m. offshore. Thus it is reasonable to conclude that the sea has transgressed at least 80 m. and perhaps more than 120 m. since Etruscan times.

There is also conclusive evidence for a change in mean sea level at Populonia. The formation of indurated iron-oxide layers is observed to occur in the vadose zone, i.e. above the zone of saturation. An indurated slag layer is found in the gulf at a (maximum?) depth of 2.5 m. below present sea level. The above-mentioned Etruscan structures could have fallen from higher levels as the beach cliff retreated, but beachrock is formed in the intertidal zone (i.e., at sea level); thus the cementation of Etruscan materials in beachrock at a depth of 1.5 m. is evidence for a post-Etruscan sea level 1.5 m. below present. Flemming[51] reported harbor structures at Populonia which suggested a sea level at the turn of the era 2 m. below the present mean sea level. Thus it is reasonable to conclude that at Populonia sea level has risen 2.0-2.5 m. since Etruscan times, with evidence for a post-Etruscan (undated), intermediate stand of sea level at 1.5 m. below present sea level. This change may have been caused by (1) a eustatic rise in sea level, brought about by melting ice, (2) tectonic subsidence, or (3) subsidence by compaction. The harbor appears to be underlain primarily by sands, which compact very little, probably eliminating explanation (3). The observation that Tyrrhenian and earlier marine terraces in the region show no signs of deformation and maintain horizontality over long distances[52] is possibly evidence against explanation (2). Thus it seems most probable that a eustatic rise in sea level has occurred since the Gulf of Baratti was occupied by the Etruscans.

50. See sections above by A. M. McCann.

51. N. C. Flemming, op. cit. (in note 43), based on written communication from Blaber.

52. R. W. Hey, "Quaternary Shorelines of the Mediterranean and Black Seas," *Quaternaria* 15 (1971) 273-284.

Two Amphoras from Populonia

by ELIZABETH LYDING WILL

The group of amphoras found underwater off Populonia represents six centuries or more of Roman trade in the area. More than half of the material is from the Republican period and several pieces are among the earliest known examples of Roman amphoras. Two typical amphora fragments from the collection are examined here.

The commercial amphoras found underwater off Populonia in 1970 are stored temporarily in the museum at Cosa, where they were studied by the writer in 1974 and again in 1975. All of the amphoras are fragmentary, but most of them can be assigned to known, and datable, categories. They therefore help us reconstruct the outlines of trading activity at Populonia during the Roman period.

The pieces studied divide into earlier and later groups. The earlier, Republican, group (49 of the 78 pieces studied) goes back to the late 4th or early 3rd centuries B.C. and is particularly rich in 2nd century B.C. fragments. The later group (30 pieces) comprises material dating from the last half of the 1st century B.C. through the 3rd century A.C. Seven centuries of commercial activity are thus reflected in the Roman amphoras, which brought to Populonia choice wine, olive oil, and *garum* (a fish sauce) from other parts of Italy as well as from production centers abroad.

Two pieces will be described here, as examples of the interest attaching to this group of fragments, a more detailed publication of which is in preparation. The first

piece, a neck fragment (Inv. No. P70-67) (FIG. 28) belongs to the so-called "Greco-Italic" type, which is represented by 23 examples at Populonia, almost one-third of the entire 1970 collection. The piece, which is unstamped, preserves the rim (entire except for chips), both handles, the neck, much of the shoulder, and a piece of the belly. The preserved height of the fragment is 0.26 m. A line is incised around the middle of the neck, and a finger-tip impression is at the base of each handle. Both the incised line and the finger-tip impressions are characteristic of this type of jar. The clay is coarse, micaceous orange-buff in color, with many dark, light, and reddish inclusions. The color of the surface of the fragment, visible under the marine deposit, is yellow-buff. This type of amphora, the origin of which is still a matter for discussion, has been found throughout the Mediterranean area. It is usually unstamped but has been found with Iberian, Greek, and Latin stamps. It may have been manufactured at several different sites. The type seems to have been especially popular in the 2nd century B.C., and probably in the latter 3rd century as well. Several early villa-sites at Cosa (founded as a Latin colony in 273 B.C.) are carpeted with "Greco-Italic" fragments.[53]

The second piece (Inv. No. P70-84) is a whole stamped handle, to which bits of the rim and upper neck still adhere (FIG. 29). The handle (0.041 m. wide x 0.03 m. thick at the center of the stamp) comes from an amphora numbered Type 11b in the writer's forthcoming volume on Roman amphoras in the *Athenian Agora* series. Seven other examples of the stamp, which reads M. TVCCI. L. F. TRO CALEONTVS, have been found at sites in Italy, France, and Egypt (FIG. 30).[54] The Populonia example is apparently the first one displaying a ligature of *N* and *T* in the second line. The second line reads CALEONVS or GALEONVS in the other examples, a word usually explained as an "archaic genitive" (see bibliography cited in note 54). Not completely clear is the relationship to another, also widespread, stamp, without ligatures, which reads M. TVCCI. L. F. TRO GALEONIS. This stamp is usually thought to refer to Cicero's friend, Galeo, named in *Att.* 11. 12. 4 and probably also in *Fam.* 8. 8. 1, where Caelius mentions an M. Tuccius. The TRO is thought

Figure 28. Populonia P70-67. Neck of "Greco-Italic" Type, 2nd century B.C. H., 0.26 m.

Figure 29. Populonia P70-84. Neck fragment of Will Type 11b ("Late Brindisi-Type"), Last half of 1st century B.C. H. of rim, 0.024 m.

53. For a recent discussion of "Greco-Italic" amphoras, see W. Culican and J. E. Curtis, "The Punic Wreck in Sicily, 2: the Pottery from the Ship," *International Journal of Nautical Archaeology* 3 (1974) 44-47.

54. For a summary of bibliography on the stamp, see André Tchernia, "Premiers résultats des fouilles de juin 1968 sur l'épave 3 de Planier," *Etudes classiques* 3 (1968-70) 60. To Tchernia's list can be added two unpublished examples from Alexandria, Benaki Collection No. 276 and Alexandria Museum No. AVG 800 (both stamps now stored in the Alexandria Museum).

Figure 30 Populonia P70-84, stamp. W. of stamp: 0.066 m., H. of stamp: 0.019 m.

to be an abbreviation for the tribe, Tromentina. This second stamp is frequently accompanied by a small, separate stamp in the shape of an anchor.[55] André Tchernia reports that a number of examples of the "Galeonis" version of the stamp were found on fragmentary amphoras in wreck 3 at Planier.[56] The only unbroken amphora known to bear the stamp is in the museum at Agde.[57]

Tchernia would like to classify all the "Tuccius" pieces as examples of the "Brindisi-type" of Roman amphora. That term was coined by the writer years ago as a nickname for Type 11a, the most frequently occurring type of Roman amphora in the eastern Mediterranean. It is not, however, the type to which the "Tuccius" pieces belong. They may very well be a late development, or a late imitation, of the "Brindisi-type," but they differ from that type in two important respects. Their coarse clay (difficult to see in the Populonia piece, which is damaged by an oily deposit on the surface) is markedly unlike the uniformly fine "Brindisi" clay, and the handle-dimensions are in every case so massive as to remove them definitively from the type, the handles of which are regularly small, delicate, and circular in section (average dimensions about 0.033 x 0.033). A final difference is that of date. Type 11a has a firm date, based on contexts at the Agora Excavations in Athens, in the first quarter of the 1st century B.C.[58] The type is very frequent at Delos, where Roman occupation had all but ceased by the middle of the 1st century B.C., but it does not occur at Corinth (refounded in 44 B.C.). Type 11b, on the other hand, to which the "Tuccius" pieces belong, does not occur at Delos but is found at Corinth. It is also reminiscent of Augustan amphoras found at such sites as Haltern and Oberaden in Germany.[59] A date no earlier than the last half of the 1st century B.C. seems strongly indicated.

The outward similarities between Types 11a and 11b are readily recognizable; thus the writer's inclusion of them under one number and use of the nickname "Late Brindisi" for Type 11b. The distinctions between the two categories, however, need to be carefully drawn, and important questions remain to be answered. Is there a possible relationship between Type 11b and the early examples of Dressel's Type 20 (*C.I.L.* XV), the Spanish amphora of which Monte Testaccio in Rome seems largely to be composed?[60] What connection is there, also, among the "Brindisi," the "Late Brindisi," the so-called "Corinthian" amphoras,[61] and Dressel's Type 25 ? Must we postulate manufacture in Brindisi for the "Tuccius" jars? The vicinity of Brindisi and Lecce was undoubtedly a center (but perhaps not the only center) of manufacture for Type 11a. Remains of what must have been kilns were discovered near Brindisi by the writer in the summer of 1961. Similar finds from Brindisi and from Lecce were subsequently

55. Cf. Tchernia's summary (above, note 54), to which can be added seven examples in the Alexandria Museum (three of them probably published in *C.I.L.* I. 2. 2654h), two in the Cairo Museum, and two (from the "Near-East") in the British Museum. My forthcoming *Athenian Agora* catalogue will give full details. How are we to explain the forms CALEONTVS, CALPONVS, and GALEONIS ? Are they related to a possible fourth version of the same name, M. TVCCI. PROCALPONIS, apparently not an amphora stamp, cited by Mommsen in *C.I.L.* X. 4691, as from Cales ? Were these all versions, or misspellings, of the same name ? What was that name ? In the process of stamping amphoras, mistakes seem often to have occurred. Producing a positive impression necessitated having the letters backwards in the stamping instrument. These instruments, matrices, which were made of wood, clay, and metal, seem to have employed sometimes permanently affixed, and sometimes movable, letters. In either case, the process of reversing letters led to errors, which we find most often in the early amphora stamps (2nd and early 1st centuries B.C.).

56. See above, note 54.

57. Fig. 10 in Tchernia's article (above, note 54).

58. Cf. E. L. Will, in H. Dunscombe Colt, *Excavations at Nessana (Auja Hafir, Palestine)* I (London 1962) 128; also E. L. Will, "Latin-stamped Amphoras in the Eastern Mediterranean Area," *Year Book of the American Philosophical Society* (1962) 649-50.

59. Haltern, Type 71 (S. Loeschcke, "Keramische Funde in Haltern," *Mitteilungen der Altertumskommission für Westfalen* 5 (1909); Oberaden, Type 83 (S. Loeschcke, in *Veröffentlichungen aus dem Städt. Museum für Vor- und Frühgeschichte Dortmund*. II: *Das Römerlager in Oberaden*, herausgegeben von Christoph Albrecht. 2: *Die römische und die belgische Keramik*).

60. See note 59 above, and Miguel Beltrán Lloris, *Las Anforas Romanas en España* (Zaragoza 1970) 464-72.

61. A publication on "Corinthian" transport amphoras is being completed by Carolyn G. Koehler.

reported by others.[62] The mass production (for such it was) of Type IIa may not, however, have been confined to the area of Brindisi, or even to Italy. Nor need we look to Brindisi as the sole source of the "Tuccius" amphoras, if indeed they had any connection with Brindisi.

62. For the evidence from Brindisi, see E. L. Will, op. cit. (in note 58). Those finds, deposited in the museum at Brindisi, were the basis for subsequent publications by B. Sciarra; for example, "Primo saggio di scavo ad Apani," *Museo Provinciale di Brindisi*, Quaderno I (1964), 112. On finds from Lecce, see Cosimo Pagliara, "Bolli anforari inediti da Vellino (Prov. Lecce)," *Studi Classici e Orientali* 17 (1968) 227-31.

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