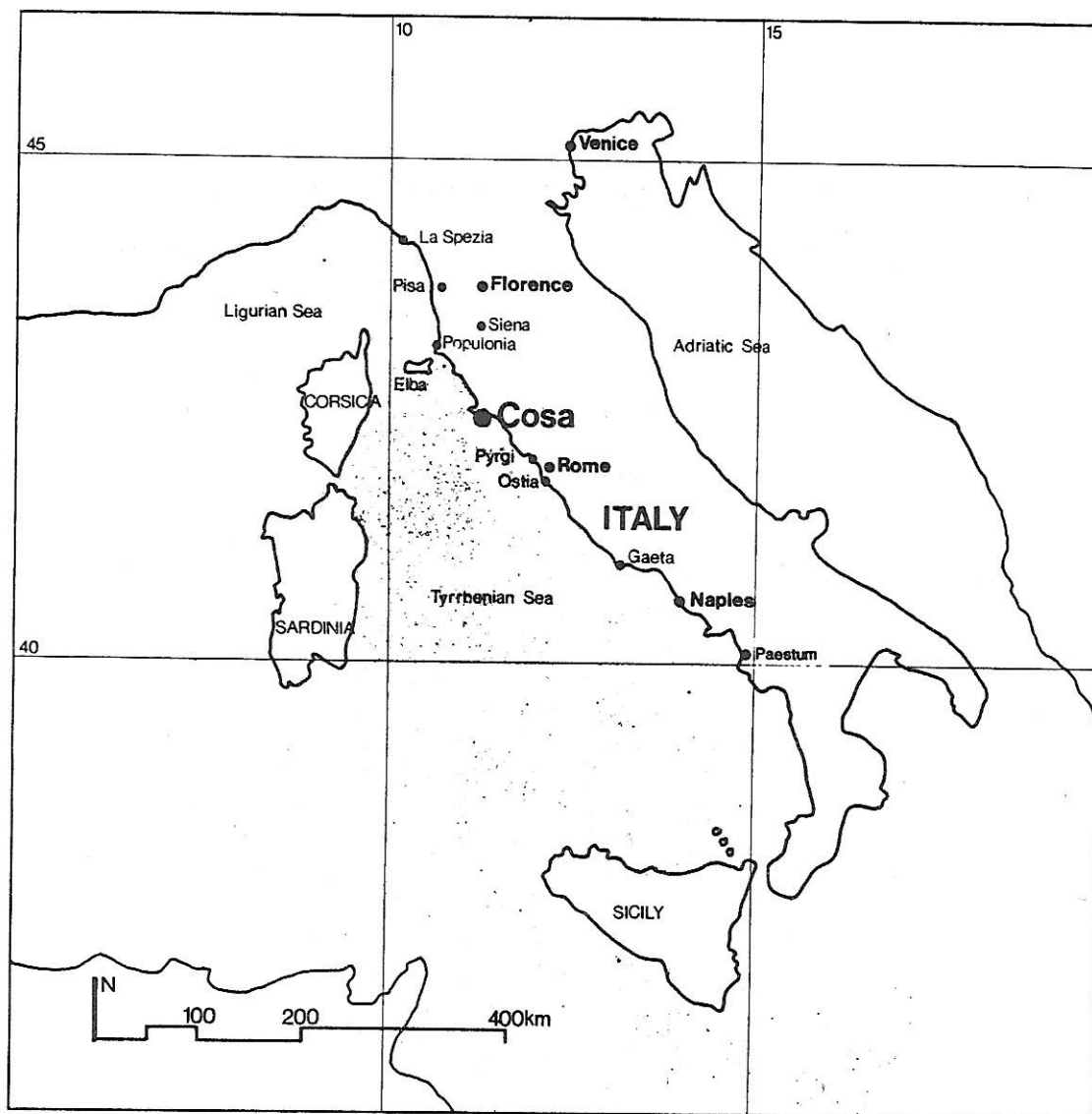


The Roman Port and Fishery of Cosa: A Center of Trade in the Late Roman Republic

The recent excavations of the ancient Roman port site of Cosa¹ on the Tyrrhenian seacoast of Italy 138 km north of Rome (Figs. 1, 2) have clearly established the Portus Cosanus as a focal point for trade in the western Mediterranean during the last two centuries of the Roman Republic². While the port of Cosa has long been known from the ancient sources³, its exact location has been debated and its dominant role in the commercial life of both the Latin colony of Cosa, founded in 273 B.C., and the whole western Mediterranean has not been recognized⁴. Previous archaeological interest in this beautiful area of ancient Etruria, modern Tuscany, has concentrated on land excavations — both within the fortified hill town of Cosa (Fig. 3) above the port⁵ and the late Republican and early Imperial villas behind the port, dotting the surrounding Ager Cosanus⁶. As important as these excavations have been, the life and history of this ancient territory has only been partially understood. Both our land and underwater excavations at the port site of Cosa, which includes an attached fishery about 250 m to the north in a now silted over ancient barrier lagoon, provide the essential missing link and the key to a full understanding of the whole area (Figs. 4, 5). Its crucial importance for the development of both Roman maritime and economic history as well as technology clearly emerges. From the interdisciplinary research of a collaborative team of archaeologists, geologists and other scientists, architects and engineers over the past 19 years, it is evident that the port was the primary reason for the original location of the colony and for the prosperity the whole region enjoyed during the last two centuries of the Republic. It is the evidence for the trading life of the Portus Cosanus during its most prosperous years in the second and first centuries B.C. that is the focus of this paper. The full archaeological, geological and other scientific evidence is presented in a collaborative volume shortly forthcoming by the Princeton University Press⁷.

Who were the builders of this earliest Roman port thus far identified? Its massive, concrete harbour piers (Figs. 6, 7) provide archaeology with the earliest dated use so far of hydraulic concrete made of tuff and pozzolana. Who conceived of the plan of the large and complex lagoonal fishery, added to the port facilities in the early first century B.C.? (Fig. 8) The long, concrete fish tanks discovered in the ancient lagoon area (Fig. 9) were linked to the sea by a series of intricate channels (Tagliata and Spacco della Regina), partly natural and partly man-made, cut into the limestone promontory protecting the harbour basin on the west as well as by man-made channels (M; A and B) within the harbour basin (see Fig. 4). The fish tanks themselves were over 90 m long and covered over two and one half acres (1.2 hectares). This extensive fish farm, where fish were probably both raised and held for processing, included a Spring House on its western bank (Figs. 10, 31 and 32) whose fresh water was carried by an aqueduct eastward across the lagoon to the central emporium area of the port (Fig. 11). The scale and complexity of this brackish-water fish farm would seem to indicate commercial rather than private use. Who financed and managed this harbour and fishery complex using imported tuff from Bolsena and pozzolana from Puteoli in the construction of its extensive concrete works⁸? Who had knowledge about and access to the most advanced Alexandrian water-lifting technology of the day — a bucket-chain driven through an angle gear (Fig. 12) — discovered in the Spring House and used to supply fresh water to both the fishery and the emporium? Parts of six wooden buckets from a garland-chain plus a complete one were found with other parts of the geared mechanism. This unique discovery gives the earliest archaeological evidence for such a water-lifting machine, first developed in the Greek Hellenistic world, probably at Alexandria, in the second century B.C. and still in use today in parts of the Near East, known by its Arabic

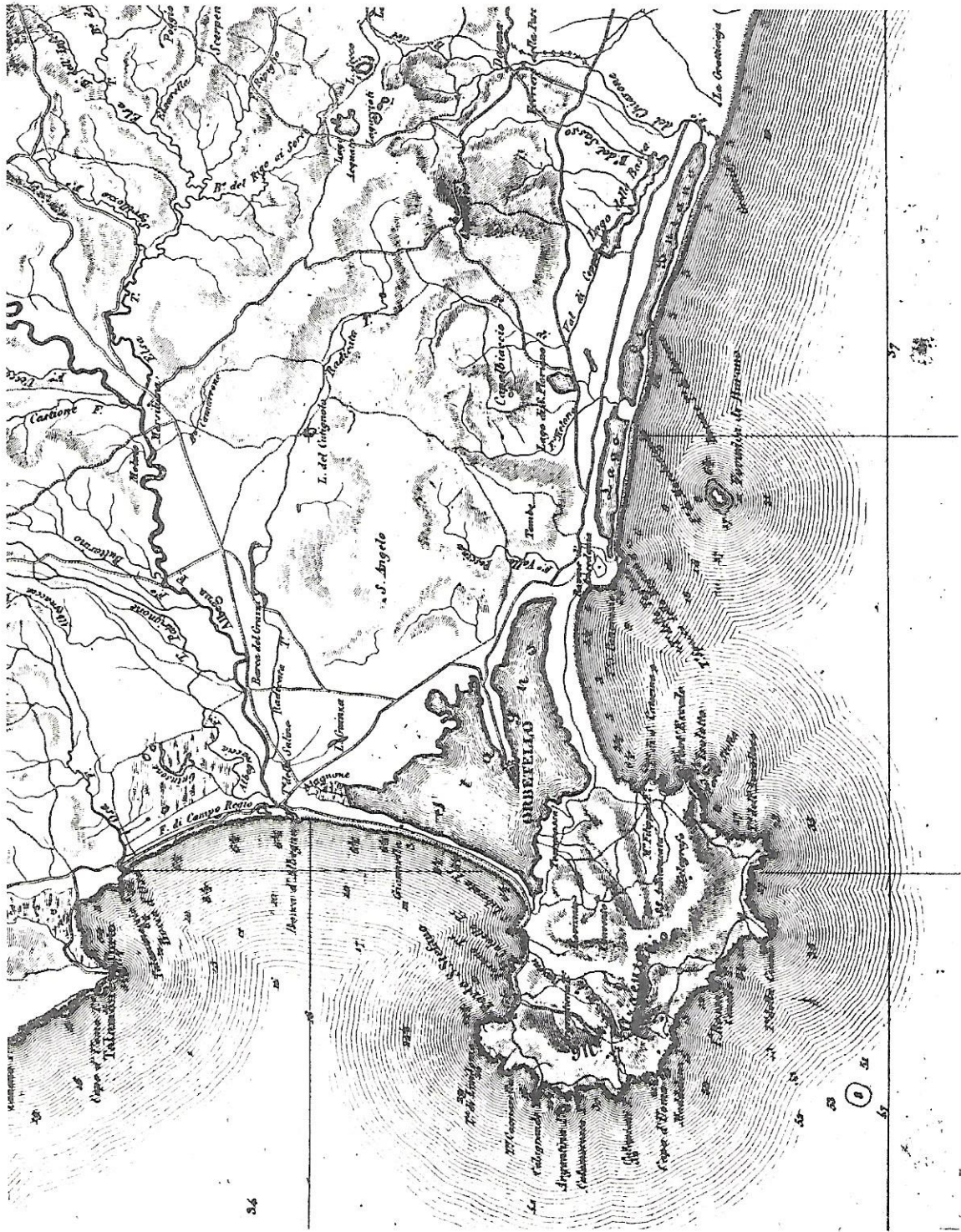


1. Map of Italy, locating Cosa.

name, *saqiya*. Wooden buckets from such devices have never been preserved before, the later ones being terracotta. Thus, Cosa's mechanism fills an important gap in the history of water-lifting technology, later to be perfected by the Romans to a remarkable degree⁹.

For what purpose was this elaborate harbour-fishery complex built? What products were shipped in the vast quantities of amphoras found both on land and underwater at Cosa? Who was their manufacturer? Who controlled the great volume of export trade loaded in the harbour and who planned the network of trading routes that linked this relatively small harbour by modern standards, ca. 25,000 sq m, to the whole western Mediterranean world for almost 200 years? Why and when did the port of Cosa cease to be a leading export center? What were some of the results of this successful commercial enterprise for both the development of Roman maritime and economic history and port and fishery technology?

Similar kinds of questions about ports are also raised by Geoffrey Rickman in his paper presented at this conference¹⁰. Besides the recovery and understanding of all the archaeological remains, Rickman urges that ports be viewed as places where people interact, as focal points for trade involving problems of geography, history and economics. To follow the wise words of the geographer Yehuda Karmon who recently wrote in his comprehensive study of *Ports Around the World*:



2. Detail of map of Tuscany by G. Inghirami, Carta geometrica della Toscana (Florence, 1830) showing Cosa and Orbetello. Scale, 1:205,000. Note existence of Cosa lagoon at western end of Lago di Burano still at this time. Photo: Courtesy of Rare Books and Manuscript Division, The New York Public Library, Astor, Lenox, and Tilden Foundations.

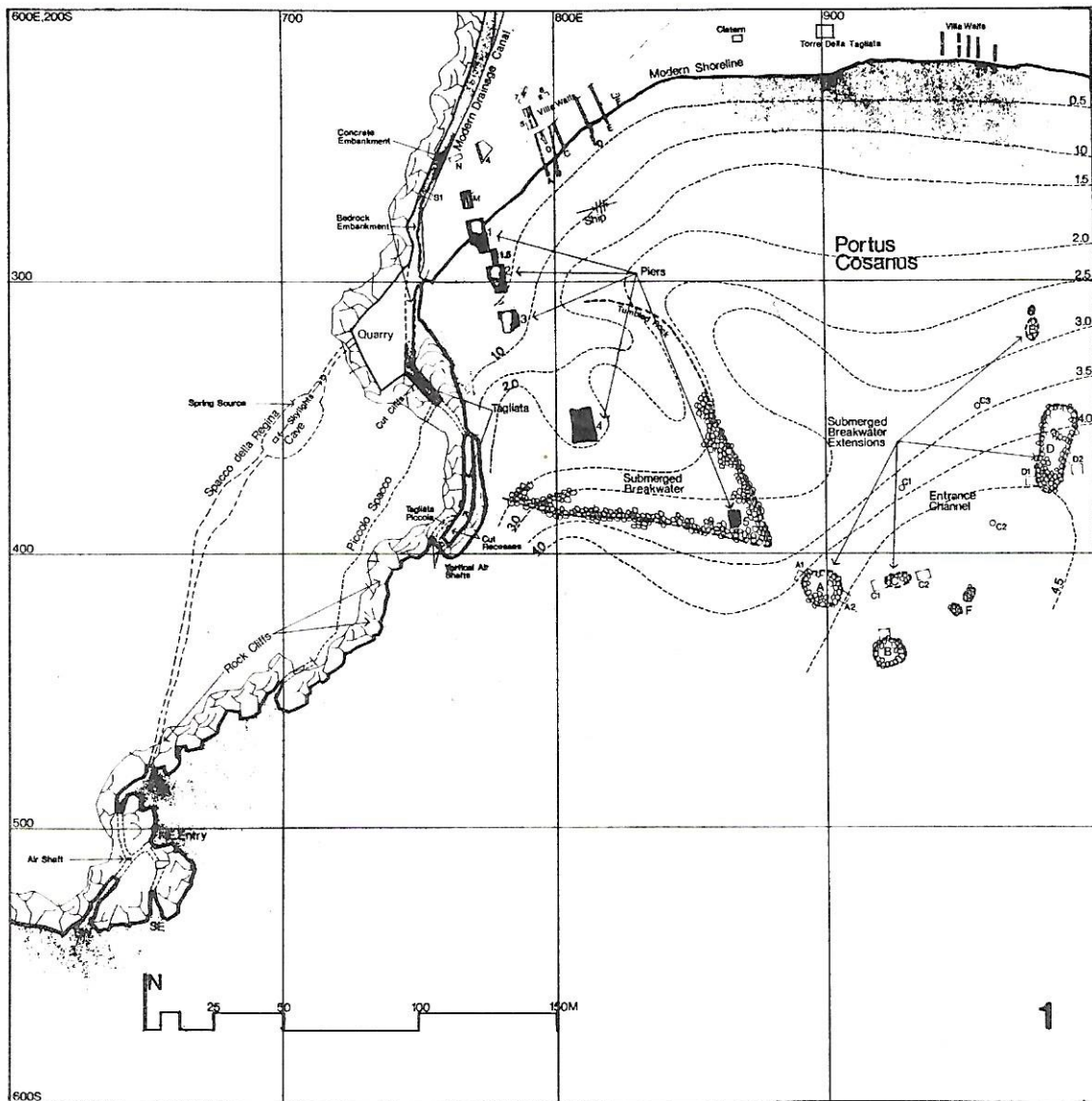


3. Map of hill town of Cosa with the Portus Cosanus and Cosa lagoon below.

A port cannot be regarded as an isolated phenomenon, but as part of the political, social and economic life of a region¹¹.

Who were the traders of Cosa? What did they trade in and where did they go? How did they achieve success and what were some of its results? These are the main issues addressed here.

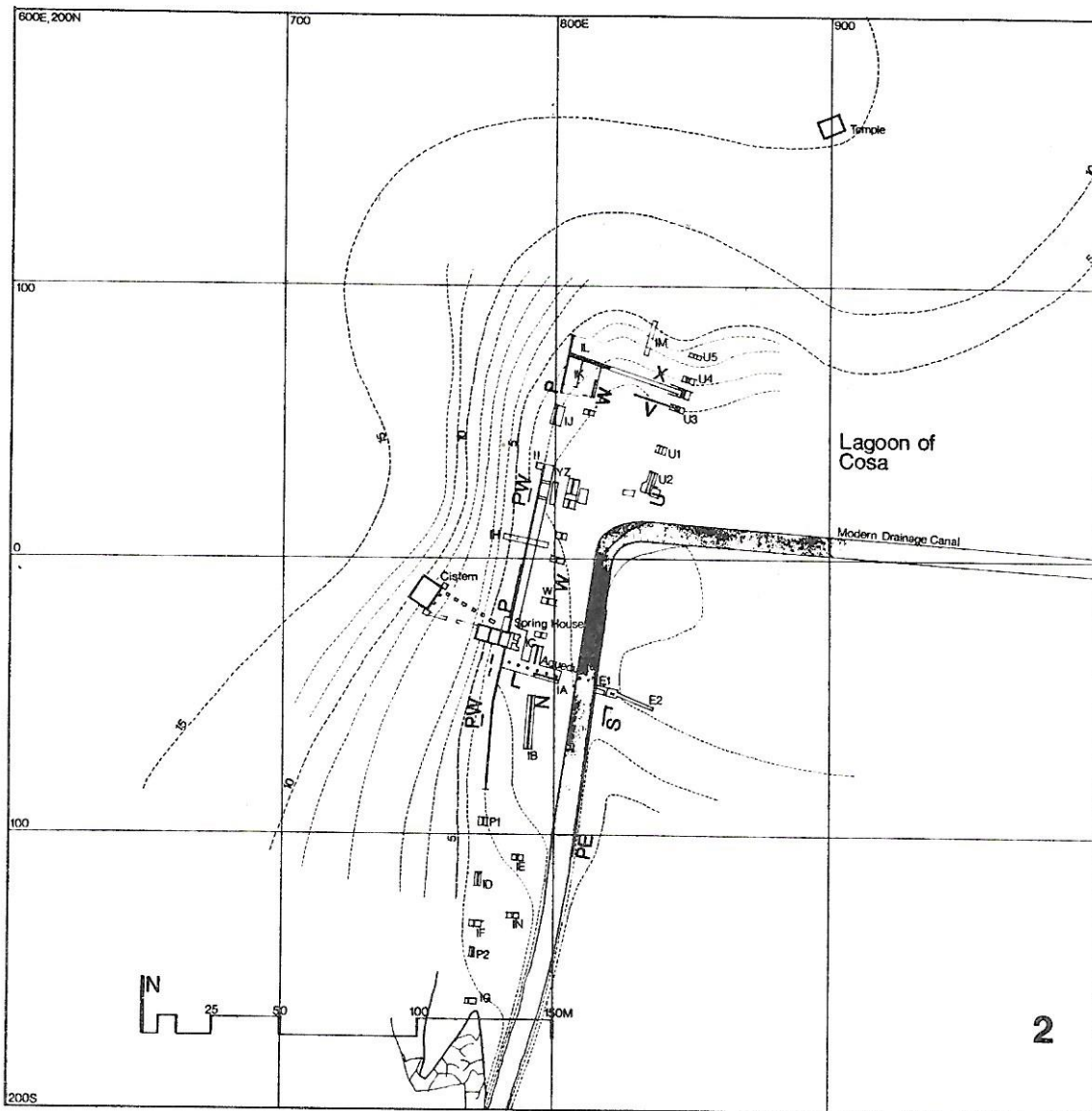
The answer to the first of these questions leads us back to the pioneering years of underwater archeology and to the famous shipwreck of the Grand Congloué found off Marseilles in 1952¹². Now recognized as two distinct wrecks, the upper one contained a cargo of about 1200 amphoras, many marked with stamps bearing the letters "SEST" and/or associated devices. Fernand Benoit interpreted these letters as an abbreviation of the *nomen* Sestius, but identified him with a certain Marcus Sestius of Fregellae, a trader mentioned in an early second century B.C. inscription from Delos. The cargo of the upper Grand Congloué wreck first brought to the attention of archaeologists this particular amphora form, now recognized as the most important of all Republican shipping containers for wine. Such amphoras are found on many sites in the western Mediterranean as well as in the Athenian Agora. The type is recognized by its tall, slender shape (over one meter high), long neck with flaring lip, vertical handles, narrow belly, and squat, solid toe (Fig. 13). Its average holding capacity measures about 26 liters. This form was first classified by the late Nino Lamboglia who revised Dressel's older, well-known



4. The Portus Cosanus, plan of ancient remains, including breakwater with its extensions A-F; concrete Piers 1-5; fish channels M and A-B; rock-cut channels in cliffs, Spacco della Regina and Tagliata; quarry; remains of walls of Imperial villa on shore (C,D,E, and F); Torre della Tagliata, built in sixteenth century.

typology and identified it as Dressel Type 1A. Both Dressel's typology, published in 1889¹³, and that of Lamboglia, published in 1955¹⁴, have now been completely revised and greatly expanded by Elizabeth Lyding Will through over 30 years of research that has included most all of the major sites in both the eastern and western Mediterranean¹⁵. She divides Roman amphoras into 24 different groups with their sub-divisions and bases her chronology upon securely dated contexts in which they have been found in the Athenian Agora excavations. Under Will's new groupings used here, 13 of which are fully published in our port of Cosa volume, the Grand Congloué jars are classified as Type 4a and dated from the last quarter of the second century B.C. through the first quarter of the first century B.C.

Shortly after the wreck at the Grand Congloué went down between 110 and 80 B.C., another cargo of Republican amphoras met its fate off the northern coast of Sardinia, near the island of Spargi¹⁶. Excavated by Lamboglia and his diving team the Spargi wreck is another turning point for the history of underwater archaeology. These excavations first established the use of a grid system for the mapping and recovery of finds from ancient wrecks. The cargo of the Spargi ship contained amphoras of Type 4a as well as Type 4b (Dressel 1), its immediate successor. These later containers, distinguished particularly by their vertical sloping rims and longer toes,



5. Lagoon of Cosa, plan of excavated remains with Spring House complex on western bank with aqueduct and fish enclosures (Walls W, V, L and N); retaining polygonal walls P, PW and PE.

may be dated from the second quarter of the first to the last quarter of the first century B.C. (Fig. 14) The cargo from the Spargi ship can now be fully studied, handsomely displayed in the museum dedicated to Lamboglia on the island of Maddalena. Both the amphoras of Types 4a and 4b from the Spargi ship (seen by Will) and at least some of Type 4a from the Grand Congloué wreck¹⁷ look to the eye to be made of the same type of reddish, coarse and highly micaceous clay with conspicuous red pottery bits which we have come to associate with the Sestius factory. The exterior surface is covered with a sandy colored, lighter wash.

Who was Sestius and from what port did these merchant ships embark, loaded with their large cargoes of wine jars? The port excavations at Cosa and the research of our amphora finds by Will have now secured the answers. Long before our formal excavations began in 1968, Will had recognized the connection with Cosa of the Sestius family, well-known from both the literary and historical sources as wealthy and prominent politicians, active in Rome in the first century B.C.¹⁸ Her evidence was based upon a number of Sestius stamps found in the excavations of the hill site of Cosa above the port, as well as upon Cicero's letter to Atticus in 44 B.C. in which he states that his friend Publius Sestius, whom he had defended in 56 B.C., had a villa at Cosa (*Att.* 15.27.1). Will further suggested that Publius might have had a pottery for the manufacture of amphoras to ship the produce from his estate at Cosa since his son, Lucius

Sestius, was known to have engaged in an extensive pottery business in the latter first century B.C., identified by the brickstamps bearing his name found in and around Rome. Now from her study of our port material, Will has been able to trace this long-lived family and their amphora factory back to at least the beginning of the second century B.C. and perhaps even earlier¹⁹. It is apparent that the Sestii were not only among the first Roman nobles to engage in trade in the western Mediterranean but were innovators in developing the first distinctly Roman amphora type, the important Greco-Italic form, Type 1d (Fig. 15). Modeled upon the earlier Greco-Italic shapes (Types 1a through 1c), Type 1d becomes the first standardized Roman amphora shape developed in the first half of the second century B.C. By comparison with its predecessors, Type 1d has increased in size with a height of between 0.75 m and 0.80 m and a belly diameter of about 0.35 m. The Romans had achieved an enlarged capacity, balanced appearance and uniform measurements in response to the demands for mass production. Type 1d is found in quantity at both the port (Fig. 17) and hill sites of Cosa. In the port, 76 fragments of Type 1d were found, representing 9% of our total material, and 142 pieces were found on the hill site of Cosa. Our port fragments are also made of the same pinkish, micaceous type of clay noted above in the Sestius jars from Spargi and the Grand Congloué. This clay has been found to be particularly high in volcanic materials — especially augite, olivine and magnetite. Now the comparative mineralogical analyses of amphoras from the port of Cosa of both Types 1d and 4a with the clays and beach sands from the area by geologists Raffaello Trigila and Jelle de Boer have provided strong evidence that this type of clay comes from the area of Cosa²⁰. Augites and olivine crystals which occur in great abundance in the Cosa beach sands are tecturally and mineralogically indistinguishable from similar minerals found in the Sestius amphora fragments. More mineralogical studies of the Sestius amphoras from other sites need to be done in the future.

While the Greco-Italic jars of Type 1d are found more frequently thus far at Cosa than on any other Mediterranean site, it is the later Type 4 amphora fragments which blanket Cosa's port and fishery. They provide the chief evidence for the dating of the most prosperous years of the harbour and the floruit of the Sestius export trade. Nowhere in the western Mediterranean has such a concentration of Type 4 been found. Moreover, with the exception of the large trading ports, as Delos and Alexandria, such a high concentration of a single amphora group with such a wide variety of stamps is unique. Eighty-six percent of the stamps found in the port (95 out of 111) are Sestius trademarks (Figs 18, 20). The Sestius stamps, which include 14 identified letter types, excluding the wide variety of devices, are all found at Cosa except for one. Of Type 4 itself, 559 pieces were collected at the port site: 300 of Type 4a and 208 of Type 4b with 51 indeterminate body fragments. Together, Type 4 represents 70% of our total amphora material. These Sestius amphora finds, which also include Type 5, 24a, as well as some experimental shapes, clearly document the port of Cosa as a key center for export trade by the Sestii in the last two centuries of the Roman Republic and the home of their chief factory. It must have been from the Portus Cosanus that the ships wrecked off the Grand Congloué and Spargi embarked, for only a factory of the scale indicated by our finds could have loaded such sizable cargoes.

Other important pieces of evidence from amphoras connecting the Sestii with the port of Cosa are a painted inscription on an amphora fragment from the Athenian Agora and a rare amphora stamp from the harbour of Cosa. The Athenian Agora fragment (P 6867) from a jar of Type 5 (Dressel 1C), made of the Sestius reddish clay, bears the letters CO/SES, painted in red upon its neck (Fig. 16)²¹. If the Latin letters are interpreted correctly by Will as abbreviations for Cosa and Sestius, as in the light of the evidence from the port excavations seems highly likely, this neck fragment serves as a major witness for the location of the Sestius firm at Cosa. We will return to this important amphora fragment, dated from its closed context to the last years of the second century B.C., when considering the contents of the Sestius jars.

The second amphora fragment of special interest for the evaluation of the relationship of the Sestii to the port of Cosa itself is one found underwater in the harbour of Cosa. On a rim of Type 4a (Cat. A79), the Sestius letters appear with a rare device — a tall, narrow, rectangular form with a flame issuing from the top (Figs. 19, 21). The device measures 0.018 m in width and

0.023 m in height²². This simplified design compares well with the schematic representations of lighthouses on Roman coins (Fig. 22)²³. Any working harbour, ancient or modern, is equipped with a lighthouse or beacon tower. The earliest example of a lighthouse in the ancient world is the famous Pharos of Alexandria, built in the early third century B.C. However, smaller beacon towers must have been used at harbour entrances before this time²⁴. In any case, the addition of the lighthouse to standard harbour works is a particularly Roman development. They were normally placed at the end of a breakwater or upon a separate island within the harbour entrance, as seen from their numerous representations in Roman art. The ancient foundations of only a very few of these lighthouses are known from archaeological remains. It is thus natural to assume that from its earliest period of use in the third century B.C., the port of Cosa had at least some kind of beacon. Archaeological evidence for such a light during the port's earliest years is lacking. But from the peak of the harbour's active commercial life in the late second and first centuries B.C., we may have significant remains. Two of the harbour's five large, concrete piers are placed on top of the main, rock-cut breakwater that extends directly eastward from the limestone cliffs on the west for about 110 m. One of these piers (Pier 4) is placed near the western end along the edge of its original, inner harbour side and the other (Pier 5) is located about 55 m to the east of it, at the tip (Fig. 23). The remains of Pier 5 are now totally submerged to a depth of ca. 2.50 m below sea level and are badly eroded (Fig. 28). Underwater probes around it with a water-jet device indicate that Pier 5 extends under the sand for at least another 1.50 m to the south. Its visible preserved core measures ca. 4.80 m (east-west) by 4.30 m (north-south). Pier 5 originally was thus a good deal larger and could have been of an appropriate size to support at least a small beacon tower. Its strategic position at the end of the long, artificial barrier protecting the harbour from the prevailing southwesterly, summer winds just to the west of the ship entrance channel (located between breakwater extensions D and F) further argues for the association of Pier 5 with a warning light. Our excavations have thus added new archaeological evidence for this type of beacon tower in the Roman world, an architectural form not otherwise well documented.

Now the fascinating identification of Paolo Zancani Montuoro of a small, votive, terracotta model of a tower from the nearby city of Vulci (Fig. 27) as the lighthouse of the Portus Cosanus lends new support to our identification of Pier 5 as a base for a harbour light²⁵. The tower model, found also with other votive architectural models, is generally dated by material from the deposit to the first half of the first century B.C.²⁶, although Professor Zancani Montuoro suggests that it could go back even to the late second century B.C. In any case, this time span is in accord with the dating of the Type 4a amphoras. The reconstructed height of the simple, square model from Vulci is ca. 0.30 m with the sides each 0.075 m. Professor Zancani Montuoro proposes an original height for the Cosa light, on the basis of her studies of other examples, as about 30 m with a base of about 7.50 m square, measurements compatible with the projected original size of Pier 5. The small votive gift from Vulci strikingly indicates the importance of the port of Cosa for the area and the inhabitants who used it. Returning safely home from a sea voyage into the shelter of the Portus Cosanus, the resident of neighboring Vulci offered his thanks. Built during Cosa's peak years, the lighthouse became, like the Pharos of Alexandria, the port's identifying symbol, adopted by the Sestii whose wealth and patronage sustained her active life for over 200 years.

The Sestius lighthouse stamp, if correctly interpreted here, is further indication for the location of the Sestius amphora factory at the port of Cosa, already overwhelmingly documented by the other amphora finds. In addition, the lighthouse stamp is of particular interest for it suggests the possibility of the involvement of the Sestii in the building and financing of the harbour's principal structures. Most of the other devices used by the Sestii on their stamps are also connected with the sea, fishing or the particular god of both — Neptune. These stamped devices include: trident, hook, fish spine, anchor, palm and pine branch. The lighthouse symbol, recognized thus far only on a very few Type 4a jars, also lends support to the proposed dating of the concrete piers of the harbour during the height of Type 4a's manufacture from the last quarter of the second century B.C. through the first quarter of the first century B.C. One would

imagine that the stamp was inspired by the erection of a contemporary monument. It must be admitted, however, that the Cosa harbour piers could even date earlier, during the time of the Type 1d amphoras in the first half of the second century B.C., or later, during the time of the early form of Type 4b in the second quarter of the first century B.C. No stamps have been indentified in the lower, original sections of the concrete piers and the coarse, reddish and micaceous body fragments of all the Sestius amphora types (Types 1d and perhaps other Greco-Italic types, 4a, 4b, 5, and 24a) used throughout all the concrete structures in both the port and fishery, are indistinguishable. Looking at the total picture, however, it seems most likely that the harbour facilities were given permanent form in concrete during the height of the Sestius trade in the late second and early first centuries B.C. documented by the overwhelming dominance of the Type 4a material. In any case, the harbour piers of Cosa still give the earliest known use thus far of hydraulic concrete made of tuff and pozzolana. When the use of this revolutionary material for harbour construction began is not known, but it must have been invented in the area of Puteoli during the course of her harbour construction and seaside villas after the foundation of the Roman colony in 194 B.C.²⁷. It is clear that the particular properties of hydraulic concrete were already well understood by the time tuff and pozzolana were imported to Cosa²⁸. A clear distinction was made by the builders of the piers and walls of Cosa's port and fishery between the concrete used in the lower, underwater portions of the structures where tuff and pozzolana were used and the upper sections above the salt water where limestone for the aggregate of the mortar was the rule. Tuff and pozzolana, both volcanic materials, are resistant to salt water, evidenced by the concrete remains at Cosa which have endured for over 2,000 years.

Excavations were carried out along the western side of Pier 1 in the Cosa harbour (Fig. 29). This pier is closest to shore and the best preserved of the five, measuring 12.50 m by 6.29 m. Resting on sand, impressions for six wooden upright planks used in the building probably of a single-walled cofferdam no longer remaining were uncovered. It would appear that the concrete piers at Cosa, built on a sandy bottom in shallow water, were constructed according to Vitruvius' first recommended method of construction for harbour works (5.12.1-3). This method used a prefabricated form made of single wooden uprights held together by tie beams. The form was then floated into place and anchored to the bottom by driving stakes into the sea floor. After the lower surface within was prepared, the hydraulic concrete was poured into the frame. To strengthen and prevent buckling while the concrete was being poured, crossbeams were laid within. Spaces for such crossbeams are still visible in Piers 2 and 3 at Cosa (Fig. 30). This single-walled caisson is particularly suited for concrete construction in shallow, protected water with sandy bottom conditions such as at Cosa. Conditions were not so favorable at Sebastos at Caesarea Maritima where much of the concrete works in the outer harbour had to be poured in deep water and in the open sea. Elsewhere in this publication, John P. Oleson identifies and describes in detail the Caesarea engineers' special solution and its relationship to Vitruvius' third recommended method for concrete harbour construction (5.12.5)²⁹. The strong, double-walled, wooden caisson found around a large concrete block at the northwestern tip of the northern breakwater at Caesarea was made on shore and floated to the site in deep water. This bottomless form was secured, not by uprights pounded into the sea bottom, but by massive sleeper beams used within the formwork and settled into a prepared sandy surface of the sea floor. Mortar was then poured into the hollow walls and rubble dumped around the outside of the caisson to steady it while the concrete was poured within. The Cosa harbour piers, by comparison, reveal a simpler and earlier stage in the evolution of Roman hydraulic concrete technology, which, in the span of only about 100 years, was capable of serving the monumental concepts of Herod the Great in the creation of his enormous port of Sebastos, designed to attract some of the Roman Imperial import trade in luxury goods coming from farther east, north and south.

During the period of the late Republic, however, before the demands of the great urban population of Rome for both grain and exotic goods imported from the ports of the eastern Mediterranean, Italy was engaged in developing her own export trade³⁰. The excavations at

the port and fishery of Cosa have brought to light startling, new information about the nature of these exported products. What was being shipped in the Sestius amphoras? It has always been assumed that wine was the sole export since the many *tituli picti* found on jars of Type 4 indicate wine as the content³¹. The discovery at the Portus Cosanus of the remains of a large, lagoonal, brackish-water fish farm covering over two and one-half acres, served by complex, imported water-lifting technology, presents new possibilities. While not all the parts of this facility have as yet been discovered — due both to the limits of the excavational permit, money and time — enough has been found thus far to allow some reasonable hypotheses to be made about what went on in the still unexcavated portions of the site, particularly the emporium area just to the east of the lagoon fishery and to the north of the harbour basin. This central land area of the site, today occupied by the Venturini family's seaside villa with a sixteenth century tower (Torre della Tagliata), was connected to the Spring House with its water-lifting machinery by an aqueduct, seven piers of which were uncovered in the mud of the silted ancient lagoon. Fresh water is essential for the healthy functioning of any brackish-water fishery. Both fresh and salt water are used to regulate water circulation, temperature and salinity. Moreover, fresh water is essential for the cleaning of any fish processing factory and for the making of pottery, to say nothing of the needs of ships and sailors. Cosa was the only ancient harbour in the area that offered such fresh water facilities. Port'Ercole across the bay on the Argentario peninsula, while more sheltered from the southwesterly winds, had no fresh water springs.

Ancient literature provides further evidence. Strabo documents in Augustan times the presence of a watch for tuna fish on Cosa's promontory above the port (5.2.8). He only documents three such watches along the western Tyrrhenian coast. Where there was a watch for tuna, there must also have been a port with a beach to process the fresh fish dragged upon the shore and a saltery of some kind to preserve them. We hope to do further excavations in the future at the site of the Portus Cosanus to test the hypotheses presented here of both a fish processing facility and an amphora factory in an emporium area (Figs. 24, 25 and 26).

Specific archaeological evidence found thus far for a fish factory at Cosa and for export by the Sestii of fish products such as garum comes again from the amphora finds. Will has identified among the material from the port site of Cosa two new forms of garum jars, Types 5 (Fig. 33) and 24a, both modeled on well-known Spanish garum containers but made of the Sestius pinkish clay from Cosa³². Type 5 is dated between about 125 B.C. and 50 B.C. and Type 24a, about 75 B.C. to 50 B.C. Garum, the fish sauce of antiquity, was usually made at a saltery, as a by-product from the guts of fish left to ferment in the sun in large vats or dolia. While vats have not been found as yet, many fragments of dolia were recovered. Garum is described by the ancient authors as a liquid substance, sometimes even blended so that it can be drunk as a liquor³³. It has usually been assumed that only the wide-mouthed amphoras contained garum, but Will's identification of the narrow-mouthed jars of Type 5 necessitates rethinking about the relationships of amphora forms to their contents. Being of a concentrated nature, probably only a small number of garum containers accompanied a shipment of wine. But even so, ancient writers assure us of the fame and fortune that could be gained by manufacturing it.

Scarcely any other liquid except unguents has come to be more highly valued, bringing fame even to the nations that make it (Pliny, *Nat. Hist.*, 31.43.94).

Although no inscriptions have as yet been identified on any amphoras of Type 5 and 24a indicating garum as the contents, *tituli picti* might well have disappeared at the port site of Cosa owing to the circumstances of preservation in mud and water. It should also be remembered that only a small number of jars were marked in any shipment and it is also possible that garum was not marked on jars at this early date. The suggested identification of one of the Sestius stamps as a fish spine on jars of Type 4a (Cats. A103-107) may also be significant. Will allows that garum as well as wine could occasionally have been exported in the Sestius jars of Types 4a and 4b. But it is the painted inscription CO/SES on the garum jar of Type 5 from the Athenian Agora that directly links the Sestii to a garum export trade from Cosa during the late second and first half of the first centuries B.C. Therefore, the fishery at Cosa and the identified garum amphoras found there are the earliest evidence I know for a Roman commercial fishery and for

the export of garum from Italy. Previously, it has been generally believed that the export of garum occurred only about a century later and not in any quantity. The famous fisheries of ancient Baetica on the southern coast of Spain are all much smaller and do not date before Augustan times and mainly from the first and second centuries A.D. when the import of garum from Spain to Rome was at its height³⁴.

Our best comparisons with this unique, ancient lagoonal fishing complex at Cosa are the modern fisheries in the neighboring lagoons of Orbetello and Lago di Burano, the unfilled portion of the ancient Cosa lagoon about 5 km to the east of the port. These coastal fishing lagoons, along with those in the Veneto, provide Italy today with one of her richest natural resources. Now the ancient Cosa fishery proves a direct heritage from the Roman past. In these barrier lagoons, certain euryhaline species of fish are drawn into the warmer, brackish waters to feed and grow and be caught when instinct drives them back to the sea to spawn. The chief kinds of fish caught in the lagoons of Orbetello today are members of the eel family, which make up about 50%; grey mullet (especially *Mugil cephalus*) which are particularly adaptable to low salinity; sea bass (*Dicentrarchus labrax*); gilthead (*Sparus auratus*); and sole (*Solea solea*)³⁵. Mullet was particularly prized in antiquity, and large ones brought exorbitant prices. A special variety of fish sauce was made from its liver³⁶.

The facilities for this type of brackish-water, lagoon fishery are very different from those made for catching and raising fish in the sea. Many remains of ancient salt-water fish tanks or *peschiere* exist throughout the Mediterranean, mostly connected with private villas³⁷. An elaborate and large sea *peschiera* exists at Caesarea. Its intricate design and water circulation system were described in detail at the conference by Alexander Flinder. While Cosa's fishing activities were largely centered upon the lagoon, there is also evidence for the use of a small sea tank to catch fish directly from the sea. Cut into the walls of the Tagliata channel in the limestone cliffs at its southern, open, seaward end (Tagliata South, Fig. 34), there are elaborate remains of cuttings for a pair of sluice gates, closing off a section about 10 m in length with a width varying from 4 m to 5 m (Figs. 35, 36 and 37). This small tank was carefully provided with circulating sea water from both diagonal tunnels cut into its eastern sea wall and by a second, narrower channel cut into its western cliff side, identified as the Tagliata Piccola. This channel which is about 1.8 m wide winds westward for about 9 m to exit into a small cove on the northwest. Its seaward mouth is angled away from the waves while the seaward mouth of the larger Tagliata South faces directly into the waves coming from the southwest. Moreover, while most of the tunnel floor of the Tagliata Piccola is cut at about 1.4 m below sea level, at its seaward end a narrow section of the floor is dropped to 2.6 m below sea level, approximately one meter lower than the seaward mouth of the Tagliata South. This change in level in the Tagliata Piccola allows for an outward flow of water from the enclosed fish tank within the Tagliata South. A similar arrangement of channels for water circulation is found in a larger Roman fish tank at Jávea (Fig. 38) on the southern coast of Spain in Alicante³⁸. Remains of a Roman fish factory dating from the first and second centuries A.D. have been excavated nearby. The Jávea *peschiera*, which measure 28 m by 7 m with a depth of 4 m, is likewise cut into the natural rock of a promontory (Punta de l'Arenal) and connected to the sea by two channels, each about 40 m long. The larger mouth of the main channel is 1.60 m wide and lies perpendicular to the sea, facing the wave direction coming from the northeast as the mouth of Tagliata South. Fresh seawater thus continually enters into the *peschiera*. The second, narrower channel is 0.50 m wide and angles obliquely off across the promontory to the northwest. Like the Tagliata Piccola, its mouth is cut about one meter lower than that of the larger channel, forcing water from the tank to flow out to sea. As at Cosa there are cuttings for sluice gates at the inner mouths of both channels for water control during high seas. Both the fish tanks at Jávea and at Cosa are ideally located for holding fish waiting to be processed in the nearby salteries, although both *peschiere* may also have been used for raising fish. At Cosa, too, fish could have made their way up through the long channel of the Tagliata leading into the lagoon, to be caught on their return to the sea. The concrete remains at the mouths of both the Tagliata

South and the Tagliata Piccola, studied by Elaine K. Gazda, also indicate their re-use during Imperial times, probably by the owners of the large maritime villa which now covered the whole area of the former export harbor and its emporium.

While there is no inscriptional evidence from either the hill or the port excavations thus far at Cosa to indicate the direct involvement of the Sestii with the building of either the port or the fishery at Cosa, the amphora evidence cited above is very suggestive. Moreover, there is no evidence either to indicate state or municipal involvement in the construction or management of port or fishery. It may well be, however, that the municipality of Cosa built at least the earliest structures at the port during the third century B.C., namely, the breakwater whose roughly hewn blocks were conveniently quarried at the harbor's edge from the limestone cliffs at its western end. Perhaps the Sestii, whose wealth and power are well documented in the ancient sources, obtained a franchise for the fishing rights in the lagoon from the new *municipium* established in 90 B.C. and used the profits derived from their successful wine trade to build the permanent concrete structures of the fishery. The rich fishing lagoons today at Orbetello are under the joint management of a fisherman's cooperative and the commune of Orbetello. The profits from the fishing industry there are divided 70% for the fishermen and 30% for the municipality³⁹. Perhaps a similar combination of a fisherman's guild (*societas*), controlled by the Sestii, and the municipal government of ancient Cosa jointly administered the local fisheries and harbor, at least during its most productive years in the late second and first centuries B.C.

The other Republican family known from the ancient sources to have had estates in the Cosa area were the famous Domitii Ahenobarbi⁴⁰. One naturally wonders if this particularly wealthy and politically powerful family also had interests at the Portus Cosanus. While no inscriptional evidence has as yet come to light to link them to this site, an inscription from the town of Cosa documents that Nero, the natural son of Gnaeus Domitius Ahenobarbus, remodeled the basilica in the forum into an odeon. Other evidence comes from the ancient sources⁴¹. Caesar writes that the younger Lucius Domitius Ahenobarbus requisitioned seven merchant ships to embark troops from the Portus Cosanus to aid Marseilles (Massilia) against Caesar in 49 B.C. (Caesar *BCiv* 1.34; cf. Cicero *Att.* 9.6.2). Indication that the Domitii may have been more deeply involved with the commercial activities at the Portus Cosanus is an amphora stamp, SEX DOMITI, that occurs repeatedly on Augustan examples of Type 24a, a form previously connected with garum. While this stamp is not found on any of the jars of Type 24a from either the port or town site of Cosa, the shape is especially well represented on the hill site where also misfired rims have been found. To the eye, the clay of Type 24a is similar to the reddish Sestius clay. Will suggests that this type of container, related to Dressel's form 28, was first manufactured at Cosa in the second quarter of the first century B.C. when the Spring House and concrete fish tanks in the lagoon were built⁴². Perhaps the stamp on these later jars of Type 24a refers to a take-over by the Domitii of the Sestius amphora and garum factories, or at least a joint control, sometime in the second half of the first century B.C. when the Sestii appear to have turned their major pottery interests to Rome. Other archaeological evidence supporting the Domitii's involvement in trade is found on a lead anchor stock now in the Palermo National Museum. Inscribed in reverse is the name "Ahenobarbi" recognized by P.A. Gianfrotta, following F. Zevi⁴³. Only further archaeological finds can resolve the question of the extent of the Domitii's involvement in the trading life of the Portus Cosanus, so clearly dominated by the Sestii from the evidence so far found.

Where then were the Sestii shipping their wine and garum and who owned the ships embarking from the Portus Cosanus carrying these products in such high demand? Will has documented the far-flung trading empire of the Sestii whose jars are more frequently found on western Mediterranean sites than any other type during the last two centuries of the Republic. Stamps of the Sestius type shipping containers have been convincingly documented on at least 31 different sites in Italy, France, Spain, Switzerland, Germany, and Austria (Fig. 39), not including the intriguing Sestius painted inscription from the Athenian Agora⁴⁴. While the cluster of Sestius stamps from Gaul suggests that Gaul may also have been a secondary place of manufacture for

the Sestius firm, it is clear that Cosa was the home of their central and largest pottery, located in all probability in the port area. The port and hill sites of Cosa, taken together, account for 69% of all Sestius stamps found thus far on land and Cosa is the only place where almost all the known varieties of Sestius trademarks appear. Other archaeological finds, including the shipwreck of the Grand Congloué and 29 other wrecks recently documented along the French coast as carrying amphoras of "Dressel Type 1", indicate that Gaul was rather the chief market for the Sestius factory and was importing rather than exporting wine at this time⁴⁵. Evidence that the Sestii were probably also the owners of at least some of these trading ships is found in Cicero who mentions *navigia luculenta...Sesti*, "the splendid ships of Sestius", in 44 B.C. (*Att.* 16.4.4). Whether this particular passage refers to warships or merchantmen, it clearly indicates that the Sestii owned enviable ships of size, and were engaged in activities on the sea, as well as on land.

What might have been carried home by the Sestii in their merchant ships? This subject has recently been addressed by André Tchernia⁴⁶ and Christian Goudineau⁴⁷ who offer their interpretation of trade between Italy and Gaul in the late Republic as based exclusively upon counter-trade — barter of goods or services — namely metals, slaves and military technology. To be sure, their arguments are bolstered by some ancient literary and archaeological evidence. No allowance, however, is made by either Goudineau or Tchernia for monetary exchange and the archaeological evidence from both the town site of Cosa as well as its port and fishery is completely ignored. The dominance of Roman coinage in the western Mediterranean following the Second Punic War with the introduction of the denarius in 211 B.C. is widely attested. Literary evidence may also be used in support of monetary exchange for wine during this period. Plutarch writes that in 124 B.C. Gaius Gracchus reported to the censors in Rome that Roman officials in Sardinia brought their own wine with them from Italy and took home the amphoras filled with gold and silver (*vit. C. Gracch.* 2.5). While coinage, of course, need never be the only means of exchange, it was part of the trading picture from the beginning of the second century B.C., as revealed by coin hoards found in France, Spain, Tunisia, Yugoslavia and Italy. While we do not know how extensive money exchange was, it is clear that a monetary system was in place and at least in limited use⁴⁸. The finds from the hill site of Cosa also indicate an influx of Roman coinage in the early second century B.C., as well as a large hoard of denarii dating from about 105 to 72 B.C.⁴⁹

Another factor, not to be ignored, is that exports and imports need not necessarily be in balance and multi-lateral trading patterns also existed. In supplying the enormous needs of the city of Rome for grain during the Empire, we know from Strabo (17.793) that ships regularly sailed in ballast from Puteoli to Alexandria where they were loaded for their return voyage⁵⁰. That ships also sailed under capacity for legs of their journey is also well documented by finds from ancient shipwrecks. For example, the seventh century A.D. ship from Yassi Ada, rated at 60 tons, was wrecked when carrying a load of just over 27 tons⁵¹.

One is forced to conclude that a picture of the wine trade between Gaul and Italy at this time, conditioned solely by a need for slaves and metals in Italy, fails both to consider the evidence of the coinage and a society already well-supplied with labor from slaves captured in her own successful wars, freedmen, and a free peasant class. The latter, recently argued by D.W. Rathbone⁵² (using the evidence of S. Dyson's survey of the Ager Cosanus as well as the excavations at the villa of Sette Finestre by A. Carandini), represented a significant factor in the labor force of the Ager Cosanus during the second and first centuries B.C. But even more critical for any interpretation of trade or the formation of any economic theory about the late Republic is the evidence of the great Sestius enterprise revealed at the Portus Cosanus. What created the margin of profits from the export of wine and garum to enable the capital investment of the extensive, concrete harbor and fishery installations, to say nothing of the sophisticated water-lifting machinery which served both? And likewise, what supported the large labor force needed to build and service this complex facility as well as produce the products manufactured there? Further expansion and diversification into the manufacture of bricks and Arretine ware by the Sestius firm in the later first century B.C. has also been

presented by Will. How were these new factories financed? Monetary profits derived from the increased volume of the Sestius wine trade, so indisputably documented from all sides, seems the most reasonable answer to this writer⁵³.

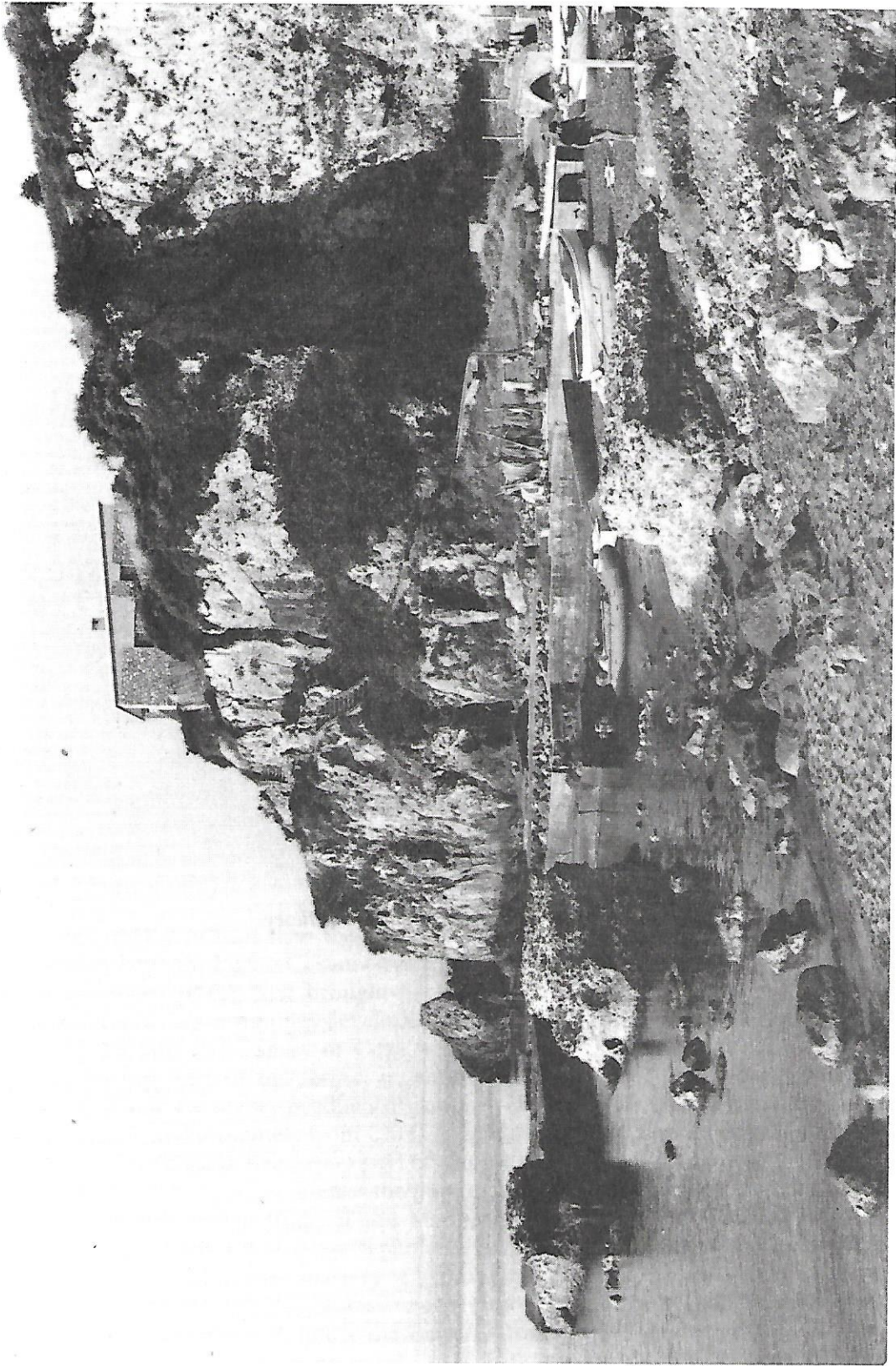
But I will leave these matters up to the economic historians. As an archaeologist, my chief concern is in presenting the evidence for this ancient center of export trade, hitherto unrecognized, and the earliest Roman one thus far known. Some of the results of this most successful trading enterprise have been indicated throughout the discussion. The dissemination of technological knowledge is surely one of the most important by-products of trading activities⁵⁴. The archaeological remains at the site of the Portus Cosanus testify to a large building program utilizing the skill of Roman engineers already familiar with the harbor technology developed by the Greeks and probably also by the Etruscans⁵⁵. The properties of hydraulic concrete, made with tuff and pozzolana, were also familiar to the Cosa port engineers who imported these materials for the construction of the harbour and fishery. The knowledge of advanced Alexandrian water-lifting technology probably also originally came to Cosa through her maritime contacts, first to serve the bath within the city walls in the mid-second century B.C.⁵⁶, and later, in the first quarter of the first century B.C., the Spring House complex. As trade increased, so did mass-production techniques evidenced by the gradual evolution of the amphora forms towards standardization of measurements, increased capacity and streamlined shapes tailored for easy handling. The Sestii emerge as leading pioneers in the establishment of economic practices in common use today as they helped form the trade routes welding the western Mediterranean together during the last two centuries of the Republic.

The Portus Cosanus and our extensive excavations both underwater and on land of its port and unique lagoonal fishery can no longer be ignored. Our remains of the Sestius Greco-Italic amphoras (Type 1d) indicate the surprising importance of trade already in the early years of the second century B.C., if not in the second half of the third century B.C. (Type 1b). This startling and new evidence pushes the international trading picture of the Roman world back at least to the first quarter of the second century B.C. and indicates the involvement of Roman noble families in its formation as they sought to acquire their own fortunes⁵⁷. Up until now, Roman colonization, in its earliest phases, has largely been viewed from military aspects⁵⁸. It now seems possible to suggest that commercial rivalry with Carthage for the western Mediterranean trade may have also played a role in the establishment of colonies along the Tyrrhenian coastline. Cosa would have provided an important economic as well as a military base along the newly acquired Etruscan littoral.

While much smaller in scale than the monumental port of Herod at Caesarea Maritima built over a century later, the Portus Cosanus had a unique role to play in the development of Rome's commercial power which first brought her into contact with her western Mediterranean neighbors. In turn, the technology developed in the west and revealed in the hydraulic concrete remains of the port and fishery of Cosa were imported by Herod for the building of his enormous harbor, one of the largest in antiquity. Under the Empire, the Roman urban populations sought the luxury products of Arabia — incense; Africa — ivory; India — pepper and other spices; and ultimately from China — silk. Herod hoped to capture his share of this profitable trade and make Sebastos a port of exit for these goods entering the Mediterranean. We await with the greatest of interest the publication of the finds from Caesarea which will make clear its role in the trade of the Mediterranean. Meanwhile, taken together, the architectural remains of the Roman Republican port of Cosa and those of the early Imperial port of Sebastos reveal Rome's mastery of hydraulic engineering, a skill which enabled her to create the monumental forms so expressive of Herod's megalomania and an empire. Through her ports and their commerce, under the Empire, Rome joined the eastern with the western Mediterranean. But this fascinating process of international trade development, still evolving today, began for the western world during the late Republic at Cosa with the Sestii — among the very first of many generations of successful Roman businessmen.



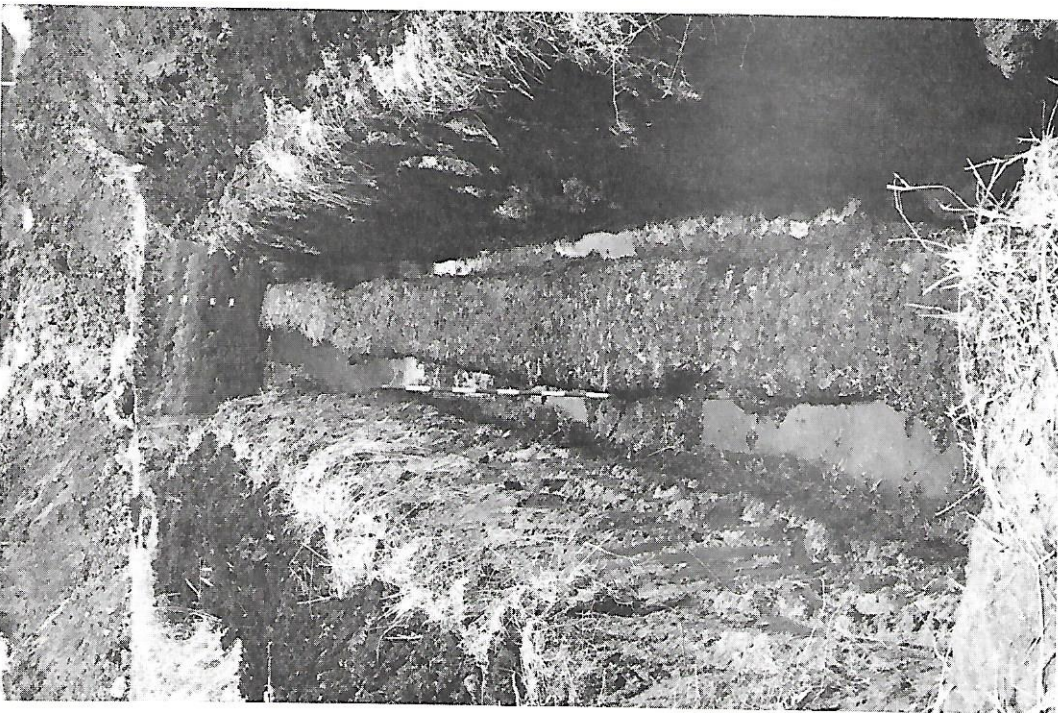
6. Aerial view of harbour of Cosa in 1969, looking north. Photo: J. Whittlesey.



7. Harbour of Cosa, looking west with concrete piers 1, 2, and 3 in foreground. Quarry and Tagliata channel in limestone cliffs in background.



8. Silted, ancient fishing lagoon of Cosa, looking south, during excavations of 1972. Modern canal cuts through center of area. Trenches of excavation and Spring House complex along western bank on right.



9. Southern fish tank (Trench IB) with concrete wall N, looking north, lagoon of Cosa.



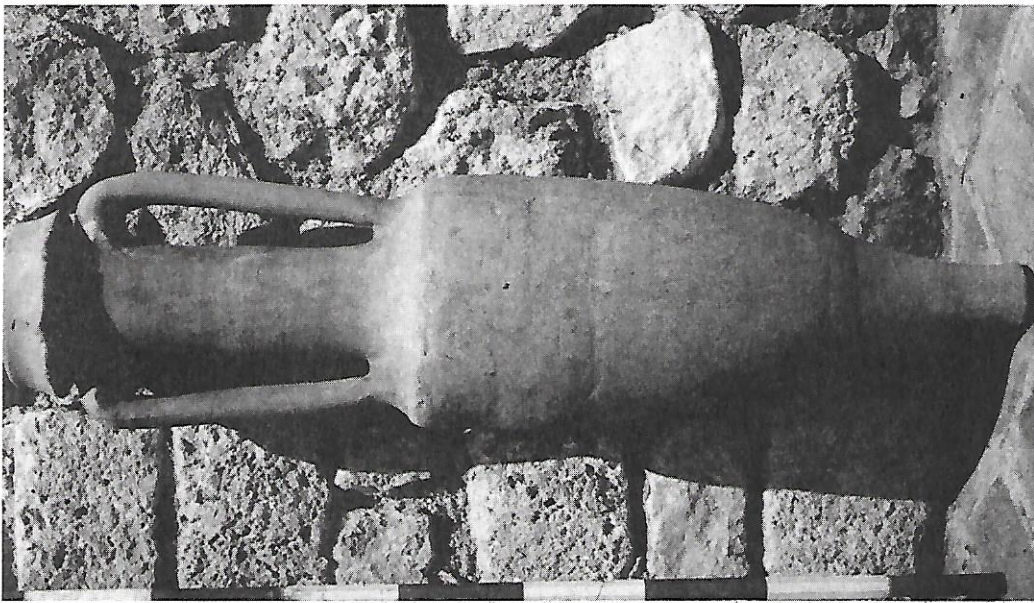
10. Spring House complex with piers of aqueduct in lower center and cistern in upper center. Spring House with polygonal wall P in center, during excavations of 1972.



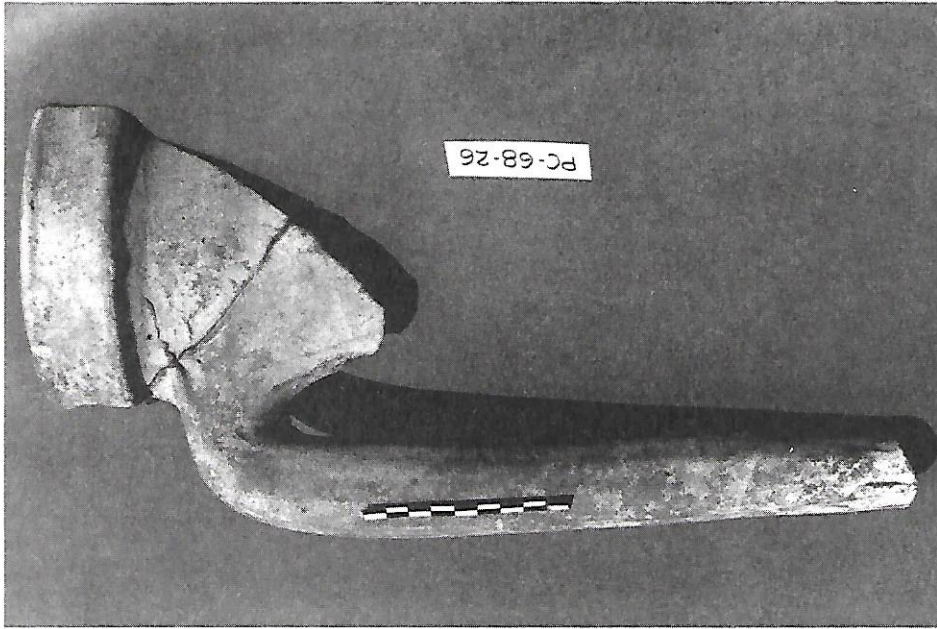
11. Three of concrete piers of aqueduct leading east from Spring House in Cosa lagoon. Excavations of 1972, with back-hoe.



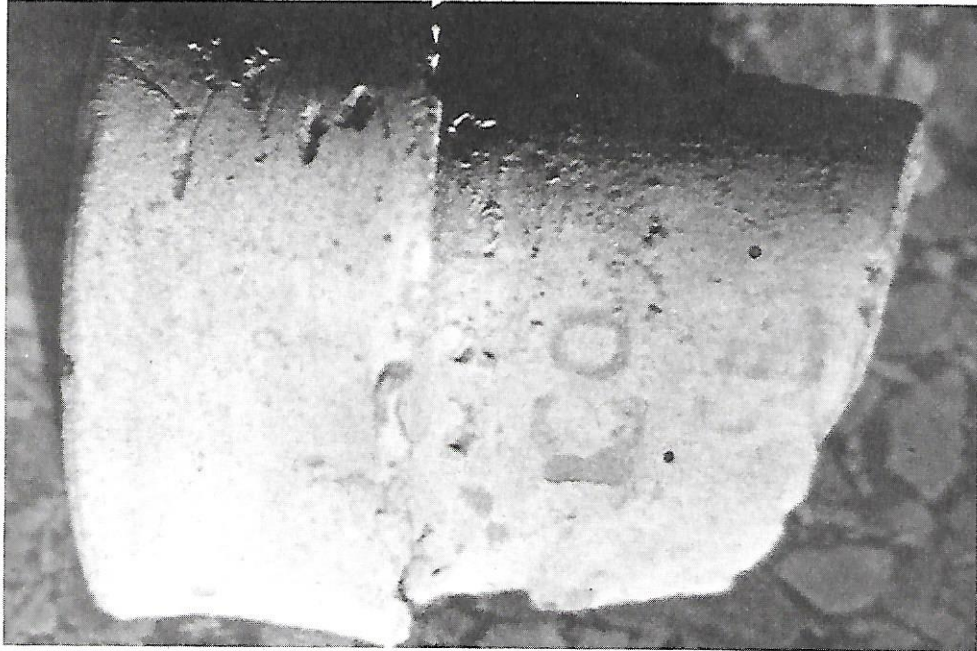
12. Remains of one of wooden buckets from water-lifting device found in room 2 of Spring House, in situ.



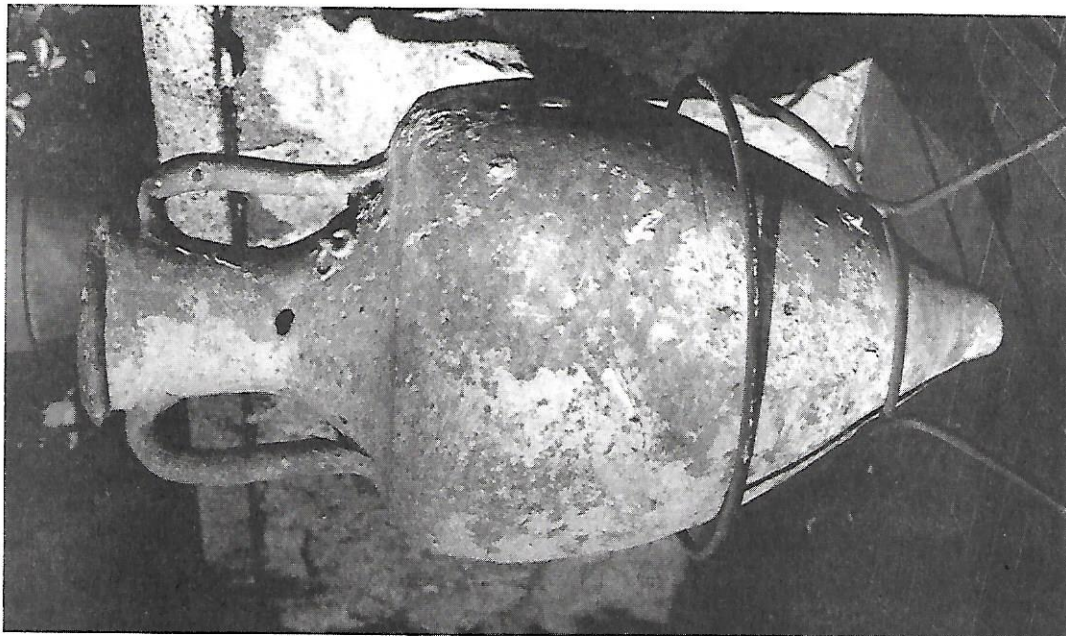
13. Amphora of Type 4a from excavations of town of Cosa (C65.94). Height, 1.02m; greatest diameter 0.26m. Stamp on rim is a trident device.



14. Amphora fragment of rim, neck and one handle of Type 4b, from port of Cosa excavations (Cat.A206). Preserved height, 0.385 m; estimated mouth diameter, 0.13 m; estimated rim diameter, 0.16 m; handle width 0.049 m; handle thickness, 0.043 m; coarse pinkish clay. Mended. Found in fill around Spring House basin in lagoon.



16. Fragment of neck of garum(?) amphora of Type 5, from the Athenian Agora excavations (P6867). Whitish slip over pinkish Sestius type of clay. Painted inscription in red on neck under rim: CO/SES. Unstamped. Preserved height, 0.155 m. Last years of second century B.C.

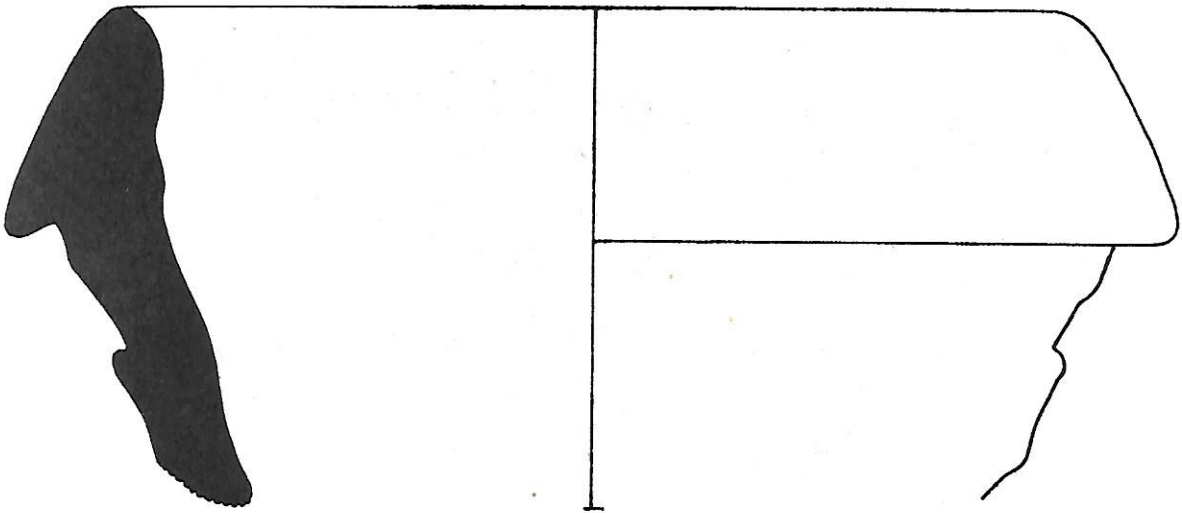


15. Amphora of Type Id (western) from Port' Ercole (?). Private collection, Ansedonia. Preserved height, 0.698 m.

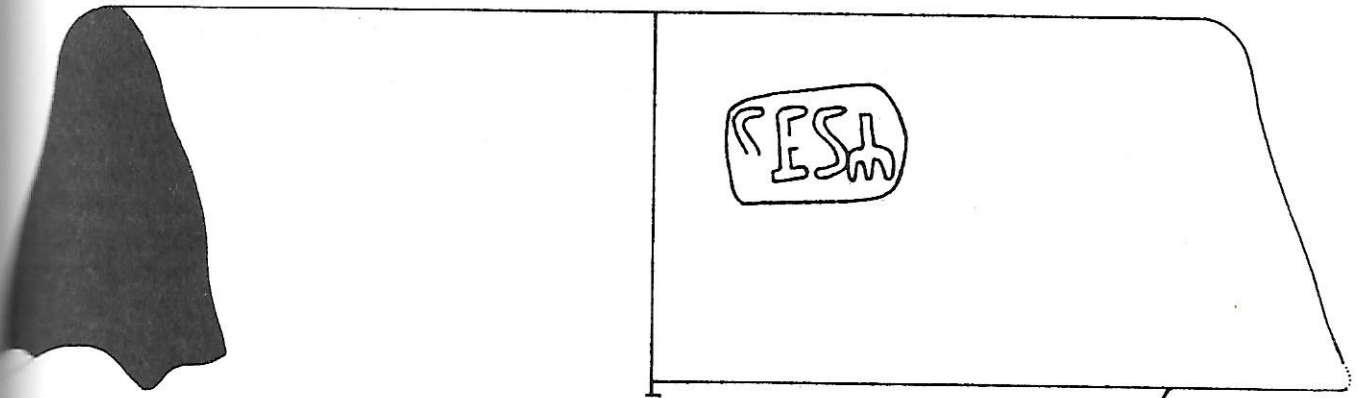
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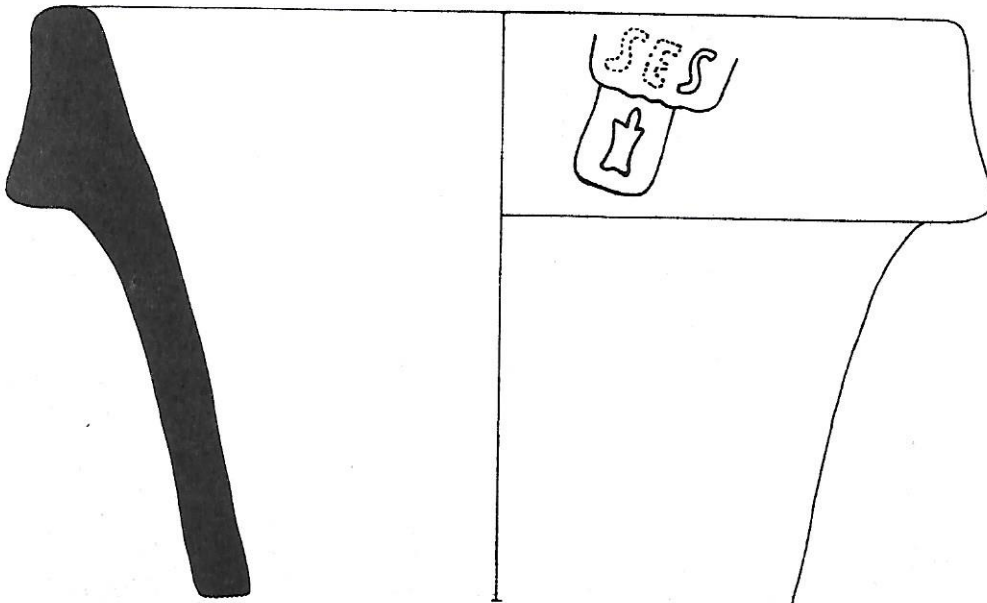
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17. Amphora rim of Type 1d, from port of Cosa excavations (Cat.A31). Lagoon, Spring House. Preserved Height, 0.067 m; rim height, 0.031 m; estimated mouth diameter, 0.12 m; estimated rim diameter, 0.16 m. Coarse pinkish clay.



18. Amphora rim of Type 4a, from port of Cosa excavations, (Cat.A60), harbour area. Stamped: SETS device (trident). Preserved height, 0.057 m; rim height, 0.055 m; estimated mouth diameter, 0.15 m; estimated rim diameter, ca.0.21 m. Coarse, pinkish clay.



19. Fragment of rim and neck of amphora, Type 4a, port of Cosa excavations, underwater in harbour (Cat.A79). Stamped: SES and device (lighthouse). Reddish, coarse clay. Preserved height, 0.118 m; rim height, 0.041 m; estimated mouth diameter, 0.16 m; estimated rim diameter, 0.20 m.



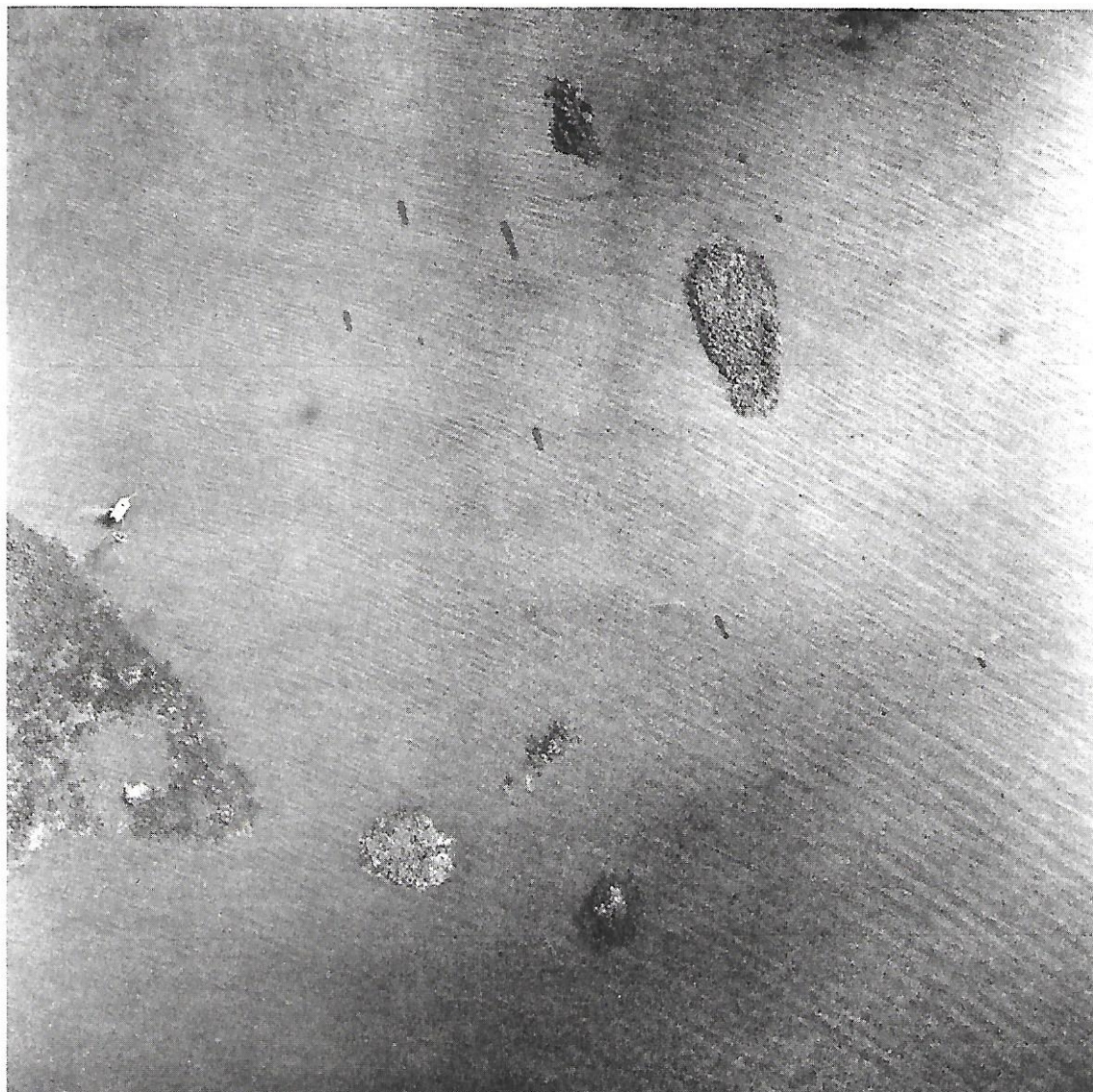
20. Stamp from amphora of Type 4a (Cat.A60), fig. 18. Stamp: SETS device (trident). Height, 0.027 m; width, 0.017 m. Coarse, pinkish clay.



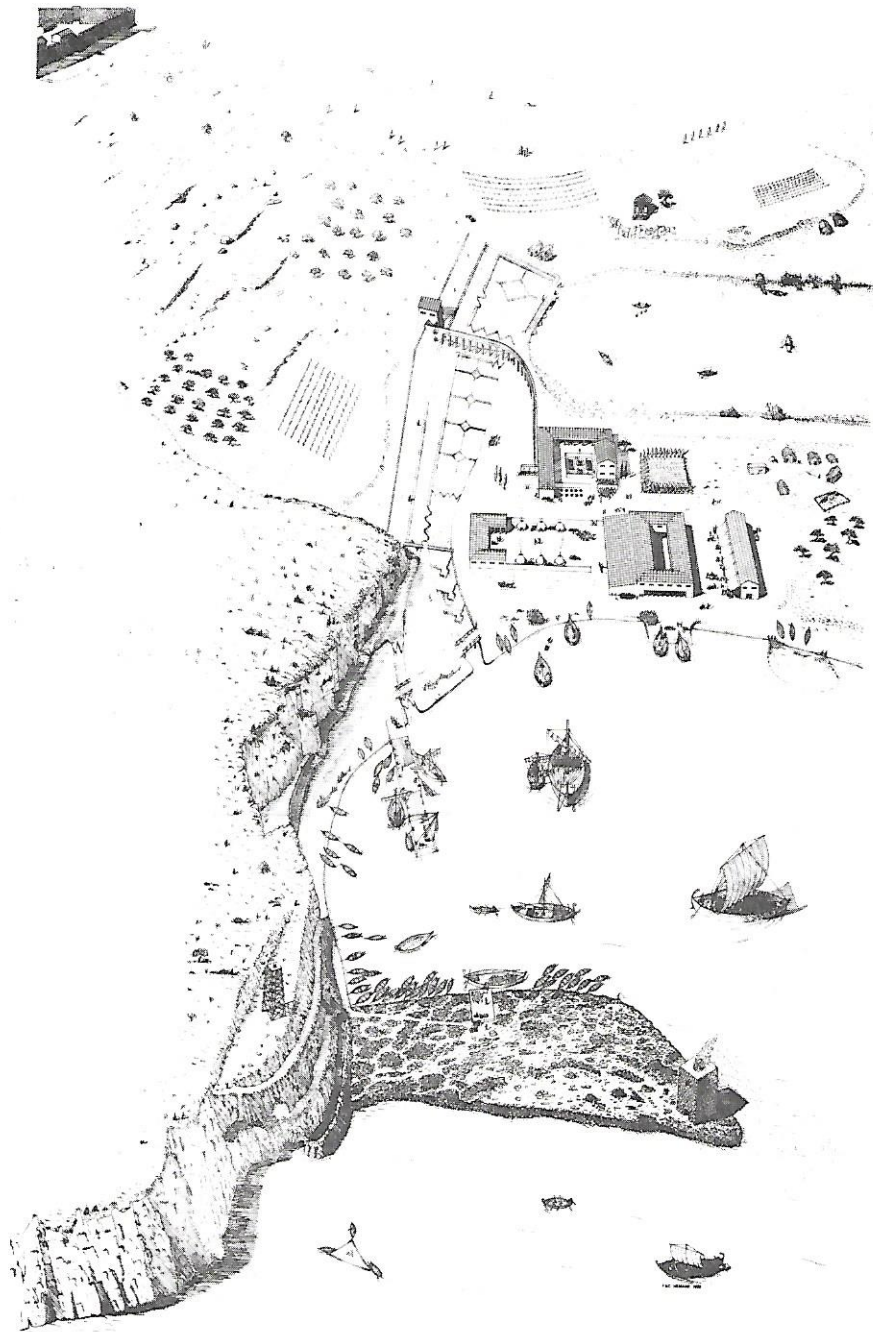
21. Stamp from amphora of Type 4a (Cat.A79), fig. 19, showing lighthouse device. Stamp width, 0.036 m; length, 0.027 m.



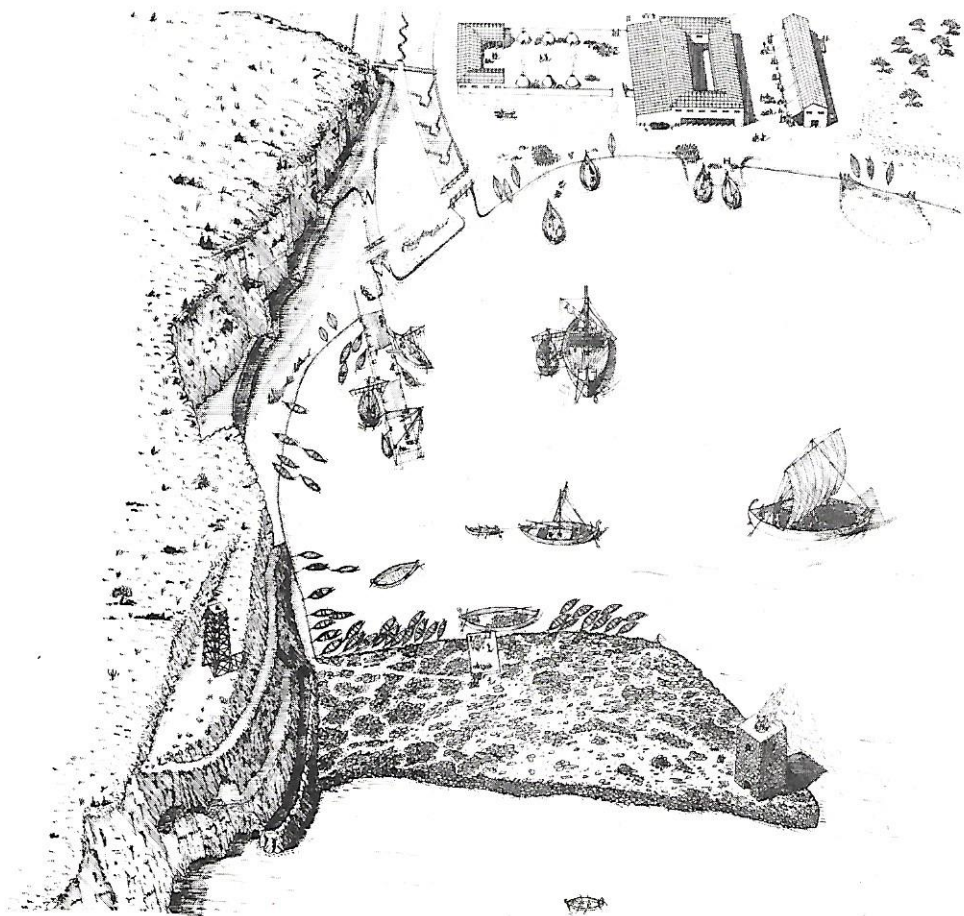
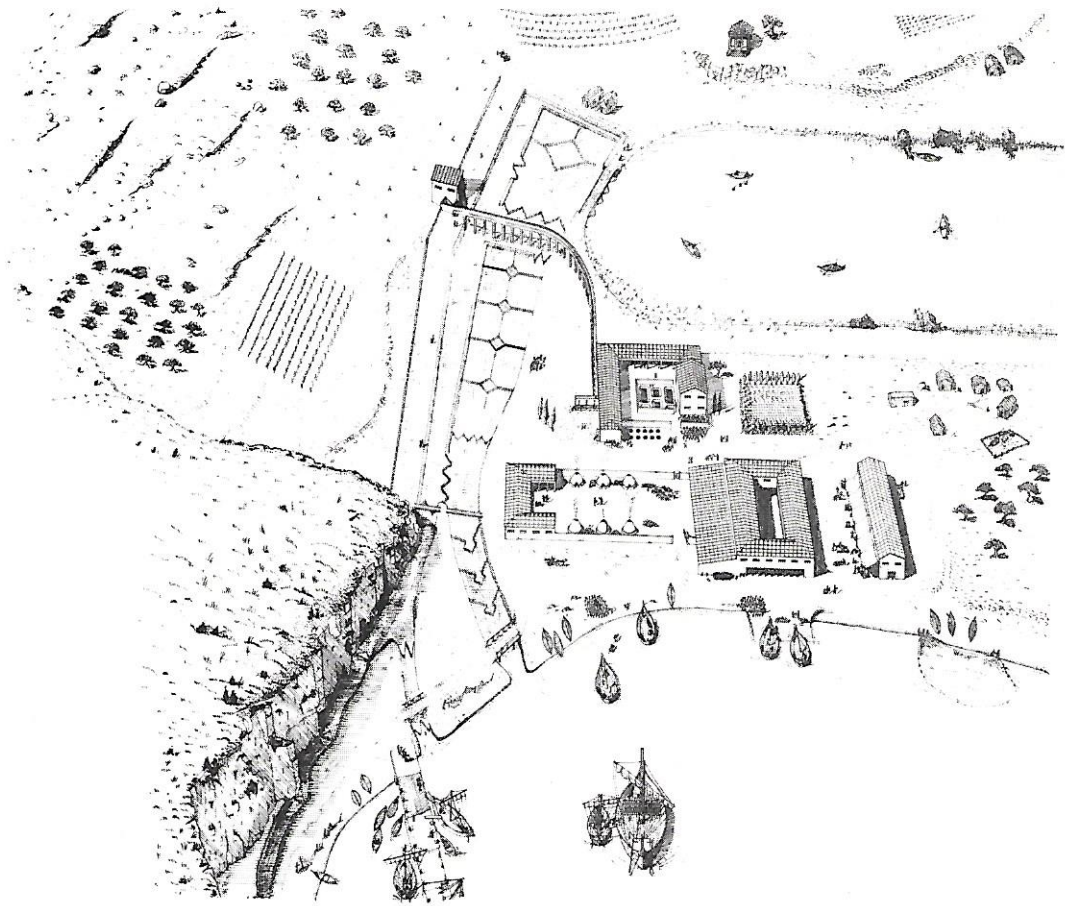
22. *Bronze coin from Alexandria. British Museum no. 1439. Commodus (188-189). Reverse: galley sailing right by Pharos, surmounted by lantern flanked by two Tritons blowing trumpets with statue on top. Below: LKO. Photo; Courtesy of the Trustees of the British Museum.*



23. *Eastern tip of main breakwater at Cosa with concrete Pier 5, submerged at end in lower left. Ship channel between breakwater extensions F and D in center.*

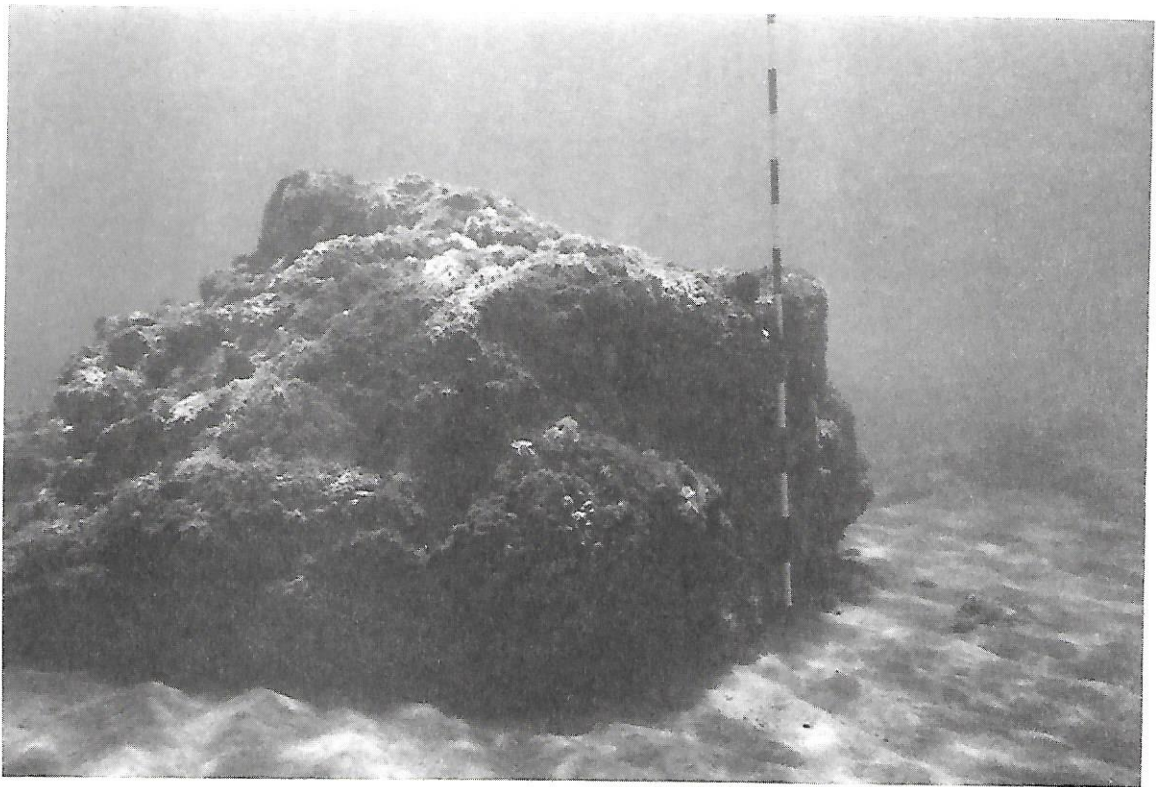


24-26. Hypothetical reconstruction of the Portus Cosanus and its fishing lagoon during the height of its trading life, during the late second and first centuries B.C. The reconstruction is based upon the archaeological evidence as well as the following sources: lighthouse, Zancani Montuoro (cited in n. 4), pp. 5-21; tuna watch tower above Tagliata, Aelian, *De natura animalium* 15.5.6; Spring House complex with aqueduct, reconstruction by J.P. Oleson, drafted by J.F. Warren; fish farm and trapping areas, R. De Angelis, *Fishing Installations in Brackish Lagoons. General Fisheries Council for the Mediterranean. Studies and Reviews* 7. Rome: FAO, 1959 and Del Rosso (cited in n. 4), p. 471; cane huts in fishing lagoon after modern huts at Lago di Burano; lagoon temple, F.E. Brown, and E.H. Richardson, and L. Richardson, *Cosa II. The Temples of the Arx. MAAR* 26 (1960) figs. 108-109. E.L. Will designed plan for amphora factory with kilns after R. Hampe and A. Winter, *Bei Töpfern und Töpferinnen in Kreta, Messenien und Zypern (Mainz, 1962)*, pls. 18, 20, 21, 23, and 29; McCann designed plan of saltery and garum facility to north of amphora factory after Ponsich and Tarradell (cited in n. 33), fig. 36 (Cotta); For the market area, loading crane on pier 3 in harbour and aqueduct terminal, see D. Macaulay, *City. A Story of Roman Planning and Construction (Boston, 1974)* pp. 21, 47, and 60. Professor Lionel Casson has kindly reviewed all drawings of the merchant ships and fishing craft. McCann and Warren are responsible for the final concept, drafted by F. and C. Hemans.

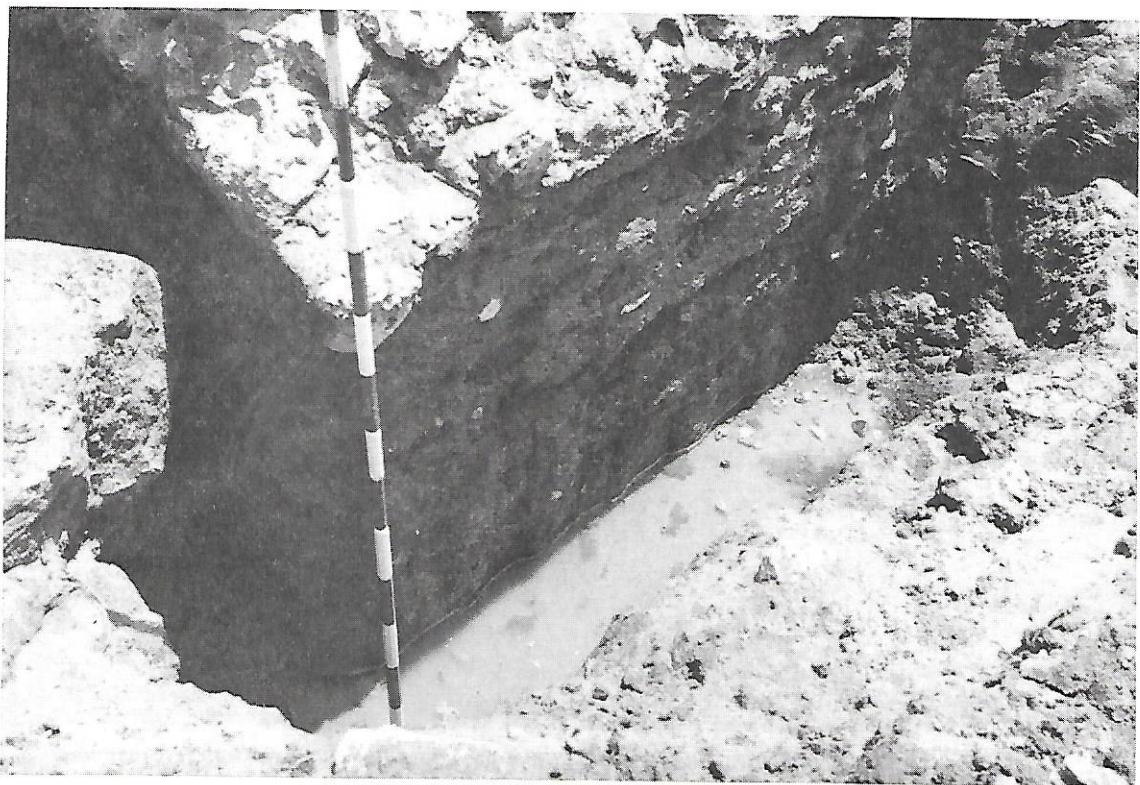




27. Terracotta model from Vulci of a lighthouse. Rome, Villa Giulia Museum. (R.A. Staccioli, *Modelli di edifici etrusco-italici. I modelli votivi*. Rome, 1968, pl. 18).



28. *Underwater remains of concrete Pier 5, harbour of Cosa.*



29. *Concrete Pier 1, harbour of Cosa, western side with impressions for ancient formwork of cofferdam.*



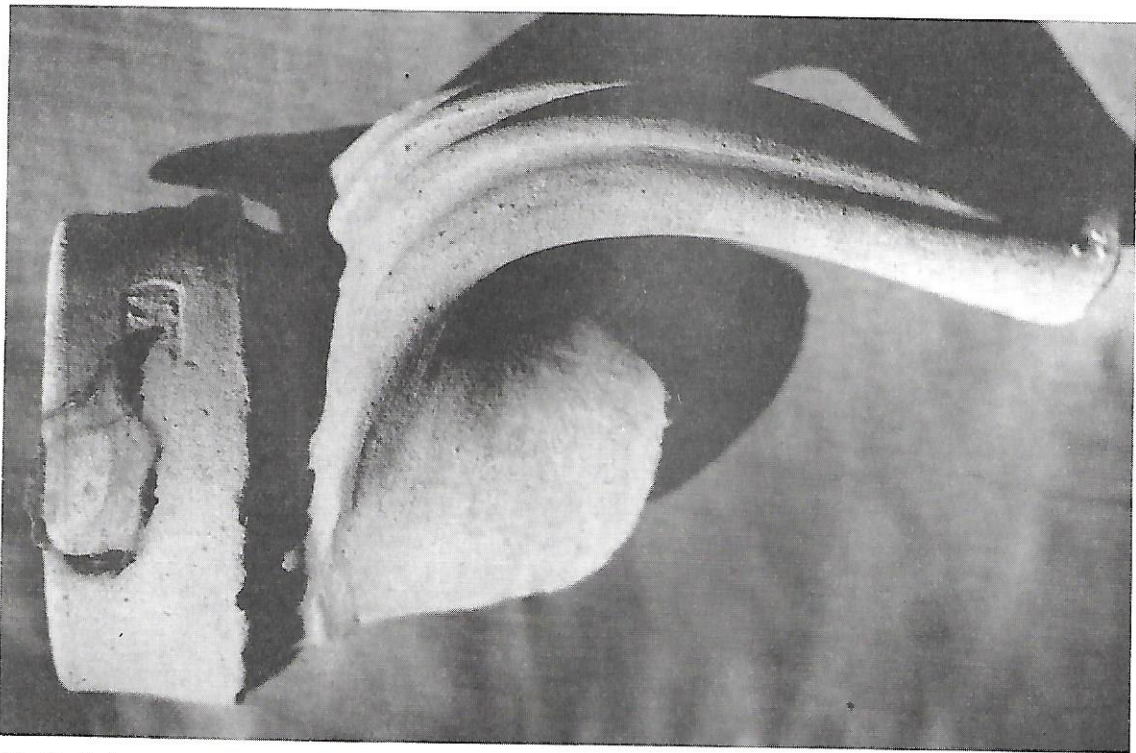
30. Concrete Pier 2, harbour of Cosa, showing holes left from strengthening crossbeams in concrete.



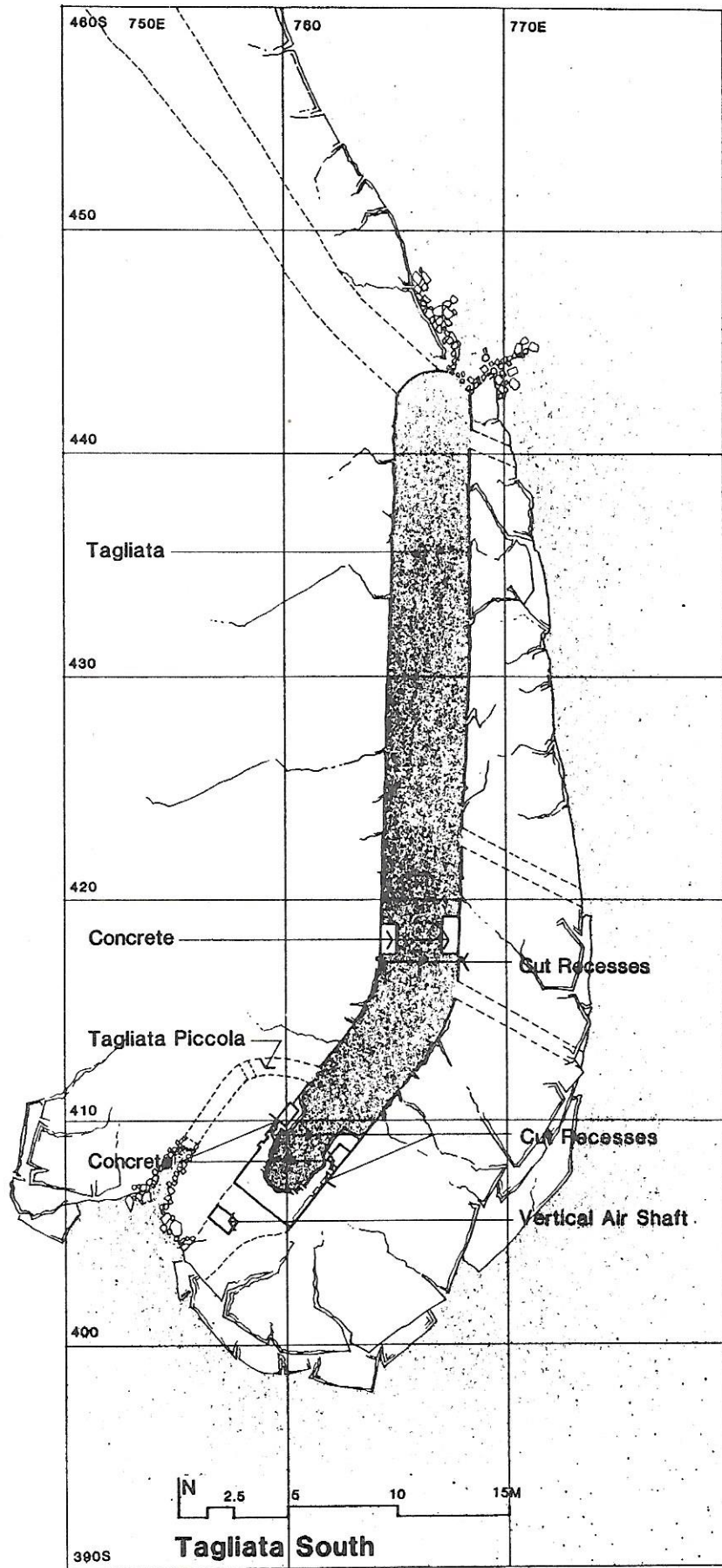
31. Spring House platform, lagoon of Cosa, with collecting tank and water channel. Concrete piers rest on top of platform surrounded by ancient wooden formwork. Retaining Wall P abuts Spring House on northern and southern buttresses.



32. *Detail of wooden formwork along southern side of Spring House platform, Cosa lagoon.*



33. *Neck fragment of amphora of Type 5 from harbour area of Cosa (Cat. A248). Stamped SEST device (palm branch). Preserved height, 0.32 m; rim height, 0.053 m; handle width, 0.067 m; handle thickness, 0.038 m. Coarse pinkish clay.*



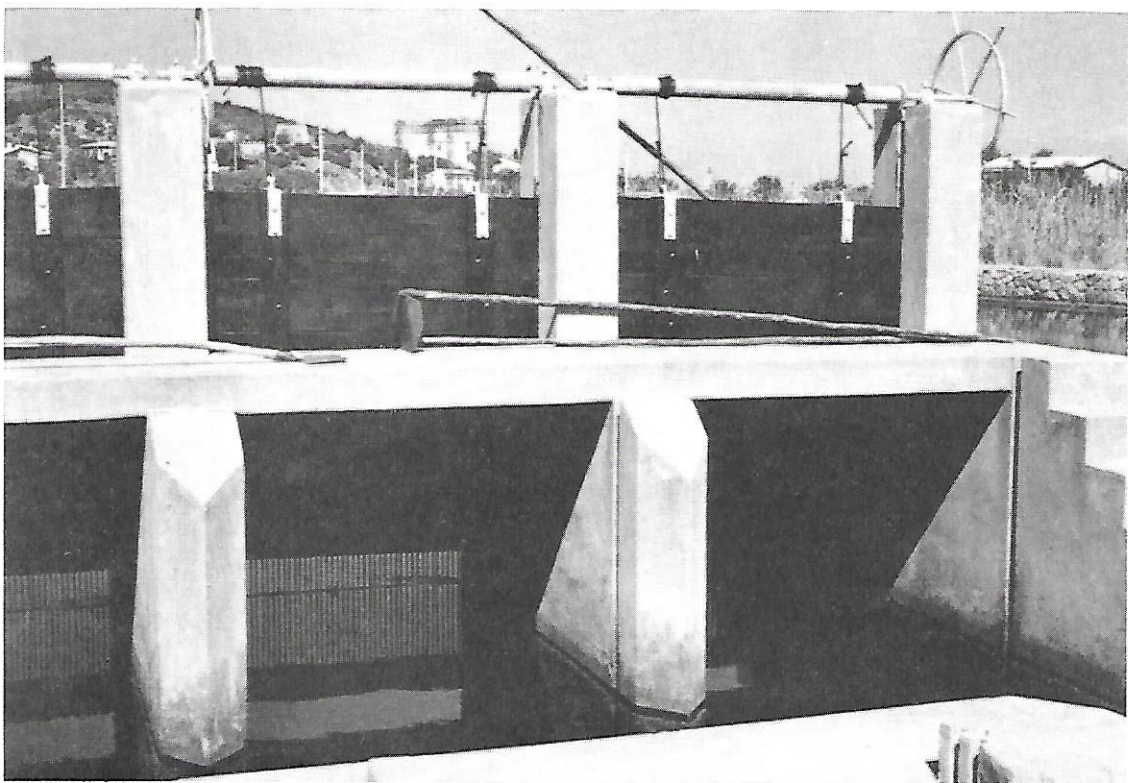
34. Plan of southern, seaward section of Tagliata, with Tagliata Piccola, looking north.



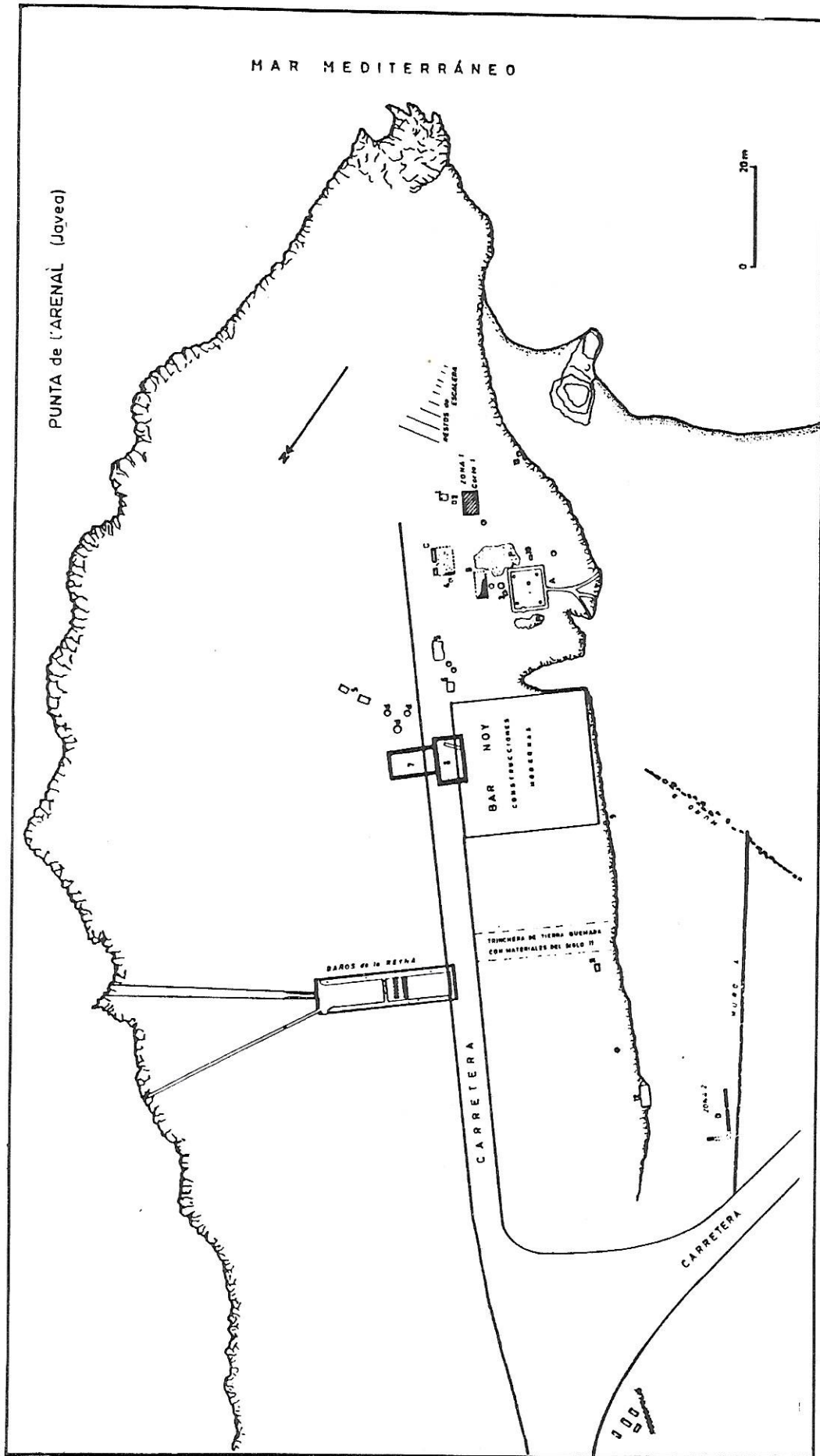
35. Seaward section of Tagliata South, looking north, with entrance of Tagliata Piccola on lower left.



36. Ancient cuttings for sluice gates for fish and water control along western side of Tagliata South.

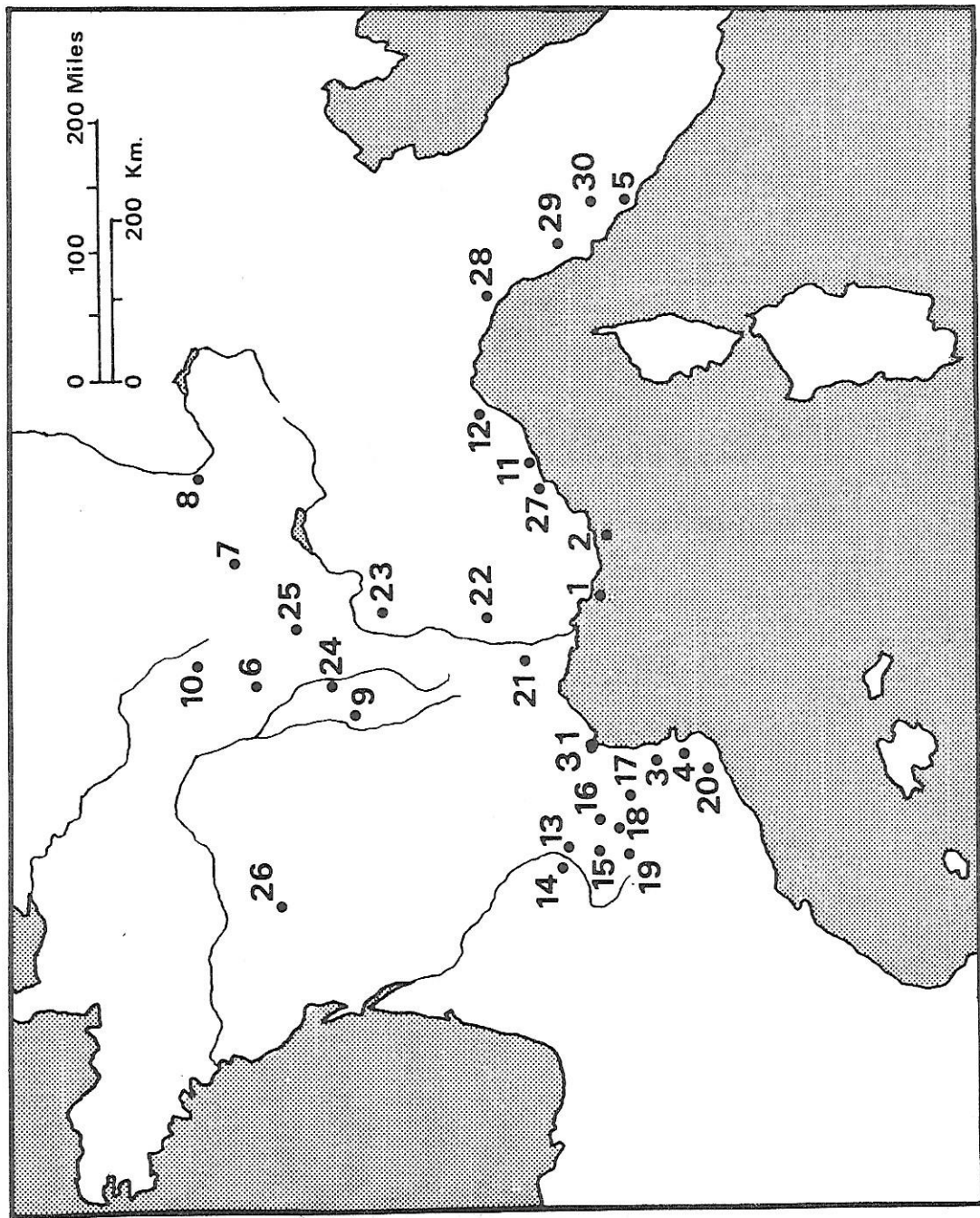


37. Modern sluice gates at fishery in Orbetello lagoon (Nassa).



38. Plan of Roman fishery and factory at Jávea, Spain. Fish tank connected to sea by two channels cut through rock in left center. Remains of fish factory with garum vats and dolia, center right. Houses, right (A,B,C,D). (G. Martín, "Las pesquerías romanas de la costa de Alicante", Trabajos de arqueología dedicados a D. Pió Beltrán. Papeles del laboratorio de arqueología de Valencia, no. 10, Valencia, 1970, fig. 2).

1. Grand Congloué.
2. Ile du Levant.
3. Ruscino.
4. Ampurias.
5. Cosa.
6. Mont Beuvcay.
7. Besançon.
8. Basel.
9. Lezoux.
10. Alise-Sainte-Reine.
11. Ventimiglia.
12. Vada Sabatia.
13. Vieille-Toulouse.
14. Toulouse.
15. Pamiers.
16. La Lagaste.
17. Peyrepertuse.
18. Le Carla à Bourrière.
19. Mayné à Bélesta.
20. Torroella.
21. Nîmes.
22. Nyon.
23. Vienne.
24. Roanne.
25. Tournus.
26. Poitiers.
27. Cap Roux.
28. Luni.
29. Volterra.
30. Saturnia (?)
31. Narbonne.



39. Map showing distribution of verified Sestius amphoras as of 1981. (Revision of map in Will, "Les Amphoras de Sestius", *RAECE* 7, 1956, p. 226, which contained only sites 1-13).

NOTES:

1. The excavations of the port and fishery of Cosa have been directed by this writer and were begun in 1968. I would like to thank the following sources for their generous support over the years: the National Endowment for the Humanities, Atlantic Foundation, Kress Foundation, University of Missouri, the American Council of Learned Societies, and private donors. The Leric Foundation in Rome provided an extensive magnetic and drilling survey in the area of the ancient lagoon and the University of Pennsylvania a magnetic and resistivity survey. The Whittlesey Foundation contributed aerial photographic coverage. Our work would not have been possible without the generosity of the Venturini family, upon whose land the port and fishery lie, and the permission for excavation from the Directorate General of Archaeology and Fine Arts and the then Superintendent of Antiquities of Etruria, Prof. Guglielmo Maetzke. I would like also to thank the American Academy in Rome, under whose auspices the project has been accomplished and Prof. Frank E. Brown for his interest and original encouragement to undertake the excavations. A shortened version of this paper was given in Oxford at the *Rei Cretariae Romanae Fautores* conference in September 1984 and will appear in *RCRF* in 1986.

The underwater excavations in the port, which took place largely in 1968 and 1969, were directed by J.D. Lewis, assisted by R.L. Hohlfelder, R. Young, S. Low, W. Robinson and S. Guthrie. Assisting in the land excavations of the now silted over ancient lagoon behind the port, accomplished largely by mechanical means in 1972, were: G. Uggeri, J.P. Oleson, M.I. Oleson, E.K. Gazda, and I. Picciolini. Architectural plans have been executed by D. van Zanten, J.F. Warren, and J. Stubbs with additional drafting by M. Stankard. Other section drawings and drawings of the finds have been made by E.F. Solomon, E.K. Gazda, Kathleen K. Borowick, M. Fenner and M. Joukowsky. The reconstruction drawings of the harbour and fishery were made by F. and C. Hemans. The excavational photography both on land and underwater was done by this author and the photography of the finds by B. Bini. Aerial photography of the site was covered by J. and E. Whittlesey. Additional photography has been done by P. Evola. Individual studies of the material have included: Spring House and its water-lifting mechanism by J.P. Oleson; geological and sedimentological study by J. Bourgeois; materials and techniques of construction by E.K. Gazda; amphoras by E.L. Will; terra sigillata by Howard Comfort; commonware pottery by J.P. Oleson and M.I. Oleson; glass by D.F. Grose; mineralogical analyses of tuffs, amphoras and clays by R. Trigila, D. Cozzupoli, and J. de Boer; soils by R.E. Linington and M. Barshad with B. Viani; human bone material by J. Lawrence Angel; faunal material by P. Wapnish, B. Hesse, and C.R. Crumly; ships and navigation by L. Casson, whose help throughout the project has been indispensable for our understanding of how the ancient harbour of Cosa functioned. To this exceptionally gifted and diversified team of scholars and scientists from whom I have learned so much, I owe my warmest and most grateful thanks. Much of the material presented here is derived from our collaborative forthcoming book, A.M. McCann, et al., *The Roman Port and Fishery of Cosa: A Center of Ancient Trade*, copyright Princeton University Press, and used with their permission. Abbreviations of periodicals used here are those accepted by the *American Journal of Archaeology* (vol. 80, no. 1, 1976, pp. 1-10). Abbreviations of the ancient texts follow those used in the *Oxford Classical Dictionary*, 1970.

2. A.M. McCann, "Excavations of the Ancient Port at Cosa, 1968," *AJA* 73 (1969) pp. 241-242; A.M. McCann and J.D. Lewis, "The Ancient Port of Cosa," *Archaeology* 23 (1970), pp. 200-211; J.D. Lewis, "Controlled Airlifting in Sand-filled Harbours," *IJNA* 1 (1972), pp. 169-170; J.D. Lewis, "Cosa; An Early Roman Harbour," in *Marine Archaeology*, Colston Papers, 23, ed. D.J. Blackman (London 1973), pp. 233-259; A.M. McCann, "Excavations at the Roman Port of Cosa, 1972," *IJNA* 2 (1973) pp. 199-200; A.M. McCann, "Excavations at the Roman Port of Cosa, 1972," *AJA* 77 (1973), p. 220; J. Bourgeois, "Sedimentation in an Ancient Harbour — Portus Cosanus, Italy," *Geological Society of American Abstracts with Programs* 6/7 (1974), p. 663; J.P. Oleson, "The Spring House and Water Lifting Device in the Roman Port of Cosa," *Archaeological Institute of American Abstracts* (1975), p. 19; A.M. McCann, "The Harbour and Fishery Remains at Cosa, Italy," *JFA* 6 (1979), pp. 391-411; E.L. Will, "The Sestius Amphoras: A Reappraisal," *JFA* 6 (1979), pp. 339-350; E.L. Will, "Greco-Italic Amphoras," *Hesperia* 51 (1982), pp. 338-356; E.L. Will, "Ambiguity in Horace, *Odes* 1.4," *Classical Philology* 77 (1982), pp. 240-245; J. Bourgeois and E.K. Gazda, "Geologic and Sedimentologic History of the Roman Harbour and Fishery Site (273 B.C. to 3rd Century A.D.), Cosa, Italy," *AJA* 86 (1982), p. 256; J.P. Oleson, *Greek and Roman Mechanical Water-Lifting Devices* (Toronto, 1984), pp. 201-204, 377-378; A.M. McCann, "Excavations at the Roman Port of Cosa," *Actes du IVe International Congrès d'Archéologie Sousmarine, Nice, 1970*, awaiting publication; A.M. McCann, "The Portus Cosanus: an Early Roman Port and Fishery," *IV Congreso Internacional de Arqueología Submarina* Cartagena, Spain, 1982, awaiting publication.
3. Livy 22.11.6; Livy 30.39.1-2; Rutilius Namatianus I.295-298; Caesar *BCiv.* I.34; Cicero *Att.* 9.6.2; Strabo 5.2.8; Tacitus *Ann.* 2.39; *It. Ant. Marit.* 513,4; 514,2; *Rav. Cosm.* 4.32; *Guidonis Geografica* 34.
4. On location of the Portus Cosanus, see D. Anziani, "Cosa-Portus Cosanus-Portus Herculis-Succosa-Orbetello dans l'antiquité", *MéRome* 30 (1910), pp. 373-395, who concluded that the ancient port of Cosa and Portus Herculis (Port'Ercole) across the bay on the Argentario peninsula were one and the same, located at the site of Port'Ercole. This assumption is continued by L.R. Taylor, *Local Cults in Etruria* (*PAAR* 2, 1923), p. 171, and later adopted by F.E. Brown, *Cosa. The Making of a Roman Town* (Ann Arbor, 1980), p. 50. Brown believes that the port of Hercules was the earliest port in the area and served the colony of Cosa in the third century B.C. before the port at the Tagliata was built. Now our finds of Greco-Italic amphoras from the Tagliata site prove otherwise. Furthermore, our underwater survey of the harbour of Port'Ercole and the adjacent coastline in 1968 produced amphora material no earlier than the second century B.C. In his book, Brown reproduces in figs. 59 and 77 maps of the port area, based upon those made during our excavations by the architect David van Zanten. These maps were reproduced without our knowledge and without acknowledgement. Fig. 77 shows Brown's reconstruction of the harbour, which, in the opinion of the excavators and present author, is not in accord with the archaeological evidence. He represents nine piers angled over a narrow breakwater. The thorough excavation of the harbour in 1968 and 1969 revealed only five piers with no evidence that

any others were ever built. Also, his reconstruction of a narrow jetty is not in accord with the archaeological remains. Compare here Fig. 4. Unfortunately, Professor Brown does not distinguish between the actual remains and his hypothetical reconstruction, which is drawn in heavy black.

Professor Brown gave an additional paper on the "Ports and Fisheries of Cosa" in 1978 at a Conference at the American Academy in Rome on *The Seaborne Commerce of Ancient Rome: Studies in Archaeology and History* (MAAR 36, 1980). This paper, unfortunately, used inaccurately the research and conclusions of the present author and her team, who had shared their material in trust and confidence with him. Despite our request to both Professor Brown and to Professor John H. D'Arms, director of the American Academy at that time, that Brown's paper not be published in view of the errors it contained, and despite their written agreement not to do so, Professor Brown did publish his paper within an article by Paola Zancani Montuoro, "Il faro di Cosa in ex-voto a Vulci?" *Riv. Ist Arch* 3, series 2 (1979), pp. 21-23. Apart from the fact that Professor Brown's paper does not acknowledge those who directed, financed, excavated and studied the material he used, it is most unfortunate that both in his text and his plans of the harbour he inaccurately presents the actual archaeological remains.

For a summary of the earlier references on the port of Cosa see R. Cardarelli's extensive historical and topographical study of the Ager Cosanus, "Confini fra Magliano e Marsiliana; fra Manciano e Montauto Scerpenna Stachilagi; fra Triscosto e Ansedonia; fra Orbetello e Marsilina; fra Port'Ercole e Monte Argentario (28 dicembre 1508 — 2 marzo 1510)", *Maremma* 1 (1924), pp. 131-142, 155-186, 205, 224; 2 (1924), pp. 3-36, 75-128, 147-213. Also see F.E. Brown, "Cosa I. History and Topography", *MAAR* 20 (1951), pp. 89-96, map II. Brown's study is the first detailed description of the site with a surveyed map since R. Del Rosso's first plan of the cliff channels of the Tagliata and Spacco in 1905 (*Pesche e Peschiere antiche e moderne nell'Etruria marittima*, Florence, pp. 71-97, 289-331). In his interpretation of the visible structures, Brown adopted many of Cardarelli's earlier theories. He located the port of Cosa within the lagoon behind the sand dunes reached by a ship channel running along the limestone cliffs following the northern course of the Tagliata channel. Brown's theories have influenced later scholars, including the present excavators in our initial research. Continued study of the excavational material over the past years, however, has led us to very different conclusions, some of which are published here. Our identification of the Tagliata as a fish tank and fish channel follows Del Rosso's first interpretation of these cliff channels. Del Rosso's pioneering work has largely been forgotten by later scholars. Del Rosso, of course, did not know about the extensive remains of the ancient lagoonal fishery at Cosa that we uncovered, buried in the mud. Compare theories of E. Rodenwaldt and H. Helmann, "Die antiken Emissare von Cosa-Ansedonia, ein Beitrag zur Frage der Entwässerung der Maremmen in etruskischer Zeit", *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* 1 (1962), pp. 3-31, who would locate the Portus Cosanus in the Orbetello lagoon or on the Tombolo di Feniglia. Also see A. Mori, "Problemi dell'insediamento umano e della vita marittima nell'antica Etruria centrale", *Bollettino della Società Geografica Italiana*, ser. 9,4 (1963), pp. 343-355. Mori returns to the inner harbour theory and locates the Portus Cosanus within the lagoon of Cosa.

5. See Brown, "Cosa 1", and Brown, *Cosa* (cited above in n. 4).
6. S.L. Dyson, "Settlement Patterns in the Ager Cosanus: The Wesleyan University Survey, 1974-1976," *JFA* 5 (1978), pp. 251-268; A. Carandini and S. Settis, *Schiavi e Padroni nell'Etruria Romana* (Bari, 1979) with other references; A. Carandini, "Il vigneto e la villa del fondo di Settefinestre nel Cosano: un caso di produzione agricola per il mercato transmarino," *MAAR* 36 (1980), pp. 1-10.
7. See McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1).
8. For an excellent study of the management of the ports of Ostia and Puteoli under the Empire see G.W. Houston, "The Administration of Italian Seaports during the First Three Centuries of the Roman Empire", *MAAR* 36 (1980), pp. 157-171. What applied to Ostia and Puteoli, however, need not necessarily have applied to smaller ports such as Cosa during the Republic, as Houston himself cautions.
9. See Oleson, *Roman Mechanical Water-Lifting Devices* (cited above in n. 2).
10. G.E. Rickman, "Towards a Study of Roman Ports", *Studies in Harbour Archaeology, Proceedings of the First International Workshop on Mediterranean Harbours of Antiquity, Center for Maritime Studies, University of Haifa and the Caesarea Ancient Harbours Excavation Project, June 24-28, 1983*.
11. New York, 1980, p. 7.
12. For a summary of the earlier research on the Grand Congloué see Will, "The Sestius Amphoras" (cited above in no. 2), pp. 339-341. Most recently, see restudy of material by Luc Long, "The Grand Congloué Site: a Reassessment", reported in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1) appendix to chapter VIII. Long's research has confirmed the existence of two wrecks.
13. H. Dressel, *Inscriptiones Urbis Romae Latinae. Instrumentum Domesticum*. CIL XV, 2 (Berlin, 1889).
14. N. Lamboglia, "Sulla cronologia delle anfore romane di età repubblicana (II-I secolo A.D.)," *RStLig* 21 (1955), pp. 241-270.
15. See E.L. Will, "Les amphores de Sestius," *Revue archéologique de l'Est et du Centre-Est* 7 (1956), pp. 224-244; idem, "Latin-stamped Amphoras in the Eastern Mediterranean Area", *Year Book of the American Philosophical Society* (1962), pp. 647-650; idem, "Les timbres amphoriques latins", in P. Bruneau, et al., *L'Ilot de la Maison des Comédiens. Exploration archéologique de Délos* 27 (Paris, 1970), pp. 383-386; idem, "The Ancient Commercial Amphora", *Archaeology* 30 (1977), pp. 264-270; idem, "The Sestius Amphoras" (cited above in n. 2); idem, "Greco-Italic Amphoras" (cited above in n. 2); idem, "Diversification in Roman Industry: Some Ceramic Evidence", *Archaeological Institute of American Abstracts* 7 (1982), p. 46; idem, "Exportation of Olive Oil from Baetica to the Eastern Mediterranean", in J.M. Blázquez Martínez, et al., *Producción y comercio del aceite en la antigüedad (II Congreso Internacional)*, Madrid, Universidad Complutense, 1983, pp. 391-440; idem, "Ähnlichkeiten zwischen Stempeln auf

Amphoren und auf arretinischen Gefässen", *Rei Cretariae Romanae Fautorum Acta* 23, 24 (1984), pp. 9-11. Twenty-three of Will's types of Roman amphoras from the eastern Mediterranean area are included in her forthcoming volume in the *Athenian Agora* series.

16. G. Roghi, "Spargi", in *Marine Archaeology*, ed. J. Du Plat Taylor (New York, 1966), pp. 103-118, with earlier references; E.L. Will, "The Spargi Wreck: A Reconsideration," *Archaeological Institute of America Abstracts* 8 (1983), p. 32; idem, "Amphoras and Trade in Roman Sardinia", *Studies in Sardinian Archaeology II: Sardinia in the Mediterranean*, ed. M.S. Balmuth, forthcoming.
17. The Spargi amphoras have been recently seen and studied by Will in the museum on the island of Maddalena. One amphora from the Grand Congloué wreck in the private collection of Dr. Harold Edgerton, MIT, Cambridge, Mass., has also been seen by Will who believes the reddish clay to be the same as that of the other Grand Congloué amphoras in Marseilles, studied by her some years ago.

It is of interest to note here also the amphora finds from the famous shipwreck found off Albenga, published by N. Lamboglia, "La nave romana di Albenga," *RSILig* 18 (1952), pp. 166ff. A large portion of the Albenga ship's cargo of wine amphoras, estimated at about 3,000 of which 728 were recovered, Will identifies with her early Type 4b (Dressel Type 1B) but they are apparently unstamped. While Will has not seen the material from Albenga and therefore does not know whether they are made of the typical reddish Sestius clay we connect with Cosa, she tells me that among the finds is an amphora of Will Type 24a (Dressel Type 28). She associates this amphora form with garum and suggests that it originated at Cosa. Could it be then that also the Albenga shipwreck was loaded at the Portus Cosanus? Will further identifies a Type 5 (Dressel Type 1C) garum jar from Cosa among the material from the Grand Congloué upper wreck.

18. See Will, "Les amphores de Sestius" (cited above in n. 15); Will, "The Sestius Amphoras" (cited above in n. 2).
19. Will, "Greco-Italic Amphoras" (cited above in n. 2); Will in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1) chapter IX.
20. See reports of Trigila and de Boer in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapter XVI.
21. For a full discussion of this important fragment and the evidence for its date see Will, "The Sestius Amphoras" (cited above in n. 2), p. 346-347 and n. 25, fig. 5.
22. Will first published this stamp as a "lighted alter (?)" in "The Sestius Amphoras" (cited above in n. 2), p. 343, fig. 4. She now agrees with me that it is a lighthouse.
23. For example, see representation of the Pharos of Alexandria on a coin of Antoninus Pius, illustrated by J.W. Shaw, "Greek and Roman Harbourworks", in G.F. Bass, ed., *A History of Seafaring Based on Underwater Archaeology* (New York, 1972), fig. 4. Compare image of lighthouse of Laodicea ad Mare (Syria) which is simpler and closer to that of the Sestius stamp (A.A. Boyce, "The Harbor of Pompeiopolis: A Study in Roman Imperial Ports and Dated Coins", *AJA* 62 (1958), pl.14, fig. 3; here fig. 22).
24. For a summary of the literature on ancient lighthouses see D.J. Blackman, "Ancient harbours in the Mediterranean. Part 2", *IJNA* 11 (1982), pp. 207-208 and nn 115-118. Also see Zancani Montuoro, "Il faro di Cosa" (cited above in n. 4), pp. 5-21.
For an illustration of a simple beacon tower see the Pompeiian painting from Stabiae of the first century A.D., D.J. Blackman, "Ancient harbours in the Mediterranean. Part 1" *IJNA* 11 (1982), fig. 5.
Numismatic evidence of terracotta lanterns on the roofs of quays in the Roman harbor of Pompeiopolis is in Boyce, "The Harbor of Pompeiopolis" (cited above in n. 23), p. 69. Also see evidence of light tower at Gorsium, T.G. Radan, "Angaben zur Frage der sogenannten Leuchttürme", *Gorsium Forschungen* 1 (1974), pp. 149-157. I am grateful to Professor Howard Comfort for this last reference.
25. Zancani Montuoro, "Il faro di Cosa" (cited above in n. 4), pp. 5-21. Apparently Professor Zancani Montuoro did not know about the underwater remains of Pier 5 at Cosa and our other finds from the site, including the material from the lagoon temple. For discussion of the association of the deity of this temple with Neptune/Poseidon rather than Dionysus and Ariadne (proposed by Zancani Montuoro) or Portunus (proposed by Brown) see McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapter VI (McCann).
26. For further discussion of the date of the votive deposit see K.F.W. Helbig, *Führer durch die öffentlichen Sammlungen klassischer Altertümer in Rom*, ed. H. Speier, 4th ed., vol. 3 (Tubingen, 1969), pp. 508-510 with earlier bibliography and especially R.A. Staccioli, *Modelli di edifici etrusco-italici. I modelli votivi* (Rome, 1968), pp. 24-28, 69-70, 75, pls. 12-18.
27. On the development of Roman concrete in general see M.E. Blake, *Ancient Roman Construction in Italy from the Prehistoric Period to Augustus* (Washington, 1947), p. 228 and chapter 10; A. Boëthius and J.B. Ward-Perkins, *Etruscan and Roman Architecture* (Baltimore, 1970), pp. 105-108, 245-263; J.B. Ward-Perkins, *Roman Architecture* (New York, 1977), pp. 97-102; G. Lugli, *La tecnica edilizia romana. II* (Rome, 1957), pp. 379-385 (Pompeii); F. Sear, *Roman Architecture* (Ithaca, New York, 1982), pp. 73-76.
28. E.K. Gazda, "The Use of Tufo in Roman Underwater Construction", *AJA* 79 (1975), p. 151, abstracts bound separately; E.K. Gazda in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapters IV and VII.
29. J.P. Oleson, "Herod and Vitruvius: Preliminary Thoughts on Harbour Engineering at Sebastos, the Harbour of Caesarea Maritima". Also see Oleson in McCann, et al., (cited above in n. 1) chapter V, for description of extensive

- wooden formwork found around the tuff and pozzolana concrete basin platform of the Spring House in the Cosa lagoon (Figs. 28, 29). Made mostly of thick spruce, oak, and pine planks (0.03 to 0.05 m thick and ca. 0.34 m wide) in varying lengths, these boards were held together by round, upright pilings (0.10 to 0.14 m in diameter) placed at irregular intervals. Some of the planks had been fastened to the supports by iron nails. In addition, along the south side, a retaining wall made of upright planks had apparently been made during construction. Oleson correctly interpretes these remains as a timber wall used to stabilize the soft side of the excavation in the muddy lagoon made for the foundations of the concrete platform, rather than a Vitruvian double-walled cofferdam. No horizontal tie beams or braces were found or interior packing. This type of simple, single-shell formwork, so well-preserved in the mud of the Cosa lagoon, was different then from the cofferdams constructed in the sea at either Cosa or Caesarea.
30. The basic work on trade and economic life in the Roman world is still *An Economic Survey of Ancient Rome*, ed. Tenney Frank, 5 vols. (Baltimore, 1933-1940). See most recently, L. Casson, *Ancient Trade and Society* (Detroit, 1984). For Roman concepts of free trade see J. Rougé, *Recherches sur l'organisation du commerce maritime en Méditerranée sous l'Empire romain* (Paris, 1966), pp. 540ff. On trade routes see L. Breglia, *Le antiche rotte del Mediterraneo* (Rome, 1966); L. Casson, *The Ancient Mariners* (New York, 1959), pp. 223-239; M.P. Charlesworth, *Trade Routes and Commerce in the Roman Empire* (Cambridge, 1924); A.J. Parker, "The Evidence Provided by Underwater Archaeology for Roman Trade in the Western Mediterranean," in *Marine Archaeology*, Colston Papers, 23, ed. D.J. Blackman (London, 1973), pp. 361-381.
 31. *CIL* XV.2.4537ff. Cf. F. Zevi, "Appunti sulle anfore romane", *ArchCl* 18 (1966), pp. 208-247.
 32. Will in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapter IX; Will, "The Sestius Amphoras" (cited above in n. 2) n. 26.
 33. Pliny *Nat.hist.* 31.43.93. On garum in antiquity see M. Ponsich and M. Tarradell, *Garum et industries antiquae des salaisons dan la Méditerranée occidentale* (Paris, 1965). For a new and comprehensive study of garum see R.I. Curtis, "The Production and Commerce of Salted Fish Products (*Garum* and *Salsamenta*) in the Roman Empire", *Aufstieg und Niedergang der römischen Welt*, II, 11, forthcoming. I am particularly grateful to Professor Curtis for sharing his unpublished manuscript and for many helpful suggestions, including the reference to dolia for the making of ancient garum (Manilius *Astronomica* 5.565-681). The modern equivalent to ancient garum appears to be the "nuoc-mam" type of liquid fish sauce produced today in Vietnam: I.M. Mackie, R. Hardy and G. Hobbs, "Fermented Fish Products," *FAO Fisheries Reports*, no. 100 (Rome, 1971), pp. 1-54. I am grateful to R.G. Thomas of FAO, Rome, for this reference.
 34. See particularly the recent excavations at Ostia in "The Bath of the Swimmer", and the chronology worked out there for Spanish fish sauce amphoras. F. Berti, et al., *Le Terme del Nuotatore*, in *Ostia II. StMisc* 16 (1968-1970); A. Carandini and C. Panella, *Le Terme del Nuotatore*, in *Ostia III. StMisc* 21 (1969-1973) pp. 506-515; C. Panella, "Annotazione in margine alle stratigrafie delle terme ostiensi nel nuotatore," *Recherches sur les amphores romaines. Collection de l'Ecole française de Rome* 10 (1972), pp. 69-107.
 35. *FAO Aquaculture Bulletin* 7 (Oct. 1974-Jan. 1975), p. 3; 8 (Jan. 1977), p. 20. V. Brasola, A.M. Kalfa, A. Cannas, "Esperienze positive di riproduzione artificiale di *Mugil cephalus* (L.) effettuate nella Laguna di Orbetello", *Riv.It.Piscic.Ittiop.* 14 (Jan. Feb. March 1979), pp. 1-6. For a report of a recent extensive survey by biologists, chemists and engineers of the lagoons of Orbetello for the City Council of Orbetello see *Risanamento e protezione dell'ambiente idrobiologico delle lagune di Orbetello* (Orbetello, 1977). I am grateful to P. Paradise for obtaining this report for me and to V. Brasola for kindly sharing his knowledge of the Orbetello fishery with me and providing further photographs. For information on the activities and publications of the Fisheries Department of FAO, Rome, I am grateful to Mr. Michael N. Mistakidis and Dr. Pagan. On lagoonal fishing and modern installations see particularly R. De Angelis, *Fishing Installations in Brackish Lagoons*, General Fisheries Council for the Mediterranean. Studies and Reviews 7, (Rome, FAO, 1959) and idem, *Mediterranean Brackish Water Lagoons and Their Exploitation*. General Fisheries Council for the Mediterranean. Studies and Reviews 12 (Rome, FAO, 1960).
 36. Suetonius *Tib.* 34; Pliny *Nat.hist.* 31.44, for *allex*, a sauce made from the sediment of garum. That Roman pisciculture was highly developed as well as lucrative is clear also from the other ancient writers on this popular subject. The chief sources, besides Pliny the Elder, are Columella, *De Re Rustica*, bk. 8.16-17, who wrote about A.D. 60-65 and Varro (116-27 B.C.) *De Re Rustica*, bk. 3. That the stocking and feeding of fish was common practice as well as the transportation of fish spawn from the sea for hatching is known from Columella *Rust.* 8.16.1-2. In the late first century A.D., when Juvenal complains that the seas off the Campanian coast were fished-out, wrasse were brought from the eastern Mediterranean to stock the waters (Juvenal 5.92-96; Pliny *Nat.hist.* 9.62; Macrobius *Sat.* 3.16.10); Columella (*Rust.* 8.16-17) and Varro (*Rust.* 3.17.2-4) distinguish between two types of fish ponds, the fresh and the salt. The fresh water ponds are associated with poorer farmers and were the earliest type. By Varro's time, fresh water fish were clearly considered inferior to those raised in saltwater. For an excellent discussion of Roman fishponds see T.H. Corcoran, "Roman Fishponds", *Classical Bulletin* 35 (1959), pp. 37-43. For further sources on ancient fishing see W. Radcliffe, *Fishing from the Earliest Times* (London, 1921, reprinted Chicago, 1974) and McCann in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapter I where a section on ancient fishing and port and fishery management is included.
 37. See particularly the basic survey by G. Schmiedt, *Il livello antico del mar tirreno* (Florence, 1972). For fish tanks in the harbour at Kenchreai see R. Scranton, J.W. Shaw and L. Ibrahim, *Kenchreai. Eastern Port of Corinth. I. Topography and Architecture* (Leiden, 1978), pp. 25-35, figs. 10, 11, pl. XV. For fish tanks at Lapithos see K. Nicolaou and A. Flinder, "Ancient Fish-tanks at Lapithos, Cyprus", *IJNA* 5 (1976), pp. 133-147.

38. G. Martin, "Las pesquerias romanas de la costa de Alicante", *Trabajos de arqueología dedicados a D. Pió Beltrán, Papeles del laboratorio de arqueología de Valencia*, no. 10 (Valencia, 1970), pp. 139-153 and figs. 2-5; G. Martin and D. Serres, *La Factoria pesquera de Punta del'Arenal y otros restos romanos de Jávea (Alicante) Servicio de Investigación prehistorica. Serie de Trabajos varios*, no. 38 (Valencia, 1970).
39. B. Leoni in *Covegno per il risanamento, la valorizzazione e l'utilizzazione della laguna di Orbetello, 8-9 marzo 1975* (Orbetello, 1979), pp. 39-41.
40. On the Domitius Ahenobarbus family as a whole see *RE V*, cols. 1315ff. (Münzer). For location of their property in the Ager Cosanus see E. Galli, "Antiche vestigia nel dominio cosano dei Domizi Ahenobarbi", *Historia* 1 (1972), pp. 15-16; Dyson, "Settlement Patterns" (cited above in n. 6) p. 260 who cites inscriptional evidence for the possible location of one of their villas near Le Grotte in the Albenga valley. For a discussion of this and the other inscriptional evidence of the Ahenobarbi in the area see D. Manacorda, "Considerazioni sull'epigrafia della regione di Cosa", *Athenaeum* 57 (1979), pp. 80-91. Note particularly inscription no. 18, fig. B., a funerary inscription of the late first or early second century A.D. found on the site of the Imperial villa in the harbour area of Cosa. The inscription identifies an Imperial freedman of Claudius or Nero, a certain Clemens, who was procurator or manager of the villa, implying that the villa at the time was Imperial property. See also P.A. Brunt on the land holdings of the Ahenobarbi, "Two Great Roman Landowners", *Latomus* 34 (1975), pp. 619-635.
41. Two inscriptions found in the basilica in the forum at Cosa are probably to be restored as dedications to Nero: Cosa Inv. CC 876 a-h, CD 259, a, b, and DC 260; CC 875, published by E.J. Bace, "Cosa: Inscriptions on Stone and Brick-stamps". Doctoral dissertation, University of Michigan, Ann Arbor, 1983, pp. 75-76, no. IIA2 and p. 80, no. IIB1.
42. Will in McCann, et al., *The Roman Port and Fishery of Cosa* (cited above in n. 1), chapter IX.
43. P.A. Gianfrotta, "Ancore 'romane'. Nuovi materiali per lo studio dei traffici marittimi", *MAAR* 36 (1980), p. 111 and fig. 26.
44. Will, "The Sestius Amphoras" (cited above in no. 2), p. 342, fig. 2
45. R. Lequément and B. Liou, "Les épaves de la côte de Transalpine," *Cahiers Ligures de préhistoire et d'archéologie* 24 (1975), pp. 75-82.
46. "Italian Wine in Gaul at the End of the Republic", in *Trade in the Ancient Economy*, ed. P. Garnsey, K. Hopkins, and C.R. Whittaker (Berkeley and Los Angeles, 1983), pp. 87-104.
47. "Marseilles, Rome and Gaul from the Third to the First Century B.C.", in Garnsey, Hopkins and Whittaker (cited above in n. 46), pp. 76-86.
48. For example, from the period 208-150 B.C. note the mixed coin hoards from Entremont (France) and the Cani Islands (Tunisia), published by M.H. Crawford, *Roman Republican Coin Hoards* (London, 1969) nos. 110 and 132. Also of special interest are the frequently large mixed hoards of Iberian denarii and Roman denarii beginning in the period from 124-92 B.C., for example, Crawford nos. 178 (La Barroca, 2 Iberian denarii and 74 denarii); 184 (Córdoba, with 79 Iberian denarii and 224 denarii); 193 (Santa Elena, 6 Iberian denarii and 568 denarii); and 205 (Salvacanete, 62 Iberian denarii and 12 denarii). From this period in France see hoard from Cheverny, Crawford, no. 216 with 45 Gallic silver coins and 3 denarii. From the period 91-79 B.C., a hoard from Pompeii includes 7 bronze coins from Massalia and 65 Gallic bronze coins, Crawford no. 245.
- For a comprehensive study of coin circulation as a whole during the Republic see J.P.C. Kent, "Les relations entre le monnayage des Romains et ceux des peuples voisins de l'ouest," *Cercle d'études numismatiques bulletin* 10,1 (1973), pp. 3-11. He notes the relationship of coin circulation and the movement of Roman soldiers in war and determines that Roman coinage does not become dominant in Gaul until after the conquest by Caesar. I am grateful to Kent for discussing coin circulation with me and for the suggestion that probably goods and slaves were sold at the emporium in the harbour of Cosa, producing the money needed for capital investments. While Roman coins were in active circulation within Italy during the last two centuries of the Republic, Kent believes they did not leave Italy in any quantity for Gaul until about the mid-first century B.C. and that the Gaulish mints were sporadic before this time.
49. T.V. Buttrey, "Cosa: The Coins" *MAAR* 34 (1980), pp. 32, 81-88.
50. L. Casson, *Ships and Seamanhip in the Ancient World* (Princeton, 1971), p. 298, n. 8. I am grateful to Professor Casson for this reference as well as that in note 51. Casson suggests that the Sestius ships could well have returned home from Gaul in ballast, coinage then the exchange.
51. J.R. Steffy in G.F. Bass and F.H. van Doorninck, et al., *Yassi Ada: A Seventh-Century Byzantine Shipwreck* (College Station, Texas, 1982) p. 86.
52. "The Development of Agriculture in the 'Ager Cosanus' during the Roman Republic: Problems of Evidence and Interpretation", *JRS* 71 (1981), pp. 10-23. Both Hopkins (cited above in n. 48) and Rathbone ignore the material from the Portus Cosanus and seem unaware of McCann's full report on our finds in *JFA*, 1979 and that of Will in *JFA*, 1979, as well as other previous publications cited above in n. 2.
53. I thank R.D. Taggart for sharing his knowledge of economic development with me and some of his ideas are used here.
54. See recent exhibition on trade at American Museum of Natural History, New York, winter, 1984 and published by J.E. Vollmer, E.J. Keall, E. Nagai-Bethrong, *Silk Roads - China Ships* (Royal Ontario Museum, Toronto, Ontario, 1983), particularly pp. 216-240.

55. See A.M. McCann, J. Bourgeois, and E.L. Will, "Underwater Excavations at the Etruscan Port of Populonia," *JFA* 4 (1977), pp. 275-296; J.P. Oleson, "Underwater Survey and Excavation in the Port of Pyrgi (Santa Severa), 1974," *JFA* 4 (1977), pp. 297-308; A.M. McCann, "Le ricerche della missione italo-americana (1974) nell'antico porto di Populonia e nelle di Pirgi", *Atti del Congresso Internazionale di Archeologia Sottomarina* (Lipari, Italy, 1976) awaiting publication; N. Lamboglia, "Campagna di scavo italo-americana nelle acque di porto Baratti (Populonia)", *Forma Maris Antiqui* 10 (1973-1974), pp. 56-61; idem, "Campagna di ricerche sottomarine italo-americana sul porto etrusco di Pirgi (Santa Severa)", *Forma Maris Antiqui* 10 (1973-1974), pp. 61-65. Also see paper by E. Shuey on the Etruscan and Roman harbour of Gravisca in this volume and idem, *BSR* 49 (1981), pp. 17-45.
56. Oleson, *Roman Mechanical Water-Lifting Devices* (cited above in n. 2), p. 201.
57. J.H. D'Arms, *Commerce and Social Standing in Ancient Rome* (Cambridge, Mass., 1981) with review by E.L. Will in *Archaeology* 36 (1983), p. 77; J.H. D'Arms, "Senators Involvement in Commerce in the Late Republic: Some Ciceronian Evidence", *MAAR* 36 (1980), pp. 77-89, with review by McCann and Will in *AJA* 88 (1984), pp. 92-95.
58. See, for example, E.T. Salmon, *Roman Colonization Under the Republic* (London, 1969), p. 15; Brown, *Cosa* (cited above in n. 4); Rathbone, "Development of Agriculture", (cited above in n. 52).