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1978 have revealed much information about the port and shore facilities. These are areas of comparative neglect, where fruitful research has been pressed forward since the invention of the scuba. In addition, the land excavations discovered rare evidence of a water-lifting apparatus of late republican date, the earliest of its kind from the Roman West.

Underwater survey and excavation revealed the evidence for a protective mole and isolated extensions constructed about the end of the third century B.C. to create a sheltered harbor of some 25,000 square miles. Slightly later, and built with hydraulic tuff-and-pozzolana concrete (the earliest recorded use of this material), is a line of piers projecting out from the present shoreline toward the mole and so creating a small inner harbor. Dating these structures accurately in the context of underwater excavation is immensely difficult, but it does appear as if improvements to the port occurred with the growth of wine exports. It is hard to determine whether commercial considerations or the need to protect a naval squadron prompted the initial construction of the mole.

A major section on amphorae by Elizabeth Lyding Will documents a very large number of wine amphorae carrying stamps attributed to the family of the Sestii. These belong mainly to the second and first centuries B.C., and, given their abundance, it is likely that they were made close to the harbor. This hypothesis is supported by petrological analysis of specimens. Examples of the stamps of the Sestii on amphorae of the types found at Cosa are recorded widely in the West, particularly in Gaul, and illustrate the extent of the penetration of the wine trade by one family. By the end of the first century B.C. this wine export had come to an end, and the port of Cosa lost its importance.

The excavations on land examined the western part of the area occupied by a lagoon in antiquity. There are two aspects of this work that demand further examination. First, there is the evidence provided by trenching for a layout of walls, which McCann interprets as the remains of at least two large fish tanks. These tanks, she argues, were linked to the sea by partly underground channels, originally natural fissures in the limestone headland that formed a natural western side to the harbor. Both

#### ■ Classical Antiquity

**Anna Marguerite McCann.** *The Roman Port and Fishery of Cosa: A Center of Ancient Trade.* With the assistance of **Joanne Bourgeois, Elaine K. Gazda, John Peter Oleson, and Elizabeth Lyding Will.** xxxiii + 353 pp., plates, maps, illus., index. Princeton, N.J./Guildford, Surrey: Princeton University Press, 1987. \$150.

The colony of Cosa, founded in 273 B.C., is situated on the coast of Tuscany 138 kilometers north of Rome. It has been a focus of archaeological work since the American Academy began excavations in 1948. Anna Marguerite McCann's investigations on land and under the sea between 1968 and

fresh seawater and fish could be allowed to enter the tanks, but cuts into the rock walls of these channels suggest that there were gates that could be raised and lowered to control movement. McCann is persuasive in her interpretation, pointing to the literary evidence for fishing at Cosa and drawing on numerous parallels for similar installations from around the Mediterranean and, particularly, from the south coast of Spain. There the exploitation of marine resources and the production and export of *garum* from the late first century B.C. are well known. A comparable manufacture and trade of fish products from Italy has not so far been attested; in the case of Cosa the export of *garum* rests on Will's identification of her types 5 and 24a amphorae as serving this purpose. The former are more numerous (but there are only twenty-two examples, or less than 3 percent of all the amphorae recovered), but they are not sufficiently different from the type 4 wine jars to be regarded as carriers of fish products; the latter (three examples), with their wide mouths, are better candidates but are not certainly local products. The case for a commercial fishery is also not helped by the total absence of fish remains. Although modern patterns of exploitation suggest that conditions at Cosa, with its brackish lagoon, might have been ideal, it is quite another matter to extrapolate this back to the Roman period. Even if McCann's reconstructions are, in the main, correct, we should not assume a commercial rather than a simple ornamental purpose without more evidence. In this respect, the proximity of a possible "maritime" villa should not be overlooked.

The second aspect of the land excavation that demands comment is the building referred to as "the Spring House." Terraced into the hillside, at a point where a natural spring emerges, and hard against the "fish tanks," it produced the remains of seven wooden buckets whose shape and fixtures are consistent with their having formed part of a bucket chain. Other wooden objects that are tentatively identified as part of the motivating wheel were also preserved. Close by the building were found two sets of piers that, at different times, could have supported the aqueducts fed by the bucket chain. This machinery would seem to date from the early first century B.C., thus providing us with the earliest physical evi-

dence of the kind of bucket chain described by Philo of Byzantium in the late third century B.C. and, later, by Vitruvius. Given the context of the find, it is entirely plausible to accept John Peter Oleson's reconstruction and posit a horizontal drive wheel, powered by human labor, that transmitted power to the bucket chain by means of a right-angle gear.

These discoveries at the port of Cosa have much of importance to add to our understanding of the development of the ancient harbor and its relationship to the export of wine in the later republic. No student of the ancient economy can afford to ignore this report. At the same time, we may also welcome the valuable contribution that has been made to the history of technology. For their detailed presentation of the evidence and their wide-ranging discussions of the implications of their findings, McCann and her colleagues deserve our congratulation.

MICHAEL FULFORD