

bored and turned true, in contrast to the normal reaming of eccentric holes in 'flat' guns. This removed much honey-combing – but also from one-fifth to one-third of the original.

It is suggested that the turning would probably have removed the metallurgical evidence with the surface layers (p. 93). That seems pessimistic and improbable if so much metal was actually removed, and the annealing period was so extended – two of the few facts we have. The proof lies in the body of the metal, until someone cuts a section from one of the guns.

For what it is worth we might guess that if initial experiments were in glasshouses, there was a lot of silica around, and there were extended periods of time for annealing. The slowly-cooled casting would be graphitized, and long annealing would allow the graphite to migrate, tending to leave rosettes in a ferrite matrix, perhaps not so different from wrought iron, less the fibrous structure. This possible outcome is almost rejected (p. 94) as being 'soft and weak' – but was that not the declared object of the Patent?

The original lists of all the guns made are reproduced, with their original assignments, mostly to 21 named ships; but their fate is not given, excepting the 11 guns identified.

RICHARD BARKER

Reference

- Barker, R., 1982, Bronze cannon founders: comments upon Göttsman 1974, 1982, *JNV*, 12, 67–75.

Excavacions arqueològiques subaquàtiques a Cala Culip 2, Culip VI (Monografies del CASC I)

HUG PALOU, ERIC RUFFI,
MANU' IZAGUIRRE, ANNA JOYER,
XAVIER NIETO, MARCEL PUJOL,
XIM RAURICH and CRUZ APESTIGUI

265 pp., 119 b&w figures

Museu d'Arqueologia de Catalunya, Centre d'Arqueologia Subaquàtica de Catalunya, Girona, 1998, NPG, ISBN 84-393-4655-7

This second volume in the monograph series published by the Centre d'Arqueologia Subaquàtica de Catalunya (CASC), Spain, is a comprehensive site report of the *Culip VI* shipwreck, a medium-sized Mediterranean trader dating to the late 13th or early 14th centuries AD. This wreck is significant in that it represents the earliest archaeological example for a hull construction process that has been rarely encountered in the archaeological record and is not documented textually prior to the 15th century.

The *Culip VI* ship sank in a small bay on the northern coast of Cap de Creus, Catalonia, Spain. Discovered in 1987 during the excavation works of another wreck (*Culip VII*), dating from the 1st century BC, it lay in shallow water 15 m buried under several layers of sea grass, which raised the level of the seabed by about a metre. Between 1988 and 1990 Dr Xavier Nieto excavated the wreck with the co-operation of the Musée de la Marine in Paris, and the Escuela Técnica Superior de Ingenieros Navales in Madrid.

The timbers utilized in its construction suggest that it was built on the northern coast of the western Mediterranean, somewhere between Barcelona and Narbonne. It was about 40 tons burden and probably carried a two-masted lateen rig. It sank with a mixed cargo primarily composed of North African Christian and Islamic ceramics.

Depositional problems complicate the vessel's interpretation. The cargo suffered from sea action that eroded and scattered it. Furthermore, contemporaneous salvage operations may be the cause of a lack of anchors, personal items and tools at the site.

Fortunately, part of the bottom of the hull survived, and its floor timbers contained a set of construction marks that explained the techniques employed in its construction. The *Culip VI* was built 'skeleton-first', following a tradition that had already been hinted at earlier in Mediterranean vessels, from the 5th/6th century AD *Tamura*, the 7th-century AD *Yassi Ada* and *Saint Gervais II* shipwrecks to the 11th-century *Serge Lamani* wreck. Fifty of *Culip VI*'s frames were pre-designed and moulded over the keel before the vessel's builders nailed the planking to them.

The design of the hull was pre-defined through a non-graphic process in which the narrowing of the bottom and the rising of the turn of the bilge followed fair curves, obtained through a geometrical calculation termed *mazzafana*. The Classical Greeks were familiar with this process, which is described in detail in later texts.

Precise information regarding the use of this technique is limited to the flat of the master frames and the distance from the end-point of the two master floors to one extremity of the keel. Nevertheless, this data permits a calculation of the vessel's dimensions. It had a keel length of slightly less than 13 m, an overall length of about 16.5 m, a beam of about 4 m, and an approximate 2 m depth of hold. It could have been manned with a crew of less than ten.

This report, written in Catalanian and French, contains eight chapters, and ends with useful and well-organized appendices, which include a good Catalanian-French glossary. In the introduction the authors supply a commendable synthesis on the ship's known archaeological parallels, describe the site, the excavation's working methodology, as well as the vessel's historical context, cargo and architecture. The report concludes with a detailed and comprehensive

REVIEWS

reconstruction of the vessel, and a discussion of the *Galathea's* last voyage.

Dating to a period of great change in the Mediterranean world for which evidence in the form of shipwrecks remains meagre, this study receives high

marks for its breadth, and deserves to be published in an English edition so that a greater audience may enjoy it.

FILIPE CASTRO