73. The Tonnage of the Syracusia. A Metrological Reconsideration

Emmanuel Nantet (University of Le Mans, Le Mans, France)

The Syracusia is known as the largest merchantman ever built in ancient times. But how large was it exactly? Many scholars have focused on this giant ship in order to determine the maximum tonnage allowed by the construction techniques used in the Hellenistic period. Although the contents of the ship’s cargo are described precisely by Athenaeus, the weight of the cargo is rendered inestimable in terms of metrological considerations. Indeed, what sort of a metrological system was used in the account given by Athenaeus? Although Athenaeus does not mention any specific unit of measurement for the ship’s grain cargo, many scholars have argued that it should have been the Attic medimnos (52l), which results in a huge tonnage (4000 tonnes) for the ship. Lionel Casson noticed, however, that the account given by Athenaeus was first written by Moschion and thus he suggested that Athenaeus, who lived during the Roman period, may have substituted the modius (8.7l) for the medimnos. Calculating the tonnage using the modius results in an enormous decrease in the size of the grain cargo and thus in the overall tonnage (2000 tonnes) of the ship. Jean Rougé objected to this particular choice of weight unit as it would not have been in accordance with the fame of a ship renowned as a huge grain carrier. No one, however, has ever suggested that the unit of measurement mentioned by Athenaeus may have been the artaba, which was used in Egypt from the Persian to the Byzantine periods. Similarly, as the Syracusia was built in Sicily, the use of a Sicilian unit of measurement should also be considered. The reconsideration of the unit of measurement mentioned by Athenaeus allows us to suggest new estimates for the tonnage of Syracusia. This metrological exercise also links two locations in the Mediterranean, Sicily and Alexandria, both of which played a significant role in Honor Frost’s research.

74. Where to Situate the Abu Rawash Boat in the Corpus of Ancient Egyptian Boats

Mohamed Abd El-Maguid (Central Department for Underwater Antiquities, Alexandria, Egypt)

In 2012, during a joint venture of the IFAO and Macquarie University, hull remains were discovered in a pit located in the archaic cemetery (M) at Abu Rawash, near Giza, on the northern side of the Mastaba no. M06. These remains, measuring 6.53m long and 1.30m wide, were consolidated in situ and then removed to the conservation center of the Grand Egyptian Museum. During the excavation and conservation processes, the boat was documented and recorded with traditional methods, a 2-D high-resolution scanner, and photogrammetry. Using this gathered documentation, it is possible to compare and contrast these remains to the corpus of known boats and hull remains in Egypt. This boat has characteristics similar to other Egyptian archaic boats but also some new and distinct features. This paper will discuss the possible functions of this boat as well as its construction method.
75. A Study in Framing Development in the Mediterranean from the Ninth century BC through the Ninth Century AD

Kevin Melia-Teevan (Nautical Archaeology Program, Texas A&M University, College Station, Texas, USA)

This paper is a selective compendium of measurements and features relating to hull framing patterns from Mediterranean shipwrecks dating from the fourth century BC through the ninth century AD, with the goal of better understanding the transition from shell-based to frame-based ship construction. With a few notable exceptions, only limited and non-uniform measurements and analyses have been published regarding the framing patterns in ancient Mediterranean ships, a system that has been broadly and nondescriptly labeled as ‘floor timbers alternating with paired half-frames’. From its first appearance in the fourth century BC until the sixth century AD, the pattern of floor timbers alternating with paired half-frames remains in relative stasis with only a few notable developments. Framing continued to be a non-integrated and largely secondary form of hull rigidity until the eighth and ninth centuries AD when a new system of framing appeared – successive and alternating L-shaped floor timbers extended by non-fastened futtocks, or in-line framing. The introduction of in-line framing, along with the transitioning away from strong hull edge-joinery, prompted the obsolescence of the centuries-old arrangement of floor timbers alternating with paired half-frames. While framing systems in ancient Mediterranean ships have received limited focused attention in the past, it is clear that the incremental changes between the fourth century BC and the ninth century AD reveal larger patterns in ship construction.

76. The Development of the Roman Merchant Ship Sail-plan

Christopher John Davey (University of Melbourne, Melbourne, Australia)

Drawing on the experience gained when sailing the Kyrenia II, this paper proposes a new translation of the Peripatetic authored Problem 7, included in the Aristotelian corpus Mekhanika (‘Mechanical Problems’), which highlights the difficulties associated with sailing to windward and going about. The common sail plan of post-Republic Roman merchant sailing ships, which included a bowsprit-sail (artemon), is depicted in modern publications with reference to iconography, literature, and shipwreck evidence. After briefly citing aerodynamic theory associated with the bowsprit sail, it is argued that the spritsail was devised independently of the foresail, probably during the second century BC, and that its adoption on Roman-period shipping vessels made sailing to windward and tacking routine in most weather conditions. The addition of the bowsprit-sail also facilitated the development of merchant sailing ships larger than the largest merchant galleys. This expansion permitted the growth of a flourishing bulk commodity trade that under-pinned Roman maritime commerce.

77. The Akko Tower Wreck, Israel: hull-construction report

Deborah Cvikel (Leon Recanati Institute for Maritime Studies, University of Haifa, Haifa, Israel)

During the eighteenth and nineteenth centuries, the city of Akko (St. Jean d’Acre) and its harbour
were considered the key to the East and the centre of several important naval events. The Akko Tower Wreck was discovered in Akko harbour in 1966, and surveyed in 1975 and 1981. At that time, the researchers came to conflicting conclusions regarding the origin of the ship. To better understand the nature of the Akko Tower Wreck, four seasons of underwater excavation were conducted in 2012, 2013, 2015 and 2016. The shipwreck, 17.8m long and 6.4m wide, was found in 4.4m of water. The preserved hull remains include the ship’s keel, rising wood, keelson and sister keelsons, several planks, frame timbers, ceiling planking, and limber boards. The hull components are made of pine (Pinus sp.) and oak (Quercus sp.). Other excavated artifacts include rigging elements, wooden objects, bricks, ceramic tiles, and the ship’s anchor chain.

Based on the construction features of the hull and artifacts associated with the wreck, it is suggested that the Akko Tower Wreck is the remains of a 25-m-long merchant brig from the first half of the nineteenth century. The ship’s design was probably influenced French shipbuilding traditions, the vessel built in a well-established shipyard, and sailed to Akko from a western Mediterranean port. The full story of the ship and its place in the maritime history of Akko, however, remains to be told.

78. A Preliminary Study of the Remains of Four Vessels Found in the Ancient Harbour of Naples, Italy

Giulia Boetto (Aix Marseilles University, CNRS, Ministry of Culture and Communication, UMR 7299, CCJ, Aix-en-Provence, France)

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The urban archaeological operation, undertaken in Naples for metro lines 1 and 6, provided a rare and unique opportunity to investigate the coastal landscape of the ancient city. Between 2004 and 2015, archaeologists, led by Daniela Giampaola of the Archaeological Superintendence of Campania, investigated a large portion of the port basin, which dates back to the Hellenistic and Roman periods, and is located in front of Castel Nuovo (Maschio Angioino) in Piazza Municipio. In addition to the port infrastructures, the remains of seven vessels were discovered dating from the Hellenistic to the Roman Imperial era. This paper will present the preliminary study of the characteristics of the remains from the four vessels discovered between 2013 and 2015 (Napoli E, F, G, and H), and will advance hypotheses concerning their original function.

79. The Construction of Ma’agan Mikhael II

Avner Hillman (Israel Antiquities Authority and Department of Maritime Civilizations, University of Haifa, Haifa, Israel)

Deborah Cvikel (The Leon Recanati Institute for Maritime Studies (RIMS), University of Haifa, Haifa, Israel)
The Ma’agan Mikhael ship, dated to ca. 400 BC, was discovered off the coast of Israel in 1985, and excavated in 1988 and 1989 by the Leon Recanati Institute for Maritime Studies at the University of Haifa. The portion of the hull below the waterline was well preserved, including the keel, false keel, endposts, two knees, sections of 12 strakes to starboard and seven to port, 14 full frames, mast step, and several other internal components. Given the archaeological significance of the find, the remains were completely excavated, raised, conserved, and placed on display in the Hecht Museum at the University of Haifa.

This merchant ship, as originally constructed, was 14.4m long, 4.24m in breadth, and with a depth of hold amidships of 2.6m. When fully laden, it could carry 15.9 tons of cargo and displaced 22.9 tons, with a maximum draught of 1.4m. The vessel was driven by a single square sail and the hydrostatic characteristics of the proposed rig design were tested by the Israel Administration of Shipping and Ports.

As the final stage of a generation-long endeavor, a full-scale sailing replica of the ship was completed in November 2016. The design of the replica was based primarily on the archaeological remains of the Ma’agan Mikhael shipwreck, and iconography was used to supplement missing information. Research models were made to clarify details of the reconstruction and a complete set of ship’s lines were generated by computer-aided design and model-building. Comparisons were also made with the reconstructions of contemporary shipwrecks. The reconstruction team consisted of maritime archaeologists, naval architects, experienced craftsmen, and sailors. Building the replica using techniques of ancient shipwrights was a challenging task but necessary for providing essential information on ancient shipbuilding techniques.

80. A Twelfth-Century Byzantine Shipwreck in the Port of Rhodes

George Koutsouflakis (Ephorate of Underwater Antiquities, Hellenic Ministry of Culture and Sports, Athens, Greece)

Eric Rieth (National Center for Scientific Research (CNRS-LAMOP) National Maritime Museum, Paris, France)

This paper presents the remains of Rhodes Shipwreck No. 4, excavated by the Hellenic Ephorate of Underwater Antiquities near the entrance of the modern Commercial Port of Rhodes, a port installation corresponding to the ancient Megas Limen, mentioned by Diodorus. The archaeological work was conducted in the framework of the MERMAID Project, funded by the European Union and led by the Technological School of Athens. Documentation was supported by a team of nautical archaeologist and experts from Centre Camille Jullian–Laboratoire de Médiévistique Occidentale de Paris (CNRS).

The shipwreck was discovered in 2008, half exposed at the northern end of the main dock at a depth of 12-13m, and subsequently excavated in November 2013. Dating to the second half of the twelfth century, the vessel was a merchantman laden with a cargo of Günsenin III type amphorae. The ship was destroyed by a fire that severely damaged both the ship and its cargo. The fire caused the amphorae to collapse into a condensed stratum of sherds. Although the upper-works of the ship itself was completely destroyed, the portion of the hull below the waterline was found to be in an excellent state preservation.
Excavation efforts were limited to only the southern extremity of the wreck in an area of about 90m² and exposed extensive portion of the ship’s frames, planking, ceiling, keel, keelson, stringers, and part of a bulkhead that formed a compartment at one end of the vessel. The main hold was lined with massive, transversally set floor-timbers, which separated the cargo from the bilge. As with most Mediterranean ships of that era, the vessel was built according to the ‘frame first’ technique with the hull planking fastened directly to predesigned frames.

The hull remains from the Rhodes No. 4 shipwreck provides valuable information from a little known period in Byzantine shipbuilding, and spans the chronological gap between the eleventh century Serçe Limani and Yenikapi shipwrecks, and the thirteenth century shipwreck in the Sea of Marmara.


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Irena Radić Rossi (University of Zadar, Zadar, Croatia)

Between 1972 and 1974, the Maritime Museum of Dubrovnik (Ragusa), under the direction of Anica Kisić, carried out rescue excavations on the remains of a post-medieval ship that sunk at the entrance of the Bay of Sudjuradž, on the island of Šipan (Croatia). Archival research conducted in the National Archive of Dubrovnik identified the wreck as that of the nava San Girolamo, a vessel that belonged to the famous Ragusan merchant Jere Primojević (Hieronymus Prim) that sank in 1576.

Following several archaeological surveys, a multi-year research project focusing on the hull remains was begun in 2014 within the framework of the Archaeology of Adriatic Shipbuilding and Seafaring (AdriaS) Project, supported by the Croatian Science Foundation. The main objectives of the project are to study the hull design of San Girolamo, its outfitting, and history. The initial portion of the study focuses on the systematic excavation and recording of the ship’s hull remains in order to determine the shipbuilding philosophy behind its design and construction. Moreover, examining contemporary shipbuilding treatises and archaeological parallels can help identify potential technology transfers between the Mediterranean and Atlantic shipbuilding traditions in the sixteenth century. The study of the hull remains, artifacts, and archival documentation related to this vessel will provide a better understanding of sixteenth century Ragusan seafaring, which encompassed the majority of the Mediterranean, extending from the Ottoman to the Spanish empire.

This paper presents the preliminary results of the archaeological survey and excavation of the hull remains of San Girolamo conducted between 2014 and 2016. During the excavation it was possible to identify and record by traditional techniques and photogrammetry several components of the ship’s bow section, including the stem and frame timber, hull planking, lead sheathing, and various rigging elements such as chainplates.