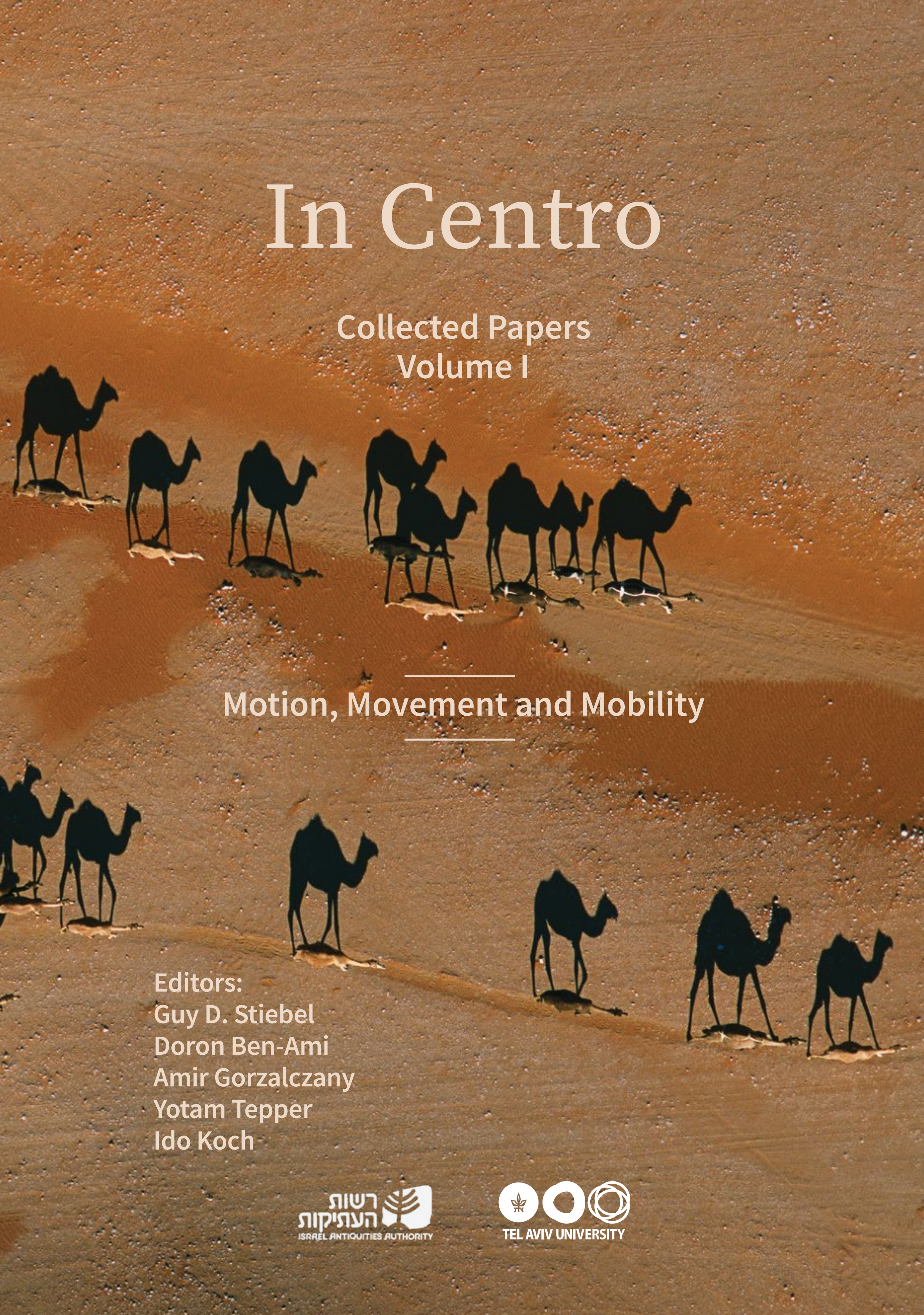

In Centro

Collected Papers
Volume I

Motion, Movement and Mobility

Editors:
Guy D. Stiebel
Doron Ben-Ami
Amir Gorzalczany
Yotam Tepper
Ido Koch

רשות העתיקות
ISRAEL ANTIQUITIES AUTHORITY
TEL AVIV UNIVERSITY

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Central Region

The Sonia and Marco Nadler Institute of Archaeology
The Jacob M. Alkow Department of Archaeology and Ancient Near Eastern Cultures
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Contents

A Roman Merchant Ship Cargo of Scrap Metal and Raw Materials in the Caesarea Harbor: Preliminary Report

Jacob Sharvit | Israel Antiquities Authority
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Introduction

In February 2016, the remains of a Roman shipwreck were found by recreational divers near the eastern corner of the northern breakwater reef of the Herodian harbor at Caesarea Maritima, Israel (Fig. 1). The site was exposed after a winter storm scoured away a large amount of sand from the seafloor (a layer of ca. 3 m), creating a 40 × 60 m shallow crater at a depth of 7–8 m. This was the first time an ancient shipwreck assemblage was detected in this area. The sudden emergence of this hitherto deeply-buried site highlights a broader trend along the coast of Israel in recent years: the reduction of inshore sediment due to a combination of storms and coastal infrastructure development.

* The field work and preliminary examination of the material described in this paper was accomplished through the generosity and support of the IAA, Ocean Gate Foundation, KORET Foundation, Steve Phelps, URI Council for Research, and the support of the Perlman family and Gussie Baxt Foundation. We wish to thank our colleagues: Prof. John Hale, Dr. Robert Kool and Dr. Donald T. Ariel (Department of Numismatics, IAA), Prof. Sariel Shalev (XRF, Metallurgic, University of Haifa), Dr. Yael Gorin-Rosen (Department of Glass, IAA), Sharon Ben-Yehuda (GIS, Graphics, IAA) Clara Amit (Photography, IAA), Eran Rosen (diving officer, University of Haifa). Special thanks are extended to Dror Planer, who spent hundreds of hours underwater at the site with us as part of the team (Marine Archaeology Unit, IAA), to the Unit for the Prevention of Antiquities Robbery (IAA), which participated in the rescue survey, and to our great team of volunteer divers and students.

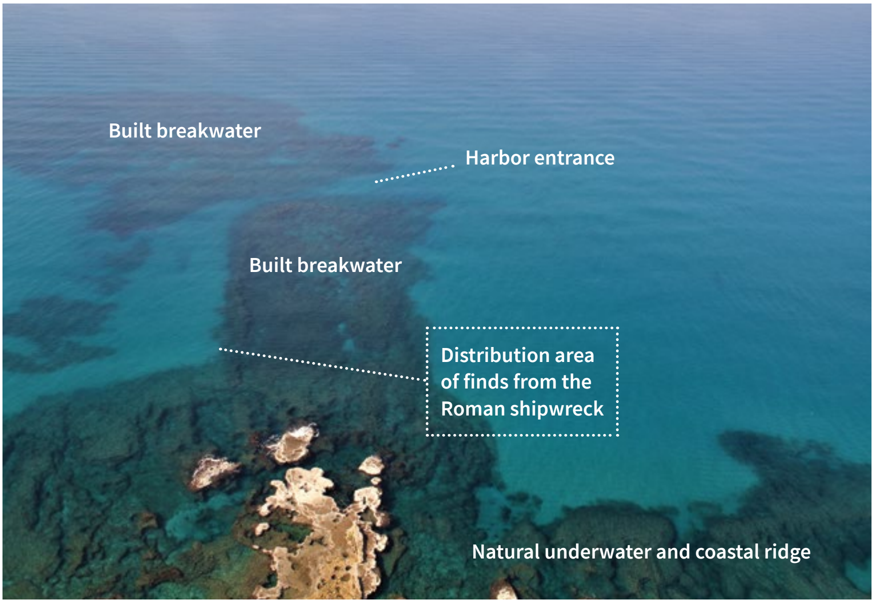

Fig. 1: Location of wreckage site

The Marine Archaeology Unit of the Israel Antiquities Authority (IAA) carried out a rescue survey and recovery of exposed artifacts at the site in May–June 2016. The combined expedition included the University of Rhode Island, the University of Louisville and several European research centers: the University of Zagreb Laboratory for Underwater System and Technologies (LABUST) and the University of Girona Laboratory for Computer Vision and Robotics (ViCOROB). Many students of archaeology, international divers and local community volunteers assisted in the fieldwork.

Since February 2016, two phases of investigation and recovery have been carried out by the combined team, including mapping, documentation and removal of surface artifacts for further study. Preliminary examination of the recovered artifacts, which include over 20,000 coins, points to a date in the early 4th century CE. The volume of material recovered from the surface of the site in 2016 confirms, even before excavation, that it is the largest ancient shipwreck cargo ever to have been discovered in Israel. The emergence of the wreck from a relatively undisturbed archaeological context under the inshore sediment enables precise dating and accounts for the excellent levels of preservation of the bronze cargo.

The bulk of the exposed cargo recovered from the surface of the site consisted of hundreds of broken pieces of bronze statues, bronze and iron tools, lumps of cast lead, hundreds of kilograms of raw glass, thousands of coins, bronze oil lamps, decorated handles, many small bronze and lead fragments, iron anchors and some sculpted marble pieces. The large assortment of scrap metal items in the cargo indicates that the vessel was engaged in collecting used and broken artifacts to be sold for recycling. Since the site was not excavated, it is not known what else the vessel may have carried: notably, only few ceramics were visible on the surface, and no hull structures have yet been identified (on this issue, see further below).

The Mapping of the Site

To understand the formation of the shipwreck site, a detailed GIS map of the artifacts was created. In order to document the exact position of each artifact, a photogrammetric survey was performed alongside conventional tape-measure triangulation using three DGPS benchmarks. The site was also documented using a 3D camera system developed by Girona University (Bosch *et al*. 2015) attached to an Autonomous Surface Vessel (ASV) developed by University of Zagreb (Buxton *et al*. 2016). These technologies provided us with the opportunity to map the visible site and to create a high-resolution photomosaic, as well as a 3D model incorporating the adjacent harbor breakwater, which was produced with multibeam sonar.

During the 2018 field season, the site (which had been reburied by storms shortly after the 2016 expedition) became partially reexposed through natural processes. A geophysical survey was conducted using a SyQwest StrataBox, a portable high-resolution marine sediment imaging instrument capable of delivering 6 cm of marine sediment strata resolution with bottom penetration of up to 40 m. Since most of the surface finds of the wreck had already been removed, we started the season using a metal detector (JW Fishers Pulse 8X) to survey the entire wreck area and to locate metal concentrations under the sand, in the hope of finding additional bronze and metal artifacts in the disturbed surface sediment. A baseline was set up on the eastern side and moved westward meter by meter to ensure a systematic metal detector search. In areas of loose sand over the bedrock or shallow clay deposits, the excavation of targets was carried out manually.

The excellent underwater visibility during the 2018 season allowed significant features of the site to be seen from the surface. The position of the buoy line was marked by divers using a DGPS receiver on the surface. Information about the site was captured using ArcPad 10.2 in the field and later processed with the use of ESRI ArcGIS in the office. Digital charts of the area were obtained and used as an initial framework on which to position other plans and targets. High-resolution aerial photographs were taken by a quadcopter drone and incorporated into the GIS.

The Assemblage of Artifacts

The assemblage consists of two main components: 1) ship fittings and objects used on the vessel; and 2) cargo. The metal objects from the cargo were preserved in excellent condition due to the protection of the 3 m deep layer of sediment that covered them, reducing oxidation and general deterioration. The preponderance of heavy cargo and anchors at the site presumably reflects the fact that these items worked their way down through the sand over time. Lighter objects, such as pottery and the ship’s wooden hull, were likely shattered and washed away by the high wave energy in the shallow bay north of the breakwater. Some of the original cargo was presumably salvaged in antiquity, as the wreck occurred close to shore near a busy harbor.

Ship Components and Tools

Anchors

Three intact iron anchors were found. The largest is 2.9 m long with an arm length of 0.9 m, a half stock 1.22 m in length, a ring 0.3 m in diameter, weighing ca. 400 kg. This was most likely the main anchor, thrown overboard in a last-ditch effort to hold the ship off the semi-submerged reefs near the northern entrance of Caesarea's harbor. The anchor stock is broken, but still attached to the shank. The other two anchors are smaller in size; one was found broken at the northeastern edge of the site, and the other on top of the adjacent reef at a depth of 5 m. Surrounding the large anchor were at least seven large (ca. 2 m) stocks, but no anchors. The anchors are all examples of Roman Imperial type C (Kapitän 1984: 42–43).

Sounding Leads and Weights

Five sounding leads were found: the largest and heaviest one (24.4 kg) was discovered next to the large anchor and the others within a small area at the eastern edge of the site. The smaller lead weights ranged from 9.9 kg down to 2.72 kg. Sounding weights were used to determine the depth and type of sediment on the seafloor (Galili and Sharvit 1999: 172–173; Galili, Oleson and Rosen 2010; Oleson 2000).

A Lead Brazier and Tray

A lead brazier and an accompanying thick rectangular lead tray were found lying together in the northeastern part of the site (Fig. 2). The brazier is shaped like a hollow shoe forming a closed container, with a cylindrical opening for pouring in water.

Both items exhibit traces of charring. The shape of the brazier's base is imprinted on the upper surface of the tray, indicating that the brazier had been placed there to prevent direct contact with the wood of the ship's hull.

Lead braziers designed for use on ships have been found in many locations along the Mediterranean coast of Israel, all, however, without a secure

Fig. 2: Finds from the site: A) lead brazier and tray; B) diver holding large fishing hook and chain

archaeological context (Chambon 2012: 78–79; Galili and Sharvit 1999: 168–69; Galili and Rosen 2012; Ashkenazi *et al*. 2012: 85–86). This is the first recovery of a brazier from a shipwreck context and the first time that a brazier was found together with a lead tray.

Nails

Hundreds of copper-alloy nails in a wide variety of sizes with square shafts typically used in Roman ship construction were found all over the site. Some of the nails were unused and were probably kept in the carpenter's tool box as spares. On the basis of the various lengths and of comparison to nails from other excavated Roman shipwrecks in the Mediterranean, it seems that the longer nails were used for joining the strakes to the frames, whereas shorter nails could have been used to join deck planks (Fitzgerald 1994: 166–168; Galili, Rosen and Sharvit 2010: 62–68). Some exceptionally long nails (up to 40 cm long) were also found; these could have been used for joining the stern or bow timbers to the keel.

A Bilge Pump

Seven sections of lead pipe were found at the site, which would have formed a tube almost 10 m long when connected. The pipe sections were produced by rolling rectangular sheets of lead (18.5 cm wide, 0.4 cm thick) to create a tube with an external diameter of 5 cm and internal diameter of 4 cm, with overlapping and welded edges (Landels 1978: 55, Table 2). This corresponds with the guidelines for the manufacture of Roman lead pipes described by Vitruvius (*De architectura* VIII.6.4) and Pliny (*Natural History* 31.58), which presumably had not changed significantly by the 4th century CE.

Two rectangular lead water containers were found: one large and partially broken and the other smaller, with two openings and a lead pipe, with a flat ring still connected to the container. Similar containers and pipes were recovered from a Roman shipwreck located in the northern anchorage of Caesarea (Fitzgerald 1994: 208–10). The main part of a piston pump made from a thick lead tube and a wooden plunger ending with a leather gasket were found together with these containers on the 4th-century Caesarea wreck under discussion. It seems that all these components were part of the ship's bilge pump. This is the first time that almost all of the components of a ship's bilge system have been found intact on a late Roman shipwreck, providing important evidence about how these systems functioned.

Fishing Tools

The site yielded a large fishing hook (12 cm long) connected to a bronze chain (ca. 60 cm long), consisting of six connected bronze links with a circular ring in the middle (Fig. 2B). The full rotation of the ring would have prevented the tackle from tangling. The only similar fishing tackle of this size and type was found in Asciutta, a suburban villa south of Pompeii (Stefani 1990: 14). This sort of fishhook was obviously intended for large species, probably the larger types of Scombridae (mackerel and tuna; see Casasola 2010: 95, Fig. 6). Dozens of lead fishing-net weights found clustered together in an area ca. 30 sq cm in size probably belonged to a single net, which has not survived. We know that fishing was a regular activity on board Roman commercial ships, as the accoutrements of fishing have been found on many shipwrecks (Parker 1992: 29; Galili, Rosen and Sharvit 2010: 80–95).

Fig. 3: Finds from the site: A) assortment of intact and broken bronze sculptures; B) two bronze fragments of male portrait heads with Julio-Claudian hairstyles; C–D) chunks of raw glass

Miscellanea

A variety of other small finds, typical of Roman shipwrecks of the Imperial period, represent evidence of the ship's construction and operations, as well as of the daily lives of those on board. These miscellaneous small finds include elements of the rigging, carpentry tools, lead sheathing, navigational instruments (sounding weights), lead rings or grommets, bronze sewing needles and netting tools, finger rings, keys, and a bronze strigil (cf. Galili, Rosen and Sharvit 2010: 103, Fig. 53), as well as a large bronze steelyard with an anthropomorphic counterweight. These items were recovered amidst hundreds of ballast stones, which were left *in situ*.

The Ship's Cargo

Bronze Sculpture and Metals

If what has been recovered so far is representative, the ship's main commercial cargo consisted of scrap metal (primarily bronze and lead) and chunks of raw glass. The fragments of copper alloy, bronze, lead and iron were probably gathered by local scrap collectors and sold to merchant ships, and some of the larger sculptural pieces appear to have been deliberately cut up for ease of transport.

The scrap-metal cargo included pieces of bronze or copper-alloy tools and a variety of handles and fixtures. Some of these were shaped as dolphins, others were shaped as small decorative figurines or heads, and one handle came from a broken trefoil oenochoe. Large fragments of at least four male and one female bronze statues, larger than life, may be all that survives of imperial or civic statue groups, perhaps damaged beyond repair in earthquakes or war. The group includes part of the torso of a male athlete type, at least one *togatus* and fragments of male portrait heads with Julio-Claudian hairstyles; a well-preserved face from one statue suggests an early portrait of the emperor Trajan (Fig. 3A–B). All of these pieces require further study and reconstruction to secure identification.

The site yielded more than ten kilograms of lead sheets and melted lumps of lead, some adhering to the bronze statue fragments, suggesting that they all originated from the same source. The total weight of all the recovered scrap metal from the shipwreck was over 500 kg.

Glass

Twenty-six chunks of raw glass, weighing a total of ca. 150 kg, were discovered in the southern part of the shipwreck site, along the rock-sand interface of the northern breakwater. The largest chunk (Fig. 3C) weighed 14.62 kg and the smallest (Fig. 3D) only 0.2 kg. All the larger pieces of glass were found clustered in a small area (4 × 3 m), with the smaller pieces scattered slightly further. The glass chunks were found together with copper-alloy parts of a statue and many ballast stones, all suggesting that the glass cargo belonged to the same large Late Roman shipwreck.

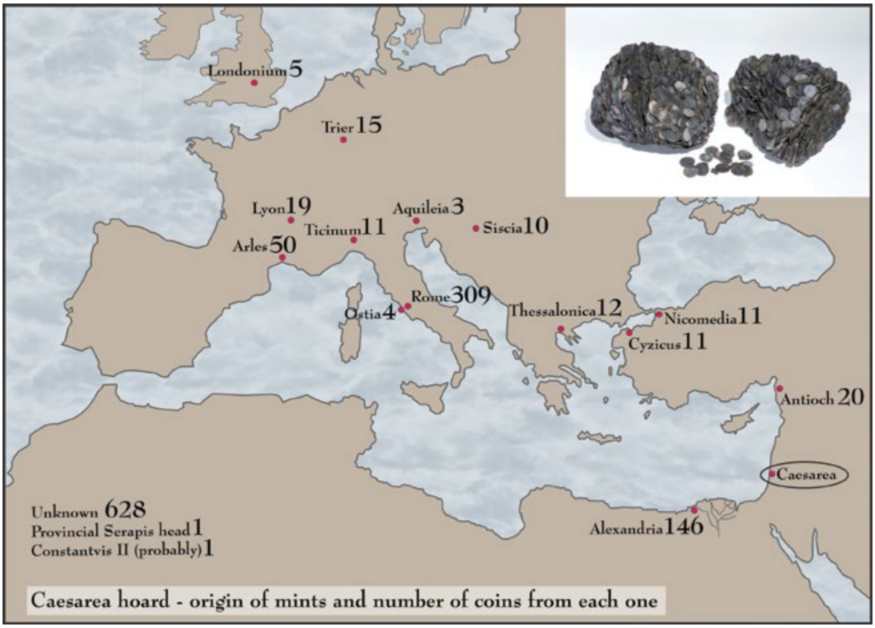

Fig. 4: Two lumps of conglomerated coins from the shipwreck and map depicting the location of their mints and number of coins from each mint

Although many chunks of raw glass have been found during underwater surveys along the coast of Israel (Galili, Gorin-Rosen and Rosen 2015), their lack of archaeological context precludes their dating. The raw glass found among the cargo of this early 4th-century shipwreck is the first such assemblage uncovered in Israel to be securely dated on the basis of its archaeological context.

Coins, Columns and Lamps

Over 20 kg of copper-alloy coins were recovered in the form of two large lumps of conglomerated coins. Each conglomerate was shaped like the lower body of an amphora, which was likely the original storage receptacle (Fig. 4). Hundreds of individuals coins were strewn around the site. Analysis conducted on a representative selection of 628 coins dated them to the first quarter of the 4th century CE.

The cargo also contained a small white marble column with a capital and a base (total height of 157 cm). The capital was decorated with acanthus leaves and adorned with two miniature busts of a male (Serapis) and a female (Isis) deities. The upper surface of the capital exhibited signs of charring. It seems that the column had been part of a shrine or an altar—either the ship's own sanctuary or part of its cargo (a less likely possibility, given the evidence of use). Not far from the column lay a decorative bronze snuffer (Fig. 5A) and two large and ornate bronze oil lamps, each with a double nozzle and figurines on the handles; one figurine appears to be a Helios (Fig. 5B), and the other may

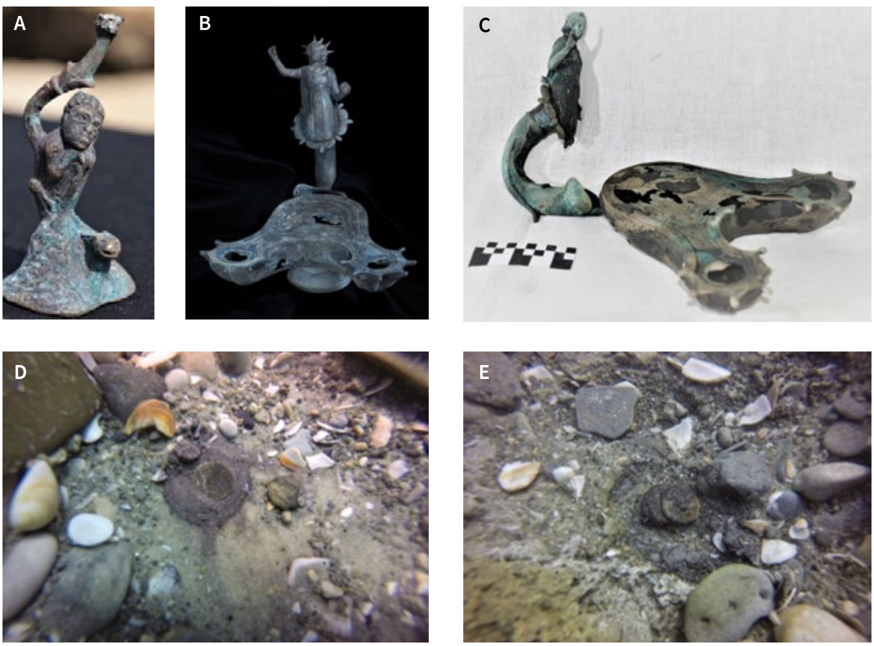

Fig. 5: A) Decorated bronze snuffer; B–C) two large and ornate bronze oil lamps with figurines (Helios and Luna); D–E) corrosion stain surrounding some of the coins, indicating that the artifacts had lain hidden and undisturbed for centuries

represent Luna (Fig. 5C). In all other respects, the same the lamps are identical; thus, they are likely from the same workshop. Their discovery near the decorative column with charred capital suggests these lamps may have originally rested on top of two columns flanking a shipboard altar, an arrangement evoking the two Victory-topped columns flanking the famous Augustan altar of the three Gauls from Lugdunum (depicted on imperial coins BMC 550 and RIC 230). Lamps were so important to the cult ritual of Isis and Serapis that their temples maintained a staff of lamp lighters (Zografou 2010: 271). Isis Pelagia or Euploia was worshipped as the deity of navigation and seafaring.

Lead Mirror Frames

Fifty-eight small round mirror frames and four square decorated ones were found together, indicating that they had all originally been stored in a single container. The frames survived better than the mirrors themselves, of which only one piece was found. All the round frames have the same diameter (5.5 cm) and decorations. The square frames are similarly sized and decorated with small heads in each corner, depicting Pan with a shepherd's crook (*pedum*) and Dionysus with a thyrsus. Similar lead frame mirrors have been found at Caseggiato di Diana (the House of Diana) in Ostia, Italy and in several other places (Vinokurov and Treister 2015: 49–53, Figs. 4, 5).

Discussion

The nature of the artifacts and their distribution in relation to the northern breakwater and the shallow rocky reefs to the north of the entrance to Caesarea's harbor suggest the presence of at least one shipwreck, most likely a large Roman merchantman. The location of the large iron anchor with stock attached and the presence of various metal parts of the ship's hull indicate that the ship sank here. The proximity of the reef to the shore and the shallow depth of the site suggest that at its uppermost levels the site has been greatly disturbed by environmental processes over the past two millennia.

However, deeper down, in the area exposed in 2016, the site appears virtually undisturbed. The lack of corrosion of the metal objects suggests that they remained buried since shortly after the sinking, and the corrosion stain visible on the sand surrounding some of the coins (Fig 5D) likewise indicates that prior to the site's exposure in 2016, the artifacts had lain hidden and undisturbed for centuries.

The size and weight of the anchor and the size of the nails suggest that the ship was likely a medium–large merchant ship, 20–30 m long, bearing a cargo weighing between 75 and 200 tons. Roman merchant ships were predominantly small, most with an overall length of 15–37 m and a capacity of 100 to 150 tons (Casson 1973: 171–172; Parker 1992: 26–27). Merchant ships were built to transport large cargos over long distances at a reasonable cost, and for this, speed and maneuverability were not a priority. Typical Roman merchantmen had a length to breadth ratio of the underwater hull of about 3:1, employed double planking, and relied on ballast for additional stability.

This 4th-century ship was probably similar to the type and size of merchantman depicted in the contemporary Lod mosaic (Hadad and Avissar 2003), or the earlier "Torlonia relief" displaying a large merchant ship entering Portus (Blackmann 1982: 83, Fig. 2; Casson 1973: 174, Fig. 144). Based on the many objects from the cargo of the Caesarea ship originating from the region of the Bay of Naples, the ship likely began its final trading voyage from Italy.

The ship foundered just outside the north-facing entrance of Caesarea's outer breakwaters and was pushed shoreward onto the coastal reefs and edge of the northern breakwater before breaking apart and scattering its cargo over a wide area (almost 40 × 60 m). The damage to the main anchor suggests a final struggle to hold the ship off the rocks in violent seas—which makes sense for a ship attempting to enter the safety of the harbor, but missing the narrow entrance. It is also possible, however, that the ship was leaving trying to leave Caesarea after having picked up additional cargo when it ran into trouble just outside the harbor. We know that the outer breakwaters of Caesarea had fallen into disrepair by the 4th century, and it is possible that in rough conditions a large ship would have been safer heading for the open seas than relying upon the limited shelter available at the port.

The cargo of raw glass was surely Levantine in origin, perhaps collected at one of the Phoenician ports to the north of Caesarea, if not at Caesarea itself. The fact that so much of the ship's precious bronze and glass cargo was never recovered indicates that these items were quickly buried by sand—perhaps in the same stormy conditions that claimed the ship.

Until the discovery of this ship's cargo with fragments of at least five bronze sculptures, no life-size or colossal bronze sculpture had ever been found at Caesarea in either land or underwater excavations. This is in keeping with the broader picture in Roman Judaea, where there is a dearth of epigraphic and archaeological evidence for the kinds of civic and imperial honorific bronze statue groups that were ubiquitous in other cities of the eastern Roman Empire, and there is virtually no identifiable civic or imperial portrait (Vermeule and Anderson 1981: 12). At present we cannot determine whether the statue fragments were loaded on the ship or originated in Caesarea itself, or whether they came from some other city inland or on the ship's route. It is perhaps worth mentioning evidence of Jewish involvement in the scrap-metal trade from three centuries later: Constantine Porphyrogennetos mentions a Jew of Edessa who purchased the fallen bronze colossus of Rhodes for scrap in the 7th century and had it carried away on 980 camels (De Administrando Imperio 20–21).

A variety of circumstances could explain the statues being broken up and sold for recycling. The statues might have been damaged in earthquakes, war, or local unrest—all frequent scenarios in the eastern Mediterranean during the political and religious strife and civil wars of the early 4th century. The cargo of the Caesarea shipwreck illustrates the final fate of the bronze statues so widely attested only by their surviving bases and dedicatory inscriptions in the Roman Near East. The identity and original location of the statues may perhaps be determined through further investigation. The scrap bronze cargo also illustrates the international transport of scrap metals and helps build a picture of the variety and complexity of maritime trade in the eastern Mediterranean during the Late Roman period.

Roman glass production was apparently divided between primary workshops (where glass was prepared as raw glass ingots) and secondary workshops (where the glass was formed into objects or vessels); there was also a flourishing trade in the reuse of cullet. To date, only a small number of primary workshops have been located, mainly along the eastern Mediterranean coast, in Israel and Egypt (Gorin-Rosen 2000: 52–56). The raw glass of the Roman Empire was mostly produced in the Near East and Egypt, where high-quality sand and soda were easily obtainable. Raw glass ingots were traded via sea to the secondary workshops, and shipwrecks can thus provide valuable information regarding the size and organization of the glass trade, which reached its technical apogee in the Late Roman period.

There are only a few Mediterranean shipwrecks that have yielded larger quantities of glass than the Caesarea wreck (Fontaine and Foy 2007; Radić Rossi 2012: 17–30); the Caesarea site is the largest Late Roman example. On the basis of the dispersal of glass ingots in the eastern part of the site and the absence of ceramic sherds or pithoi, the glass was probably stacked in baskets or barrels that have not survived.

The 4th-century Caesarea shipwreck offers many insights into the nature and scale of international maritime trade during the Late Roman period, at a time when the eastern part of the empire was transitioning out of a long period of economic and political chaos into a brief era of relative security and stability. The size of the wreck and the diversity of its surviving cargo provide a detailed snapshot of that world on the day the ship foundered. That said, investigation of the site to date has necessarily been limited to visual and acoustic survey and to the salvage excavation of artifacts exposed in a highly dynamic coastal surf zone. While the site is temporarily reburied, the analysis and conservation of the recovered cargo will continue for years to come. The complete excavation of the Caesarea shipwreck will be a task for the future—if and when the sea decides to uncover it once again.

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