A Ninth-Century Arab Shipwreck in Indonesia

THE FIRST ARCHAEOLOGICAL EVIDENCE OF DIRECT TRADE WITH CHINA

Michael Flecker

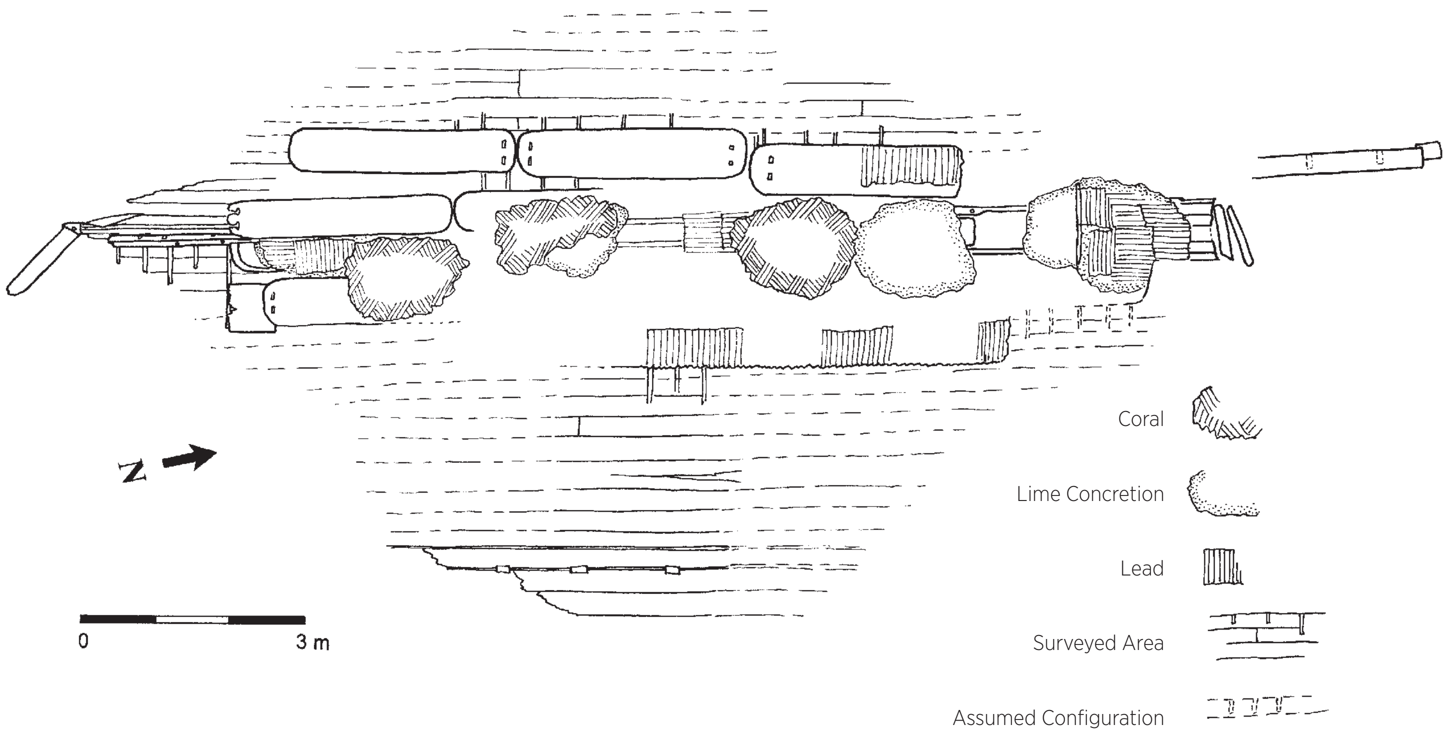
In 1998, an Indonesian sea-cucumber diver stumbled across a mound of ceramics—primarily bowls and ewers—on an otherwise flat, featureless seabed (figs. 22, 72). The distinctly colored ceramics were readily identified as originating from the Changsha kilns of Hunan province, China, which were in operation during the Tang dynasty (618–907). Indeed, the earliest known dated example of Changsha ware (not part of this cargo) bears an iron-oxide inscription that reads *kaichen san nian jou yue* (the third year of Kaicheng era), equivalent to 838.[1]

The sea-cucumber diver and his companions sold the position of the site to Seabed Explorations GBR, a German company that held a survey and excavation license issued by the Indonesian government. The company carried out excavation work in September and October of 1998. Work was suspended during the northwest monsoon and recommenced in April 1999. The author directed the excavation during the second season.

The fact that this very significant wreck was found only recently is surprising. It lies a mere 4 nautical miles north of the main town and port of Belitung Island, Tanjung Pandan, and less than 2 nautical miles offshore, in position 2° 41' S, 107° 35' E (see map on pp. 2–3). The depth of the site is only 17 meters, with reasonably clear water over a silty sand seabed. The mound was more than a meter above the surrounding seabed level, with several coral conglomerates standing above it. The hull remains were approximately 1 meter below seabed level or 2 meters below the top of the mound. The area is frequented by fishermen and sea-cucumber divers but is clear of commercial shipping due to an extensive reef system.[2] Batu Hitam (Indonesian, meaning "Black Rock"), a reef just 150 meters to the northwest of the wreck site, was more than likely the cause of the loss.

Approximately two-thirds of the ceramics cargo was recovered during the first season of excavation. The site was gridded, and records were kept of the ceramics recovered from each grid square. During the second season, a new grid was installed parallel to the longitudinal hull remains. The original skewed grid had been damaged during the monsoon, although it remained sufficiently intact to correlate with the new grid. Large coral conglomerates and lime-based concretions, which entrapped lead ballast ingots, made it impossible to record the hull in its entirety (fig. 73). Despite these limitations several key areas were recorded in detail, while many others were documented on film and video. Timber samples from most of the main structural elements also were taken for identification.

The construction technique was immediately evident. Every timber was fastened with stitching, with no sign of wooden dowels or iron fastenings. This was the first suggestion that the vessel was from the western Indian Ocean. The later discovery of through-beams reinforced the supposition, and identification of timber samples removed all doubt. This is the first ancient Arab shipwreck to be found and excavated. Its cargo of Chinese ceramics and its location in



Indonesian waters provide irrefutable archaeological evidence that there was direct trade between the western Indian Ocean and China during the latter part of the first millennium.

While Arabia and Persia certainly must be regarded as two distinct and independent trading nations, it is impossible to differentiate between ancient Arab and Persian ships based on historical evidence. Indeed, it is very difficult to differentiate between Near Eastern ships and those of India as the interaction and interinfluence across the Arabian Sea was so great. Therefore, for the sake of convenience Arab and Persian are both incorporated in the term "Arab" in this essay, unless clearly stated otherwise.[3]

The Ship

The hull remains are extensive and relatively well preserved (fig. 78). The 15.3-meter-long keel is believed to have survived intact. The bow, inclusive of a section of the stempost, heads 170 degrees. Much of the hull and cargo have collapsed to port, which makes theoretical reconstruction problematic. At the widest point, the hull extends 5.1 meters to port from the ship's centerline.

KEEL, KEELSON, AND STEMPOST

Due largely to the lead ballast and lime-based concretion, the keel could be observed only at the bow (figs. 75–77). There is no sign of any cant. Rather, it runs level to the prow where it rises slightly to fit the stempost at a horizontal mortise and tenon joint, which facilitates alignment and prevents lateral movement but otherwise lends little strength. Strength is provided to

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Fig. 72 In 1998, sea-cucumber divers stumbled upon a coral-covered conglomeration of bowls and other objects from the Belitung cargo.

ABOVE

Fig. 73 Shipwreck structural layout.

some extent by stitching with 1.6-centimeter diameter rope but mostly by the stitched-in hull planking. The plank edges are chiseled to shape the correct angle and butted directly against the flat surface of the keel and stempost (fig. 92). Diagonal holes at 5- to 6-centimeter spacing provide for the stitching.

There is a keelson or at least an Eastern equivalent (fig. 78), which is essential for providing longitudinal stiffness to the vessel. Part of it is exposed near the bow, although it has been displaced to port and lies at a 45-degree angle (fig. 79). Two shallow circular recesses have been cut into its upper surface and contain remnants of a lime compound. They closely resemble good-luck *baosongkong* found on Chinese ships.[4] However, there is no evidence that this practice was followed by Arab shipbuilders. They could have formed the base of light stanchions, a theory that is reinforced by another timber found loose on the site, which otherwise proves enigmatic.

In Western ship construction, large iron bolts clamp the keelson rigidly in place, effectively creating an integral stiffening piece. Without stout fastening, the keelson is of little use other than as a support for the ceiling timbers.[5] No rope holes were observed on the *in situ* keelson; however, one hole was recorded near the end of the scarf joint of the loose stringer (a longitudinal stiffening timber that parallels the keelson).[6] It seems that lashings must have passed over the keelson and under the frames to hold it firmly in place. None of those lashings have survived, but there are two 6-centimeter-wide indentations on the upper edge of the visible keelson section, which may have been caused by large ropes.

CEILING

The ceiling of this ship is a far cry from that of a Western ship, but the purpose is similar so the terminology remains appropriate in this context. The ceiling timbers are, in fact, large slabs of wood that have been placed across the vessel as a supporting bed for the lead ballast and cargo (fig. 80). There are as many as five ceiling timbers across the ship and four along the ship's length. They range in length from 2.8 to 3.08 meters, in width from 46 to 65 centimeters, in thickness from 5 to 6 centimeters, and have rounded ends. Most of the timbers have a pair of small rectangular holes at each end, although some have the holes at one end only.

The author is of the opinion that these ceiling timbers were removable. The primary evidence for this is the large quantity of neatly stacked ceramic bowls found well under the timbers. A few stacks could be easily explained by cargo shifts during the wrecking process. But these bowls were stacked several layers deep and under the inner ceiling timbers. Furthermore, they were stacked just high enough to fit beneath the ceiling. They may have been stowed prior to installing the ceiling. The pairs of holes in the ends of the timbers provide the only points for lashing, but none was observed. Perhaps the ceiling timbers were simply held in place by the weight of the cargo. The holes would have facilitated handling in the harbor and may have encompassed a rope handle.

HULL PLANKS AND FRAMES

The hull planks are typically 4 centimeters thick and vary in width from 20 to 40 centimeters. Marks on the plank surfaces clearly indicate that they were sawn. They are stitched edge-to-edge with rope passing through holes at 5- to 6-centimeter spacing. Wadding material was placed under the stitching both inside and outside the hull. The frames vary markedly in size, shape, and spacing in an almost haphazard manner. Toward the middle of the ship the ceiling timbers sat directly on the frames, but the load was shared by dunnage (packing material), in the form of branches, that was placed between the hull planks and the ceiling in several places. A limelike sealing compound was found on the plank edges and along the joints.

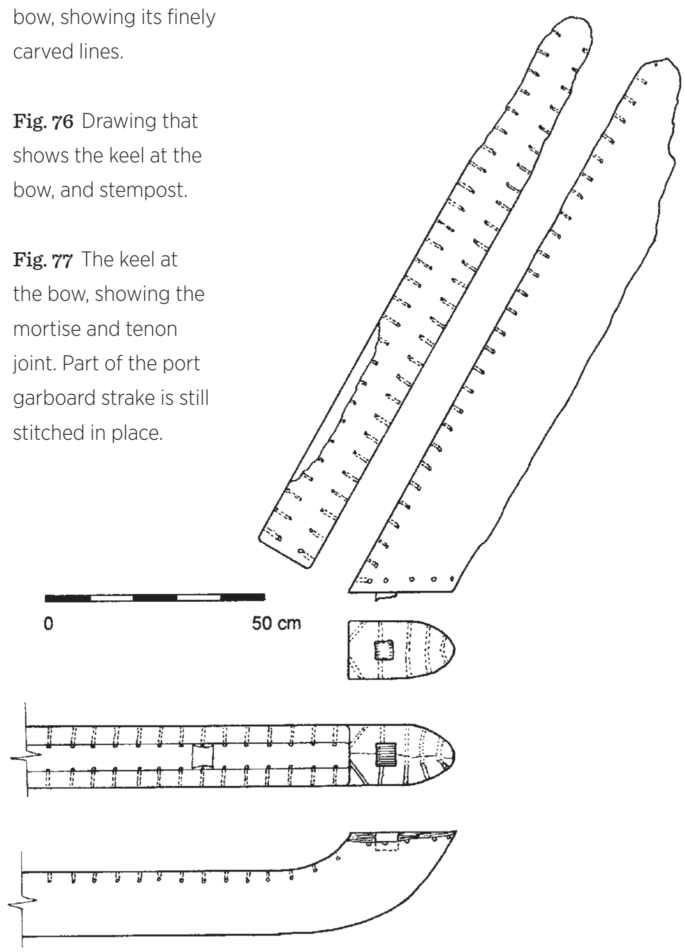
Fig. 74 Neat stacks of Changsha bowls exposed deep within the wreck mound.

CLOCKWISE FROM TOP

Fig. 75 The keel at the bow, showing its finely carved lines.

Fig. 76 Drawing that shows the keel at the bow, and stempost.

Fig. 77 The keel at the bow, showing the mortise and tenon joint. Part of the port garboard strake is still stitched in place.



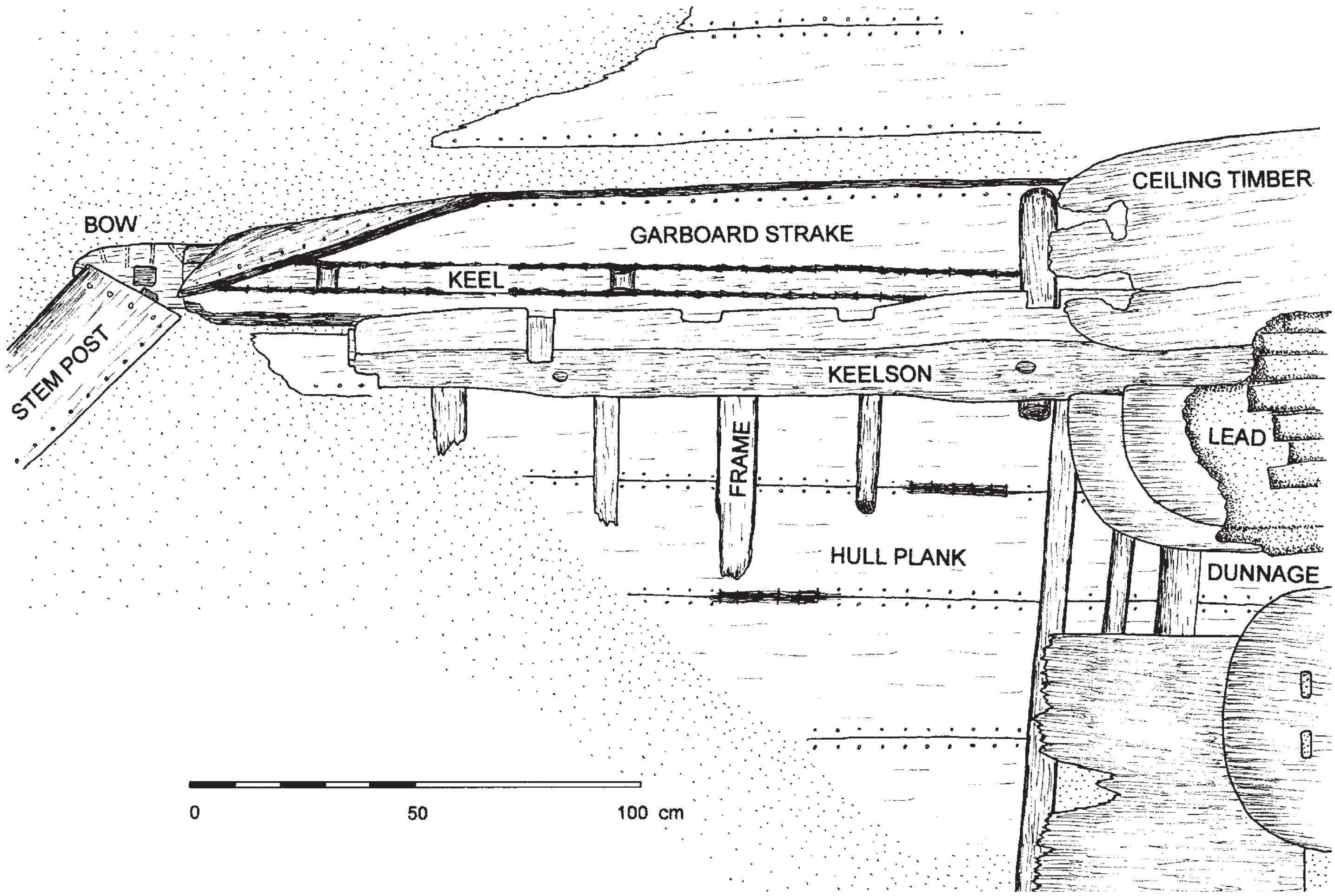


Fig. 78 Detail of the hull remains near the bow.

HULL FORM

Since the stitching rotted away relatively early in the wrecking process, the hull collapsed onto a flat seabed before there was time for sediment to build up around it. Consequently, there is no cross-sectional data to work with, and the hull form must be deduced.

Because it is clear where the hull planks terminate, the keel length of 15.3 meters can be stated with some confidence. Iconographic and ethnographic evidence can be called upon to determine that the vessel was more than likely double-ended, and the stern was probably vertical. This being the case, it is possible to deduce a length overall (LOA) if the molded depth (distance from top to bottom) is known. The coral conglomerates stand 0.5 to 1 meter above the original mound level, which was up to 2 meters above the hull timbers. They encompass ceramics even near the upper surface, an indication of how high the cargo was stowed. It is therefore reasonable to assume that the molded depth was on the order of 2.5 meters, and the depth to the base of the keel could have been approximately 3 meters. From a scaled drawing, this gives a waterline length of approximately 16 meters. The extremities, particularly the stem, are likely to have extended well above deck level, so the LOA could have been on the order of 18 meters.

The hull structure is also extraordinarily light. It is similar in these respects to the thirteenth-century Chinese junk known as the Quanzhou ship, although that was significantly heavier and larger than the Belitung wreck. Green says of that ship, “[it] was a rather broad-beamed, but shallow drafted ship; seemingly designed to carry a relatively light cargo and to sail lightly over the water rather than drag a deep and capacious hull through the water."[7] These comments seem to be quite apt for the Belitung wreck as well.

ANCHOR

The anchor was constructed from iron and wood (see figs. 84–85). Only the lower end of the wooden shank survived, and one of the iron arms is broken, but otherwise it remained in good condition. The arms protrude straight outward and are separated vertically by a heavy iron bell-shaped disk, which has a hole through the center. It is not at all clear how the arms were attached to the disk. The disk is a form that lends itself to casting, while the arms are thought to be wrought iron. The connection of these two materials is very problematic because cast iron cannot be welded to wrought iron. There also is an interesting link to China, which was the only place with the technology to cast iron at the time. Perhaps China supplied the anchor for the Belitung ship, although it is not a Chinese design.

LEAD BALLAST

Lead ballast ingots, weighing approximately 10 metric tons, were stacked on the ceiling timbers the full length of the ship (fig. 87). They flanked a large lime deposit that entrapped many ceramics. While varying a little in size, the ingots typically measure 40 centimeters long by 5 centimeters wide by 2 centimeters high and are half-round in section. The average weight of each ingot is approximately 4.5 kilograms. Much of the lead ballast was concreted in place by the lime compound and therefore could not be recovered.

The lead could be paying ballast—that is, it served the role of ballast but would have been unloaded and sold at the final destination. The reasons for this assumption are twofold. First, bowls were stacked beneath the ceiling and therefore beneath the lead. Both ceiling and ballast had to be removed to unload the bowls, a backbreaking task that would not be performed just for the sake of cramming in a few extra low-quality ceramics. Second, a green-ware jar was found to contain nine lead ingots of the same shape as the ballast ingots, although they had been cut in half. The ingots, therefore, had export value. China is known to have been a lead producer. Lead was used as a major alloying element in the manufacture of coins when the cost of making bronze coins became prohibitive.

The Cargo

CERAMIC CARGO AND STOWAGE

Nearly the entire surviving cargo of the Arab ship consists of Chinese ceramics. Some 60,000 pieces have been recovered. The breakage level was relatively low, perhaps 20 percent, so the original ceramics cargo would have been on the order of 70,000 pieces. The vast majority of the ceramics is in the form of bowls. There are also many large storage jars, but the additional weight of these is offset by many tiny jarlets. The weight of the ceramic cargo, therefore, can be roughly estimated. Each bowl weighs approximately 0.35 kilograms, giving a total ceramic cargo weight on the order of 25 metric tons.

The quality varies from the most basic utilitarian ware to some of the finest white ware produced at the time. The ceramic cargo is the subject of special studies elsewhere in this book, so provenance and style will not be discussed in detail here. Of more relevance is the stowage pattern.

Changsha Ware

The very distinctive underglazed copper- and iron-decorated ware of the Changsha kilns dominates the cargo. Bowls make up the majority, followed by ewers, jarlets, and a variety of less common forms.

Fig. 79 A curved frame underlying the keelson, which is canted 45 degrees to port.

Fig. 80 The ends of two ceiling timbers supported by frames. Hull planks in the foreground bear imprints of upturned bowls.

OPPOSITE

Fig. 81 These lead ingots were stored inside this medium-sized jar.

The bowls were stacked in the hull adjacent to the ceiling timbers, presumably packed in straw "cylinders." Bowls also were stored inside large green-glazed storage jars (fig. 47). As many as 130 bowls could be stowed inside a jar when packed in a helical fashion. Interestingly, many jars of the same type and in the same area did not contain anything at all, implying that they originally held liquid or perishable goods. The jars had fallen to both sides of the ship's centerline, but originally they probably were stowed on top of the lead ballast ingots. Most of the bowls, and the jars containing bowls, were recovered from the center of the boat and aft of that.

Ewers with molded decorations in relief tended to be stowed forward and were stacked together with no sign of packing material remaining. Tiny jarlets were found scattered about and probably were stowed among the other wares where space allowed. A quantity of small open-mouthed jars with two lug handles was stowed together, and many remain there, firmly adhering to the lime compound (fig. 83).

Green Wares

A limited quantity of pieces from the Yue kilns of Zhejiang province, mostly round and square dishes, were recovered in the stern area. Two vases with four lug handles and an incised double-fish decoration are also Yue-type ware. Several large basins with six lug handles around the rim have the same glaze as the storage jars and therefore are thought to have originated from the same kilns. Certain shallow bowls were of sufficiently low value to be stowed beneath the ceiling timbers, where there must have been a degree of breakage (fig. 86).

As has been mentioned, many storage jars were used to stow Changsha bowls. Others of the same size must have contained a perishable substance. There are a number of green-glazed jars that are bigger still; one has a short spout near the base, an obvious sign that it held a liquid. Smaller green-glazed jars have a small spout between two of the four lug handles. Many of these remain entrapped in the lime compound. One of these jars was found to contain nine lead ingots, and several were still full of star anise (fig. 11).

White Ware

The white ware is of high quality and includes different shaped cups, lobed saucers for cups with inverted rims, and bottles with four small lug handles. They are thought to derive from the Xing kilns of Hebei province or the Gongxian kilns of Henan province, which are famous for their exquisite products. As with the other valuable items, these pieces were recovered from the stern of the ship.

Blue-and-White Ware

While the earliest production of blue-and-white ware has long been debated, several kiln finds have now shown that it was produced, at least in experimental form, as early as the Tang dynasty. Three distinctively decorated dishes—with a simple foliage design around one or two squares containing flowers—from the Belitung wreck are the earliest known intact examples of blue-and-white ware. Thought to be decorated with Persian cobalt and produced at the Gongxian kilns, they were recovered from the stern area of the ship during the first season of excavation.

Green-splashed Ware

High-quality white and green stoneware, from the northern kilns of Hebei, Henan, and Shanxi, was found in limited quantities in the stern area. Included are fine green-glazed wine cups modeled on metal ware, a large covered box, lobed dishes and bowls, and a unique ewer with a high stand, well-rounded body, tall neck, double-strap handle incorporating a snake, and a matching lid in the form of a dragon's head.

NON-CERAMIC ARTIFACTS

Only a few non-ceramic artifacts can be regarded as items of general trade. The rest consist of items for personal trade or tribute, personal belongings, ship's gear, and provisions. Although found in relatively small quantities, the following artifact types can be regarded as general trade items: cast-iron vessels, copper-alloy bowls, grindstones, and lime.

Cast-iron vessels occurred in a variety of forms—including cauldrons and woklike vessels—and sizes but were all heavily concreted, the metallic iron having completely rusted away. Since China was the only producer of cast iron at the time, it is no surprise to find these vessels as part of the cargo.[8] The thirteenth-century Chinese chronicler Chau Ju-Kua mentions that Chinese tripod cauldrons were imported by two places, one of which is thought to be in the Philippines and the other in Java.[9] The only other identifiable iron artifact was a parang, or machete. The wrought-iron blade has disappeared, but the wooden handle remains in part, under a layer of lime compound.

Copper-alloy bowls were found in stacks and, unfortunately, are badly corroded. Two copper-alloy handles that were once riveted to a large cauldron also were recovered.

Several grindstones were discovered toward the stern, and several more remain concreted in the lime compound. Two sets remained together, face to face, while the others were scattered. A whitish, crumbly, rocklike substance, found on the wreck in discrete scattered lumps, was initially thought to be alum, the most common type of which is a double sulphate of potassium and aluminum. It typically is used as a dying mordant for textiles and has been a major Chinese export up to recent times.[10] Chemical analysis of this substance, however, clearly shows that it is not alum but rather an aluminum oxide–rich mineral of unknown use.

The lime compound that entraps a large portion of the lead ballast ingots and many ceramics (fig. 72) is somewhat enigmatic. Had it just covered the ingots, it may have been regarded as an intentional cementing process, although the lead is assumed to be a paying ballast. But because it also entraps a portion of the ceramics, there is no doubt that the lime compound originally formed part of the cargo and, during the wrecking process, flowed out before hardening. A very similar phenomenon was observed on a sixteenth-century Thai shipwreck, where bamboo partitions and ovoid storage jars were entrapped in lime.[11] One would expect this material to have been stowed in the ceramic storage jars, but there was no evidence of this. Perhaps it was stowed in woven baskets or textile bags. Used by Chinese shipbuilders to fill seams and cover recessed iron fastenings, a lime compound also was observed in the seams of the Belitung wreck.

Gilt silver ware may have been an item of private trade or perhaps was intended as a tribute gift. While three long-handled spoons were found scattered around the stern, all of the silver vessels were concentrated in a very small area. The rims and walls of most have suffered badly, but the bases, while extremely fragile, often remain intact. It is interesting that several high-quality green-splashed wares and white-ware ceramics were excavated adjacent to the silver ware. A pair of intricately embossed plates with tripod feet was found, as were a number of silver-covered boxes, including a large one that contained four small boxes, and a large silver flask with a pivoting handle.

Chinese bronze mirrors comprise another high-value item that probably was intended for private trade. Twenty-nine were recovered, some with the famous lion-and-grape design of the Tang dynasty. One tiny blue glass bottle was recovered, very similar to a ninth- or tenth-century Near Eastern bottle found at Laem Po, Thailand.[12] Strangely, this bottle and two stoneware jars are the only artifacts that are of probable Near Eastern origin. The only evidence of armament consisted of approximately thirty highly degraded wooden shafts protruding from two fragile concretions. They were originally two bundles of iron-tipped arrows.

Considerable quantities of star anise (*Illicium verum*), found inside green-glazed jars and scattered throughout the wreck site, must have been an export item. The plant is native to southern China and Vietnam.[13] Its eight-pointed star-shaped pods are a spice often used in curries and are thought to have medicinal properties.[14]

Fig. 82 Changsha bowls stacked longitudinally and overlying a frame. More bowls were stacked on top of these.

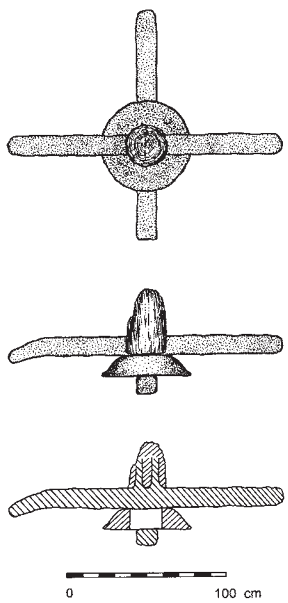
Fig. 83 Small glazed jars entrapped in the lime compound.

RIGHT, CLOCKWISE FROM TOP

Fig. 84 Drawing of composite iron and wood anchor.

Fig. 85 The composite wood and iron anchor sitting upright on the seabed.

Fig. 86 Poor quality green-glazed bowls stacked between hull planks and ceiling timbers.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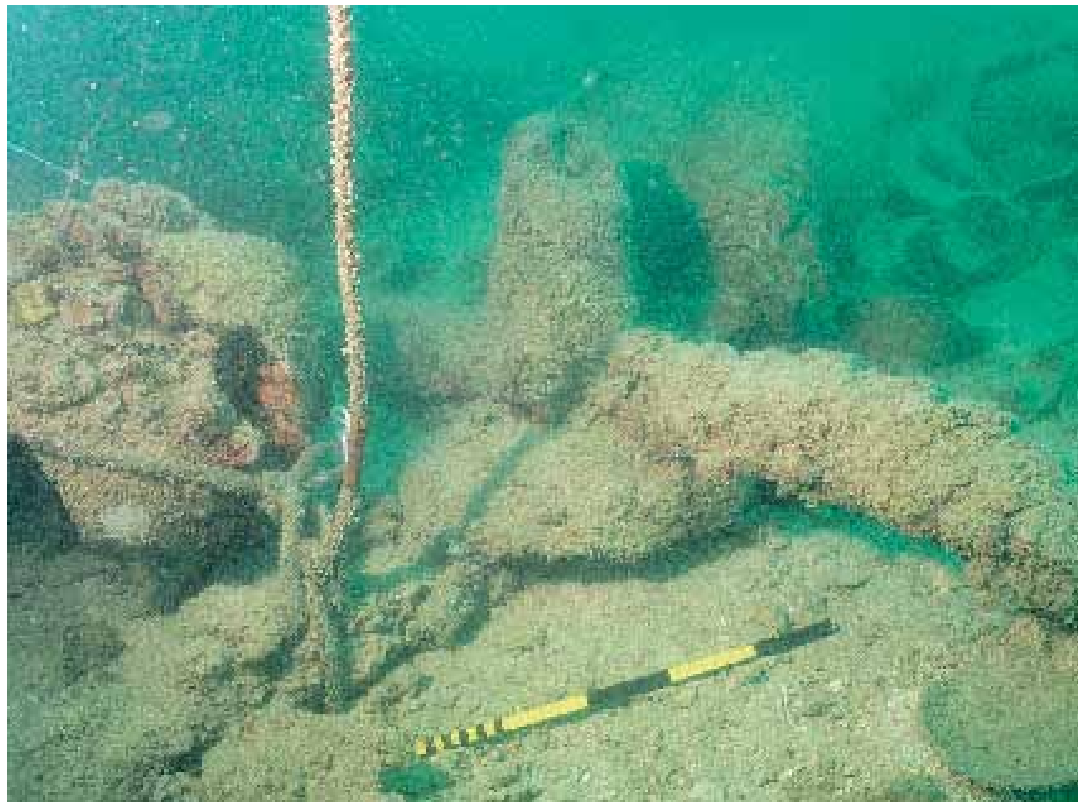

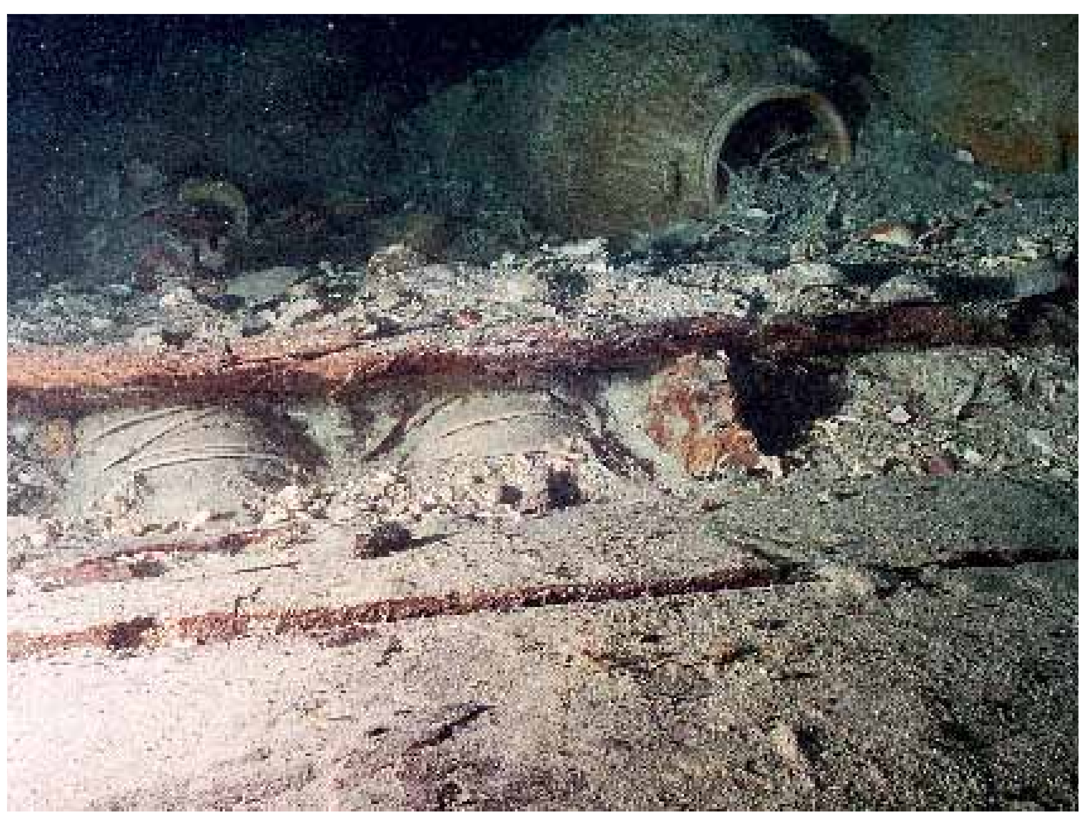

Several small chunks of aromatic resin present something of an enigma. Macroscopically and in scent, they strongly resemble *styrax benzoin*, the aromatic resin that was a major export item from Sumatra to China, replacing the frankincense and myrrh once obtained from the Near East. It is hard to imagine why Sumatran aromatics would have been shipped to their original source, unless it was for use aboard ship. If the recovered resin was indeed a Near Eastern product, then it may have been the remnants of an outward cargo.

Several fragments of worked wood were found beneath the exposed keelson. Some of them appeared to be wood chips left over from the building of the ship, but one had been worked into a pointed end. One other piece is pierced with holes and the remnants of wooden dowels, suggesting that it was part of a box. Toward the stern of the ship, a reasonably intact wooden box was found. The contents must have been perishable, for nothing but sand was found inside.

An Arab Ship in Indonesia?

This shipwreck has the potential to prove that Arabs traded directly with China as early as the ninth century. To establish this, it must be concluded, beyond a reasonable doubt, that the ship was indeed an Arab vessel and that the cargo of Chinese ceramics was destined for the western Indian Ocean. The final destination is not as important. The mere presence of an Arab ship with a Chinese cargo at the southernmost extremity of the South China Sea is momentous enough.

THE SHIP'S ORIGIN

The origin of the ship can be determined from three interrelated factors: construction technique, hull form, and construction materials. The construction technique can be studied in relation to ethnographic information, i.e., traditions that have persisted to this day, and historic records, which occasionally give detailed descriptions. Hull form can be studied with respect to ethnographic and iconographic data, but the subtleties between forms make textual records difficult to interpret. Construction materials allow for a more scientific approach. Timber species can be identified and correlated to geographical distribution. However, the scientific approach must be combined with historic records for, in the case of Arab ships, much of the timber is reported to have been imported from India.

Looking at construction technique and hull form first, the key features of the Belitung wreck are as follows: cross-stitched seams, with wadding inside and out; no dowels used for edge joining; a sharp bow that is only slightly inclined; stitched-in frames; through-beams stitched to the hull; an iron and wood grapnel-type anchor; removable ceiling timbers; a keelson; and stringers. The latter two features can be disregarded as they have not been associated with any ancient vessel under consideration.[15]

For comparison, ocean-going Chinese ships of the early second millennium featured the following: a transom (flat) bow; bulkhead construction (not necessarily watertight); iron fastenings; an axial rudder; and sometimes multilayered planking. Without going any further, it is clear that the Belitung wreck is not of Chinese origin. Ships that were constructed by what Manguin appropriately calls the South China Sea Tradition have bulkheads, planks edge-joined with dowels and fastened to bulkheads with iron nails, and an axial rudder; are multiplanked; and usually are built from teak.[16] Furthermore, they are not thought to have developed until the fourteenth century. Lashed-lug ships of Southeast Asia, which are well known from archaeological evidence, come closest to the wreck type, but even that is not very close at all. The earliest example, found at Pontian on the Malay Peninsula, has been dated to around the middle of the first millennium.[17] But while this type of vessel is stitched, the manner of construction is distinctly different from that of the Belitung wreck.

The task then remains to determine whether it is Arab or Indian, which is made difficult by a complete lack of archaeological evidence of ships of these regions.[18]

Deloche states that not a single ancient shipwreck has been discovered near the Indian shores in the Arabian Sea or in the Bay of Bengal.[19] He relies largely on scanty iconographic evidence to examine the evolution of Indian shipbuilding. The only evidence of stitched-hull construction is provided by two small riverine craft depicted on first- and second-century BCE monuments at Bharhut and Sanchi (in India) and a larger vessel carved on a twelfth-century memorial stone found near Eskar, also in India. The stitching is visible on the outside of the hull and therefore penetrates right through the hull planks.

According to Hourani, fully stitched construction was observed by ancient and medieval writers on the Red Sea, along the East African coast, and in Oman, the Gulf, the Malabar and Coromandel coasts of India, and the Maldive and Laccadive islands.[20] It remains unclear whether this tradition emerged from the east or the west side of the Arabian Sea. Stitched-hull construction was the only technique used by both Indians and Arabs until iron nails were introduced by the Portuguese.[21] The twelfth-century memorial stone clearly shows a ship with an axial rudder, suggesting that Indians began to replace quarter rudders with the far superior axial rudder at about the same time as the Arabs. The Chinese are perhaps responsible for the introduction to both.

Deloche summarizes the characteristics of pre-European influence, ocean-going Indian ships based on pictorial evidence.[22] They were double-ended craft. After the eleventh century, a long projecting bow replaced a less-raked stem. Hulls were carvel built (i.e., the planks did not overlap), with the stitches crossed and penetrating right through the planks.[23]

Arab vessels are mentioned in the first- or second-century *Periplus*: "from Omana local sewn boats called *madarte* are exported to Arabia."[24] In the same chapter, there is mention of the cargoes brought to Arabia and Persia, including timber balks and beams of shisham, which may have been imported for shipbuilding. In the sixth-century work of Procopius, the ships used in the Indian seas "are not covered with pitch or any other substance, and the planks are fastened together, not with nails, but with cords."[25] The thirteenth-century account of Marco Polo is less than complimentary: "The vessels built at Ormuz [Hormuz] are of the worst kind, and dangerous for navigation, exposing the merchants and others who make use of them to great hazards."[26] The planks are fixed with wooden dowels and then stitched "with a kind of rope yarn stripped from the husk of the Indian nuts [coconuts]." On anchors, Marco Polo comments, "they have no iron anchors, but in their stead employ another kind of ground tackle; the consequence of which is that in bad weather they are frequently driven on shore and lost."[27]

Some historians believe that traditional Arab ships were built primarily from teak or coconut.[28] The teak, arguably the best wood for shipbuilding, probably was imported from India. Coconut wood also was imported from India and the nearby island groups [29]; it is heavy-grained and not particularly strong. Burkhill, however, comments that the wood lasts fairly well and better still if soaked for a few months in seawater.[30] The palm trees and cypresses that grow around the Gulf generally were not suitable for ship's timbers.[31]

The hulls were put together in the simplest manner possible. First, the keel was laid on the ground; then horizontal planks on each side were fastened to it and to each other by means of stitches of fiber.[32] Unlike the stitches in early Indonesian lashed-lug craft, the stitches of Arab vessels pass right through the planks and can be readily seen on the outside of the hull. Early illustrations of this include one of the Sanchi sculptures of the second century BCE and paintings accompanying al-Hariri's *Maqamat* of 1237 (fig. 6).[33]

Interestingly, there is no evidence of ribs or frames in early sources or in two nineteenth-century models of traditional Arab vessels in the National Maritime Museum, Greenwich.[34] There are, however, long stringers under the stitching on the inside of one of the models. This hardly seems sufficient to stiffen the vessels, particularly as no iron nails or treenails were used in the entire construction.[35] However, during a survey of traditional Omani fishing craft, Vosmer observed that dowels were used for joining, or at least aligning, the edges of stitched planks.[36]

Fig. 87 Lead ballast ingots concreted to two ceiling timbers.

Hourani speculates that stitching, along with the wood used for shipbuilding, may have been introduced to the Arabs by Indians.[37] He also reasons that stitching could have been used first on the available palm wood and later transferred to superior timbers imported from India, or even spread to India itself. Many reasons are given for the use of stitching, right through to the fifteenth century, when iron fastenings finally began to take over, but the most probable are availability of materials, economics, and the force of tradition.

Arab vessels used quarter rudders, much like Indonesian craft. But it is interesting to note that an axial stern rudder had been introduced at the latest by the twelfth century, at the same time it was making an appearance in Europe. There seem to have been one or two masts, with square sails. Arabs are believed to have introduced the lateen rig to the world but at a later date.

Ethnographic evidence of boatbuilding in Oman shows strong parallels with the Belitung wreck.[38] The cross-stitching and through-beam attachment are nearly identical on small craft surviving to this day. Even the hull form of the *batil qarib* illustrated in Vosmer is thought to be similar to the original hull form of the wreck (fig. 89).[39]

The anchor from the wreck should provide more clues, but its materials and form are different from those usually associated with the region and period. So-called Arab-Indian anchors typically have a long stone shank with wooden arms and/or stock.[40] In the last decade of the seventeenth century, Gemelli Carreri noted stone anchors in the Gulf, but metal anchors were perhaps known, as they had been used in the Mediterranean for a long time.[41] The Belitung anchor is quite like one depicted on a thirteenth-century ship painting in the Paris copy of al-Hariri's *Maqamat* from 1237.[42] The *Maqamat* anchor has two arms that cross each other at different levels and, from the color variations in the painting, seems to have a shank of a different material. It lacks the iron disk found on the Belitung anchor, but there is an element protruding below the arms that may serve a similar role, i.e., providing weight.

Ibn Majid, writing in the fifteenth century about Arab navigation but drawing on earlier works, refers to an unknown anchor type as *al-anjar al-siniya*, "the Chinese anchor," and to an iron grapnel as *al-hadid*, which means "the iron."[43] This allusion to Chinese anchors is very interesting if the disk between the arms of the Belitung anchor is indeed cast iron. During the first millennium and well into the second, only the Chinese could manufacture cast iron, so it is possible that the Chinese actually supplied this anchor or at least the cast-iron disk. Yet the design bears no resemblance to traditional Chinese anchors, which were made either entirely of hardwood or iron grapnels.[44]

While the Belitung wreck has parallels with both Indian and Arab ships, from the limited information available it is not possible to determine definitively the origin of the wreck from construction techniques and hull form alone.

In 2007, the author asked Professor Nili Liphschitz of the Institute of Archaeology, Botanical Laboratories, Tel Aviv University, to analyze timber samples from key structural elements of the wreck. In her opinion, the samples were in quite good condition despite being in untreated wet storage for seven years. Drawing on cross, tangential, and radial reference sections, Liphschitz says she has no doubt about the genus identifications and is "pretty confident" about the species.

The stempost, frames, hull planks, anchor shank, and dunnage are an African timber (*Afzelia africana*). The keelson is *Afzelia bipindensis*. The through-beams are teak (*Tectona grandis*), and the ceiling planks are probably African juniper (*Juniperus procera*).

Afzelia africana, as the name implies, is native only to Africa, specifically northeast, east, west, and west-central tropical Africa, including Sudan and Zaire.[45] *Afzelia bipindensis* is also native only to Africa, being found in south, west, and west-central tropical Africa, Zaire being the closest region to the Near East.[46] *Juniperus procera* is native to the mountains of eastern Africa, from eastern Sudan south to Zimbabwe, and to the southwest region of the Arabian Peninsula, present-day Yemen.[47] *Tectona grandis* is the anomaly, being native to India, Burma, Laos, and Thailand.[48]

Teak can be used in almost any part of a vessel and is ideally suited to the critical through-beams. It is durable, strong, of moderate weight, easily worked, and is resistant to the teredo worm. It is specifically mentioned as an early export from India to Arabia for shipbuilding.[49] The keelson also relies on a timber imported from afar. If the *Afzelia bipindensis* originated in the region of Zaire, it could have been transported at least part of the way to a shipyard via the Nile.

Repeated attempts to identify scientifically the twine that held the Belitung ship together have been thwarted by the severely deteriorated condition of the samples. They appear cohesive when dry but turn to mush as soon as they are prepared on a slide. Changmo Sung of the Center for Advanced Materials at the University of Massachusetts did study a small sample of rope under a scanning electron microscope and has tentatively identified it as hemp. Originally native to the Caucasus region of far eastern Europe, northern India, and Iran,[50] hemp certainly would have been available to Near Eastern shipwrights. It is a strong fiber but apparently rots in seawater, making it a questionable choice for stitching twine on which the vessel would rely so heavily.

With a Near Eastern origin looking more and more probable, it is very interesting to note that the wadding that helped keep the ship watertight could have originated in Southeast Asia. It has so far proved impossible to identify the wadding scientifically due to its deteriorated state. However, Shawn Lum, a botanist specializing in tropical forests, and Nick Burningham, a specialist in Southeast Asian boatbuilding, have visually identified the material as paperbark (*Melaleuca*), which occurs only in Australia, Malaysia, Indonesia, and Papua New Guinea. The Southeast Asian swamp-dwelling species *Melaleuca cajuputi* is still used in local boatbuilding as caulking between edge-joined hull planks.[51]

Lum also suspects that the twine holding the Belitung ship together is hibiscus, a particularly strong fiber that is thought to have originated in southern China but spread early to tropical Southeast Asia. Burkill notes that *Hibiscus tiliaceus* (sea hibiscus) was one of the most important fiber plants among the inhabitants of Malaysia, who seemed to have put it to use wherever they went.[52] Lum notes that wherever *Melaleuca cajuputi* is found, *Hibiscus tiliaceus* is never far away.[53]

If the stitching is indeed hibiscus and the wadding is paperbark, there is a ready explanation. It is quite feasible that the Belitung ship, which was lost in Indonesian waters, had been totally restitched in Indonesia using local materials prior to the tragic event. After such a long voyage, from the Near East to China and part of the way back, restitching almost certainly would have been necessary. Systematic unstitching and restitching would permit such a major overhaul without the need to dismantle the ship. As noted by the contemporary John of Montecorvino,[54] "The ships in those parts [Arabia] are mighty frail and uncouth with no iron in them and no caulking. And so if the twine breaks anywhere there is a breach indeed. Once every year, therefore, there is a mending of this, more or less, if they propose to go to sea."

Based on the timber identifications, the Belitung ship was definitely not built in India. It likely was constructed in the Near East, perhaps in the region of Oman, Yemen, or Iran.

DESTINATION

Excavations at the Tang city precinct of Yangzhou have yielded a significant quantity of Tang ceramics such as green-splashed ware, Northern white ware, painted ware from Changsha, green-glazed ware of the Yue type, and even pottery from Persia.[55] These finds, at an ancient Chinese port known to have held a large contingent of foreign merchants, provide a wonderful continuum. Nearly all of the ceramic types recovered from the Belitung wreck were loaded at Yangzhou during Tang times, and the fact that they all occur on one wreck means that they were exported simultaneously.

Tang ceramics have been found in Southeast Asia, the Indian subcontinent, Sri Lanka, the Indus Valley, the Gulf, and the Red Sea; as far inland as Samarra, the Abbasid capital, and Nishapur in Khurasan; as far west as Fustat (old Cairo) in Egypt and Antioch on the Syrian coast[56]; and as far south as the Comoros Islands and Zanzibar.[57] Early finds are particularly abundant at Siraf, the principal Persian port up to the eleventh century. Ceramics in levels predating the great Friday mosque (circa 820) include olive-green glazed jar shards, Hunan stoneware (Changsha), and some white porcellaneous pieces. All of these types, together with Yue celadon, continue in the ninth- and tenth-century levels.[58] Chinese ceramics found at Shiraz indicate that cargoes were distributed throughout the hinterland. The only Arabian port with significant imports of Chinese ceramics was Sohar, on the Gulf of Oman, whose wealth and trading activities rivaled Siraf. Finds from ninth- and tenth-century levels, in fact, reflect those of Siraf.[59]

While Carswell and Lam state that Tang ceramics have been found in India,[60] the quantities must have been small. Subbarayalu, in fact, notes that the earliest Chinese ceramics to be found in southern India date to the eleventh century, with most attributable to the thirteenth and fourteenth centuries.[61] Thus, from archaeological evidence, there is a much higher probability that the Belitung ship was heading for the Gulf.

Of course, there are also significant Tang ceramic finds in Indonesia, notably at Palembang and the Prambanan temple complex in central Java. Perhaps the Belitung ship was purchased by a Chinese or Indonesian merchant and used to transport goods between these two countries. Given the extremely high demand for Chinese ceramics in the Near East, and the larger size and greater strength of Indonesian lashed-lug ships that already plied this route, this scenario seems improbable. But a visit to an Indonesian port is almost certain.

It is unlikely that lead and ceramics formed the only bulk-cargo items on the Belitung ship. Silk was another major Chinese export at the time, largely due to a monopoly on silk production. Spices were very much in demand in the Near East. It is quite possible that the Belitung ship was heading for an Indonesian port to top up its cargo with spices from the eastern archipelago before finally embarking on the long crossing of the Indian Ocean.

One-off artifacts also imply that the ship had visited a Southeast Asian port. These tend to be ship equipment or items belonging to members of the crew or accompanying merchants. Most are Chinese in origin, which is no surprise given that the ship loaded a full cargo in China. They include an inkstone, spoons, a needle, a lacquer dish, a sword handle, cymbals, and tweezers. Perhaps Arab members of the crew developed a taste for things Chinese. Some could have been in China for many years, as there were large Arab contingents living at the main trading ports. Then again, there is a reasonable chance that at least one Chinese merchant embarked on the voyage and took his personal possessions with him.

A grindstone and roller, aromatic resin, a scales bar, scales weights, and a *piloncito* (rough cut and stamped) gold coin have a Southeast Asian provenance, with the coin and weights almost certainly originating from Indonesia. They strongly suggest that the ship called at a Southeast Asian port either on the way to China or on the return trip before it was wrecked. Certainly Palembang was a major entrepôt at the time, and the powerful navy of the Srivijayan kingdom ensured that most passing ships made a call. Furthermore, having crossed the northern reaches of the Indian Ocean and traversed the Strait of Malacca, it is more than likely that the ship would stop to resupply, if not to trade. Of course, there is also strong evidence that the vessel was restitched in Southeast Asia, a major undertaking.

If such a stopover was made, there may well have been a replenishment of the crew. Many centuries later, European vessels would suffer extreme crew losses during voyages. While the journey from the western Indian Ocean to Southeast Asia or China is considerably shorter than the journey to Europe, there was still ample opportunity for decline through disease, malnutrition, battle, and accident. Just as the Europeans did in later times, the Arabs could have taken on a Southeast Asian crew to make up the numbers. Likewise, they could have recruited Southeast Asian pilots who had a sound knowledge of local waters and, perhaps, of the entire route north.

Conclusion

From an analysis of construction methods and materials and hull form, the author has determined that the Belitung wreck is an Arab vessel. The archaeological evidence for the trade in Chinese ceramics indicates that the Near East was the most likely destination for the Belitung ship. Hourani's sweeping statement, "The sea route from the Persian Gulf to Canton was the longest in regular use by mankind before European expansion in the 16th century"[62] certainly seems to hold water.

SHIPWRECKED

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Twelve centuries ago, a merchant ship—an Arab dhow—foundered on a reef just off the coast of Belitung, a small island in the Java Sea. The cargo was a remarkable assemblage of lead ingots, bronze mirrors, spice-filled jars, intricately worked vessels of silver and gold, and more than 60,000 glazed bowls, ewers, and other ceramics. The ship remained buried at sea for more than a millennium, its contents protected from erosion by their packing and the conditions of the silty sea floor. *Shipwrecked: Tang Treasures and Monsoon Winds* explores the story of both the sailors and the ship’s precious cargo through more than 400 gorgeous photographs and essays by international experts in Arab ship-building methods, pan-Asian maritime trade, ceramics, precious metalwork, and more.

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