

THE EXCAVATION
OF THE
PATTAYA WRECK SITE
AND
SURVEY OF THREE OTHER SITES
THAILAND
1982

Jeremy Green
and
Rosemary Harper



Australian Institute for Maritime Archaeology
Special Publication No.1.
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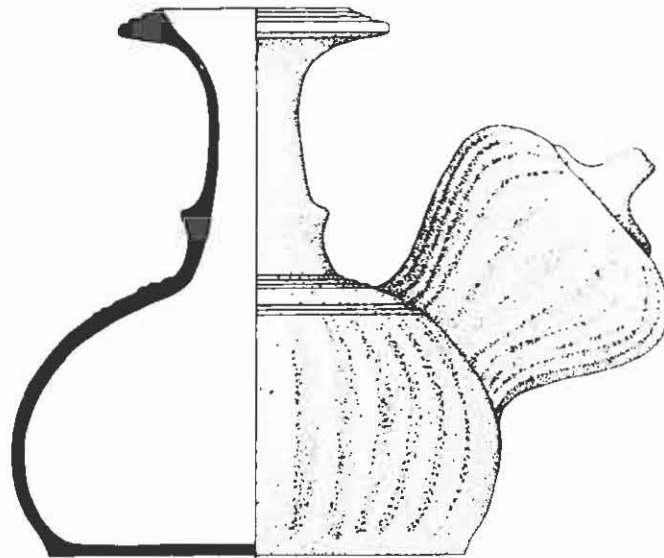
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CHAPTER 1. THE PATTAYA POTTERY WRECK SITE

INTRODUCTION

In January 1982, a joint Thai-Australian team of maritime archaeologists carried out an excavation of a wreck site near Pattaya, in the Gulf of Thailand. The team comprised of staff from the Underwater Section of the Fine Arts Department of Thailand, under the leadership of Vidya Intakosi; a group of four staff members from the Department of Maritime Archaeology and one staff member of the Department of Conservation and Material Restoration from the Western Australian Maritime Museum; three other Australian volunteers; and one American volunteer from the American-based Institute for Nautical Archaeology.

The excavation was part of a three-year program to investigate wreck sites in the Pattaya area in conjunction with the Fine Arts Department, as part of a National Research Council of Thailand project, see Green & Harper (1982b), and Green & Intakosi (1983).

The site, known as the Pattaya Pottery Site, was first discovered in about 1976 by sports divers, and has been the subject of continual looting ever since. Howitz (1977) reported that:

"to a very large extent treasure-hunters had already looted valuable and good-quality items, and had, as well, seriously damaged the remains of the ship itself. There is evidence that they had used explosives to enter the cargo compartments, and an airlift to blow away the mud and sand."

In 1979 the co-author (Green) visited the site and noted divers working on the site with an induction water dredge. At that time, extensive hull structure was noted protruding from the sand in a number of places. As a result of this inspection, and because of the promising hull structure, the site was selected for excavation.

THE WRECK SITE

The Pattaya wreck site lies approximately midway between Ko Lan and Laem Pattaya near the group of rocks called Hin Ko Lan (Fig.1). It is on the direct tourist boat route to the coral areas west of Ko Lan, and as such, makes an ideal spot for tourist diving. This explains, to some extent, the deteriorated state of the site.

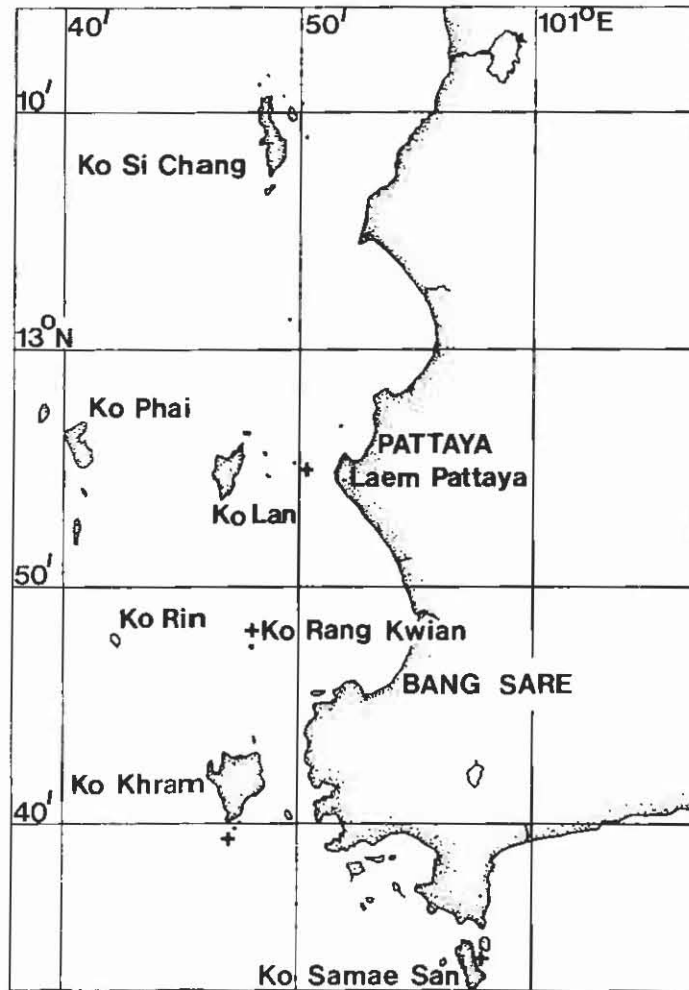


Figure 1. Plan of Pattaya area showing location of wreck sites.



Figure 2. Complete and Semi-complete storage jars on wreck site.

The site lies on a silt-shell seabed at a depth of 26 m. The axis of the site is approximately 30° and the extent of the timber was noted to be about 20 m by 4 m. Around the site were numerous fragments of semi-complete and complete large storage jars (Fig. 2). These had clearly been moved during the previous work on the site, presumably to gain access to deeper layers.

The tidal range during the January period was about 2 m and generally the current set to the south. At the time of the excavation, the current was about one knot on the surface, but appeared to be confined to the first 10 m or so, and was almost unnoticeable on the seabed. Visibility was variable, at best, up to 10 m, and at the worst, 3-4 m.

THE EXCAVATION

Sections of the hull protruded from the seabed at either end of the long axis of the site, consequently the base line was attached to these structures. The line was 20 m long and was used to make a rough offset survey of the site.

It was decided to start the excavation at the southern end of the wreck site, and proceed northwards in a systematic manner, uncovering the full timber width with an airlift.

The positions of artifacts found during the excavation were recorded in relation to their offset and position on the base line. The accuracy of location was about ± 100 mm. Throughout the excavation, evidence was found that the site had been previously excavated down to the hull timbers. This implies that the site has been excavated to a depth of about 750 mm, which is the depth of the existing overburden. Numerous intrusive modern artifacts were found in the overburden, including plastic rope and electric flash cubes!

Not surprisingly, very few artifacts were found in the excavation area. Those found included ceramic sherds of earthenware, coarse stoneware, celadon, and one porcelain fragment, together with a number of conical-shaped lead ingots.

By contrast, the hull was exceedingly interesting, with a large amount of complex structure. Thus, the major thrust of the excavation was to uncover the hull so that it could be fully recorded.

During the excavation, a few large storage jars were raised for recording purposes. Otherwise the excavation was confined entirely to the hull itself. At the end of the excavation, the site was covered using an induction water dredge to pump sterile sand over the timbers. In the past, this has been found to be a very effective way of preserving a wreck site.

HULL RECORDING TECHNIQUES

Two methods of recording the exposed hull were used: one incorporated photography; the other used ordinary measuring techniques to record profiles.

Photography

As each section of the hull was uncovered, and during the periods when the underwater visibility was reasonably good, a photomosaic of the site was made.

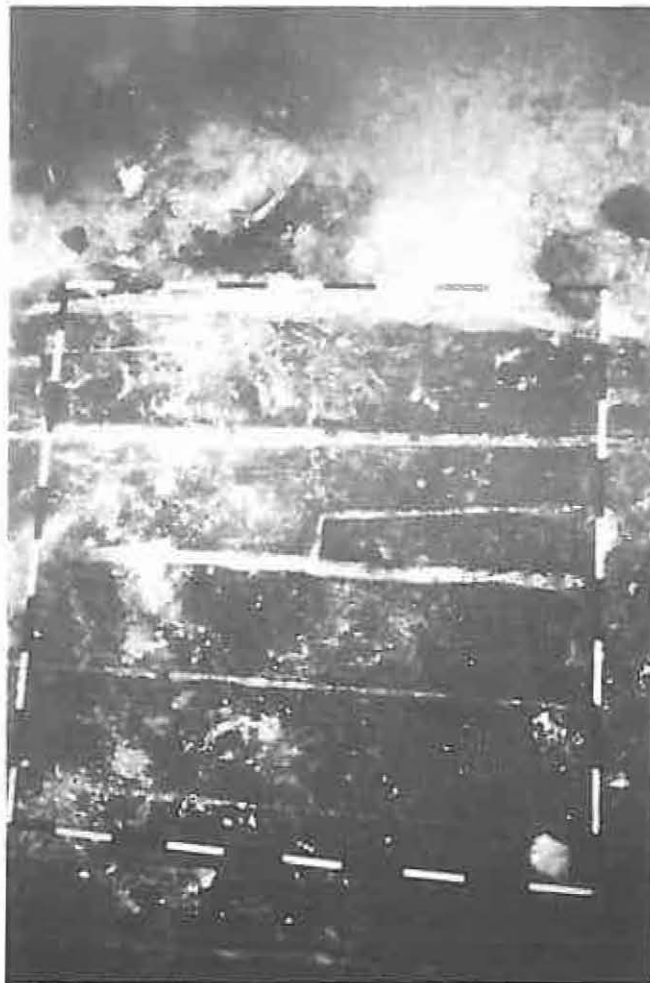


Figure 3. A near vertical photograph of the timbers.



Jeremy Green & Brian Richards

A 1 m square grid frame (graduated in 100 mm intervals) was used in combination with a standard Nikonos Camera and a 15 mm water-corrected lens, to take overlapping photographs over the area concerned. The photographer attempted to position the camera so that it was as near vertical to the grid frame as possible (Fig.3). In general, this coverage was made by a single operator who moved the grid frame over the area and took the photographs. The frame was moved in 500 mm intervals across the site. These approximated to photographic runs, and at the end of each run, the grid was moved forward 500 mm so that, as near as possible, a 100% overlap occurred. The photographs of successive coverages were printed and the results were laid up as a photomosaic (Fig.4). This process has been discussed widely elsewhere, Green *et al.*(1971).

Profiles

A simple profile recording system was used to record the shape of the hull. This consisted of a mild steel square-section tube 5 m long, 20 mm x 20 mm cross-section, with two cross rods about 500 mm long at either end, so that the whole resembled a squat "H". This bar was placed across the site at right angles to the keel. The ends of the bar were located and held in place by steel pins driven into the seabed, so that the whole was reasonably rigid and steady. A metal square (with sides of 200 mm) was made to slide along the whole length of the bar. This was constructed so that it made an accurate right angle with the bar. A tape measure was attached to the upper surface of the bar, so that the position of the square could be located. The whole arrangement was set up in a position where a profile was required. The square was adjusted so that, by sighting along one of the sides perpendicular to the bar, the edge was aligned with a plank joint or the feature to be recorded. A rigid steel ruler was then placed against the edge of the bar, and the vertical height of the bar above the joint, measured. At the same time, the alignment was checked by ensuring that, when the ruler was held up against the square, the end edge of the ruler was positioned at the joint (Fig.5). After measuring the vertical height, the horizontal distance was recorded by noting the position of the square on the tape measure fixed to the upper surface of the bar. The third co-ordinate was the longitudinal position of the bar on the base line.

Thus, each plank joint on the profile is uniquely recorded in three dimensions. However, in each profile, the angle that the bar makes with the plane of the wreck site is arbitrary. Therefore, the angle of the bar had to be determined for each profile. A plumb-bob was suspended from the top of the square

and its off-set at the bottom measured. By simple trigonometry, the angle of tilt can be determined since the length of the side of the square is known. Thus, in each profile, the angle the bar made to the horizontal was determined.



Figure 5. Diver using profile machine.

A longitudinal profile along the keel was made by stretching a wire bar-tight between either end of the keel. At 500 mm intervals along the wire, a vertical measurement was made to the keel and a measurement was made of the lateral off-set from the centre of the keel of the vertical measurement. In this way, the curvature of the keel in the horizontal and vertical plane was determined. The data from these profiles was processed in a small desk top computer to reduce the measurements to a common rectangular co-ordinate system. Briefly, each profile was first rotated into the plane of the surface of the keel, then the resulting profiles were translated to correspond with the vertical curvature of the keel. The readings were thus reduced to a common co-ordinate framework which corresponded with that of the ship itself. Profiles were then replotted, together with a plan and side elevation.

Some distortion was noted in the profiles, possibly due to the inaccuracy of the system. As a result, the lines were faired to give the best fit (Fig.15).

CHAPTER 2. CATALOGUE OF MATERIAL FROM THE PATTAYA WRECK SITE

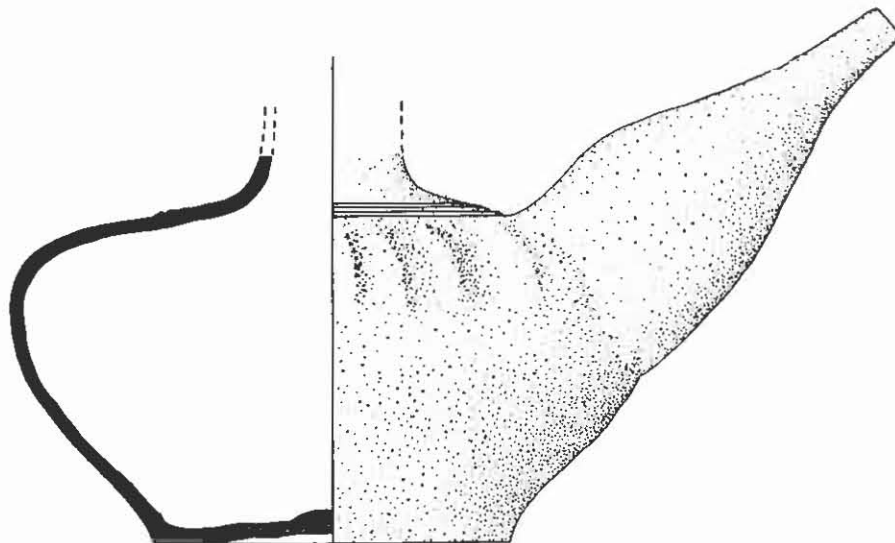
The catalogue is divided into three basic material types: ceramic, metal and wood. The largest group is the ceramic which, in turn, is subdivided into: earthenware (kendi, plain bowls, bowls with pressed decoration, lids); celadons (bowls, bottle); stoneware (bottle, medium jars, medium ovoid jars, large jars, miscellaneous); earthenware-stoneware and porcelain. As discussed above, the material was not found in any real context or stratigraphy, except for the lead ingots which were all sitting on, or close to, the hull of the ship (not an unexpected find considering their weight).

PATTAYA WRECK SITE ARTIFACT CATALOGUE

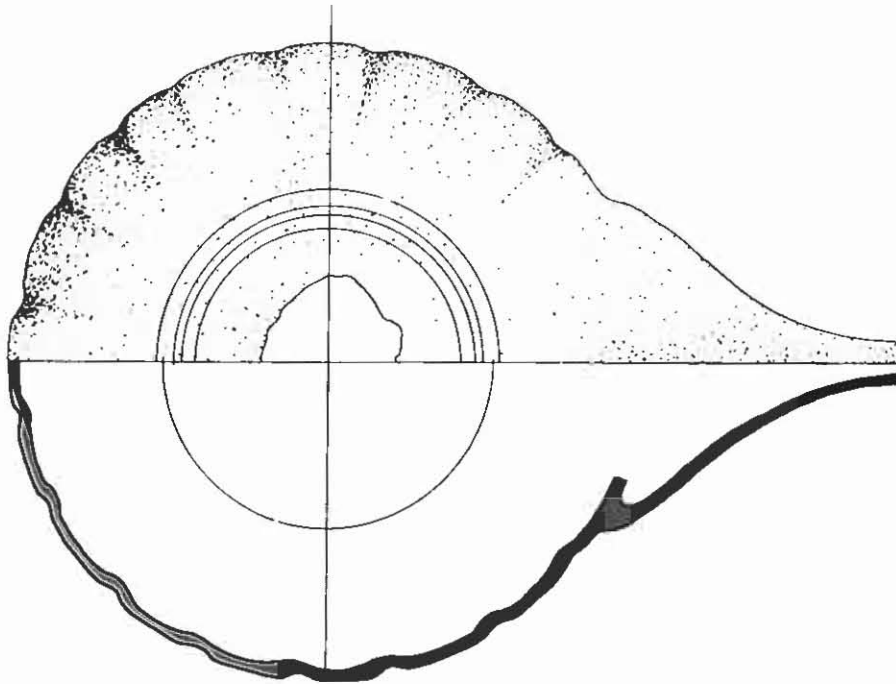
NOTE ALL ARTIFACT
DRAWINGS SCALE 1:2
EXCEPT WHERE OTHERWISE STATED

1. EARTHENWARE

a) Kendi

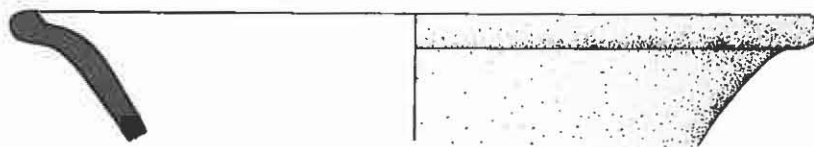


P168
Dark grey brown body, fine grained. Upper body lightly fluted, elongated spout, concentric ridges on shoulder.



Whilst there is no exact parallel, Refuge (1976) Afb.110, illustrates a group of red earthenware kendis from Sawankhalok, of which the closest is similar in shape, but without fluting (bottom right). Sullivan (1957) discusses Thai kendis and refers to a fired yet unglazed stoneware kendi fragment from Sawankhalok.

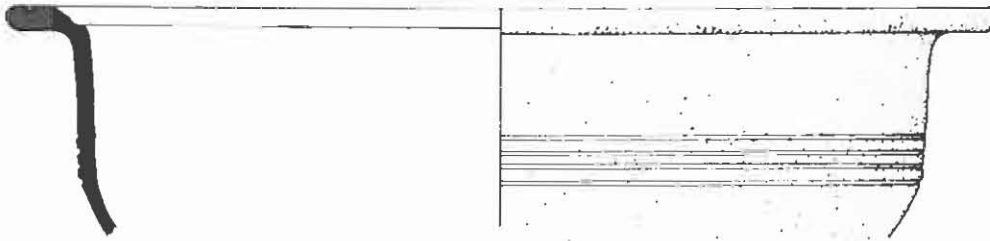
b) Plain Bowls



P536
 Fragment. Beige body, interior body grey.
 Flared rim, grooved on upper surface.



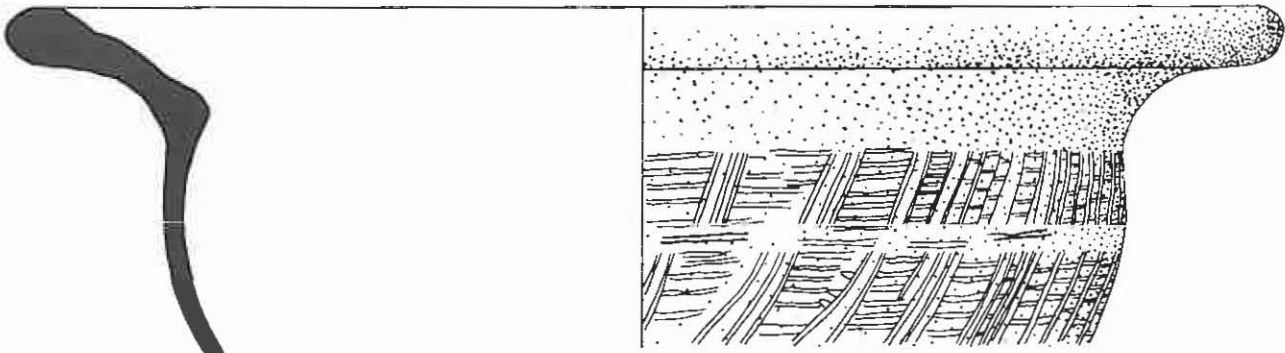
P491
Fragment. Grey body. Flared rim.



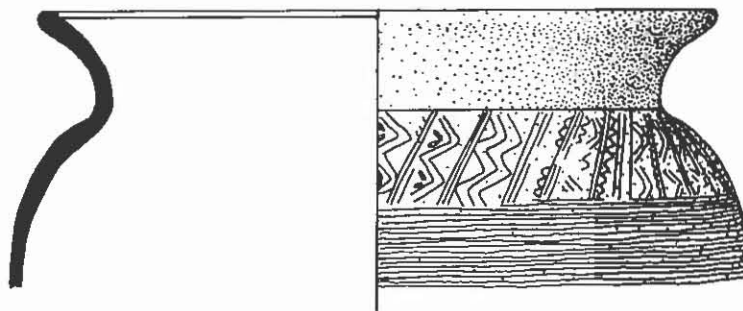
P543
Fragment. Beige-grey body. Flattened rim, grooved on upper surface, four incised lines on side.

c) Pots Pressed Decoration

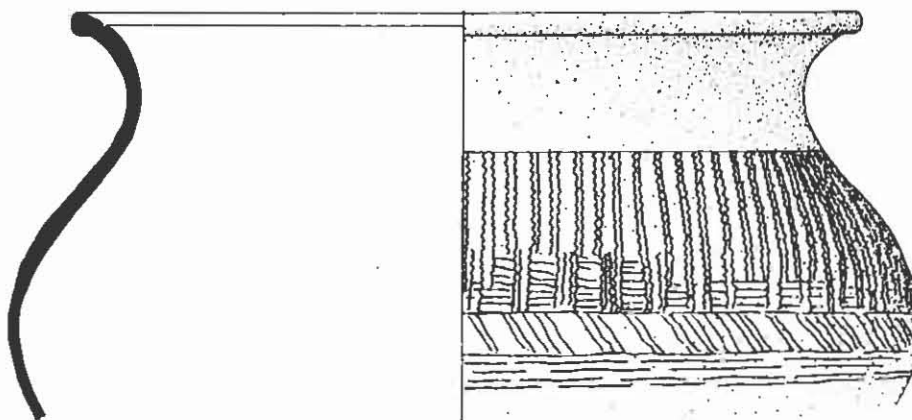
This group is widely represented in wreck sites from Southeast Asia. The paddle and anvil decoration varies and, in some cases, the impression of the basket in which they were made can be seen.



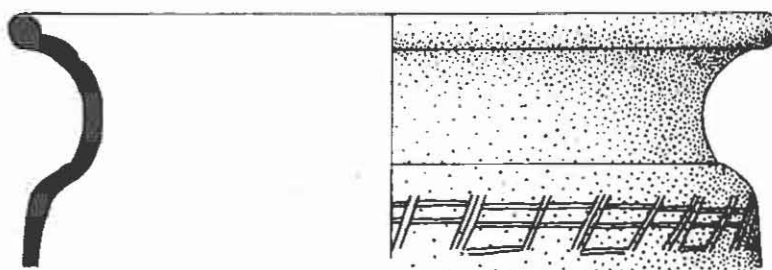
P471/531
Fragments (two joined). Darkish grey body, coarse grained. Flattened rim, grooved on upper surface.



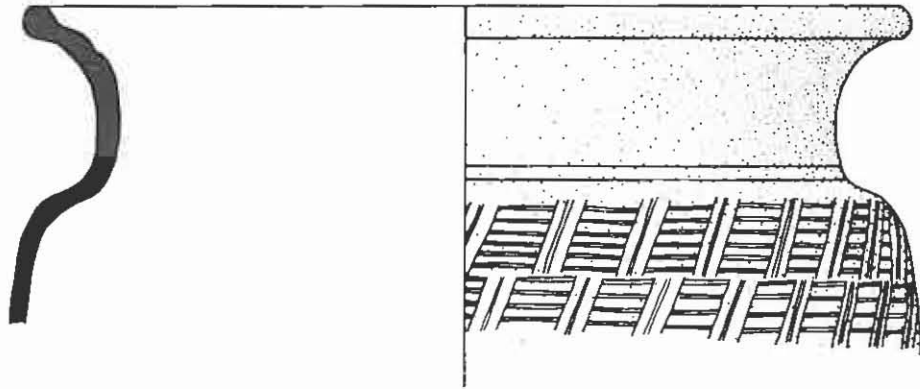
P191
 Fragment. Buff-yellow body. Flared rim, grooved on upper surface.



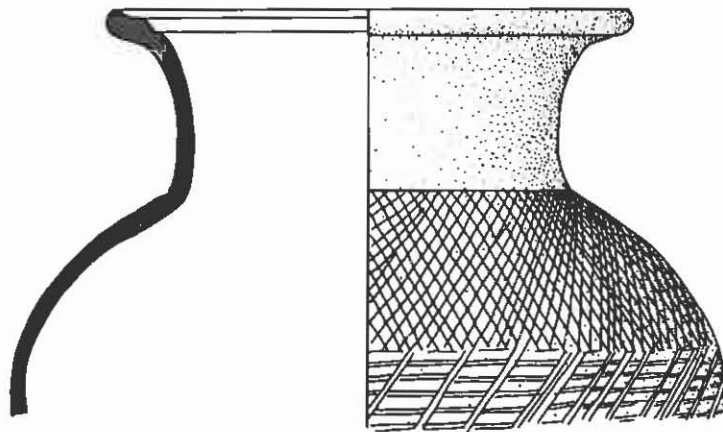
P470
 Fragment. Beige-grey body. Flared rim, grooved on upper surface.



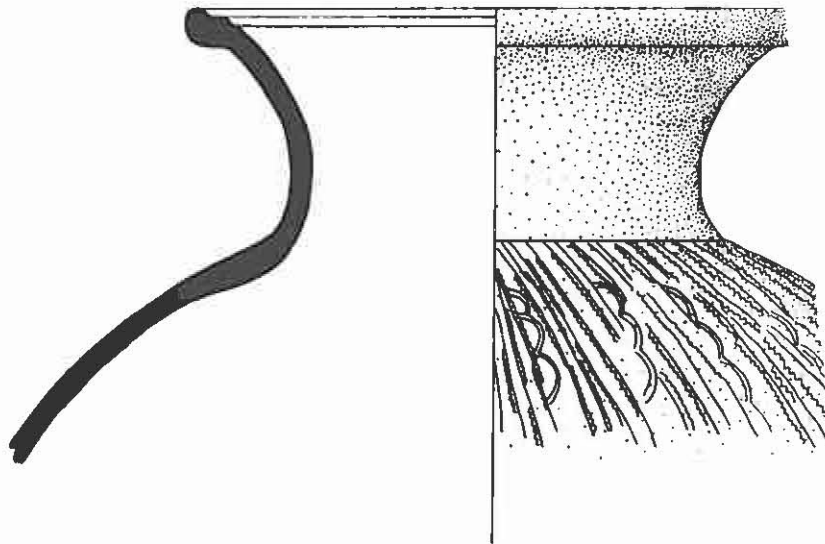
P57
 Fragment. Grey body, interior body beige. Flared rim, grooved on upper surface.



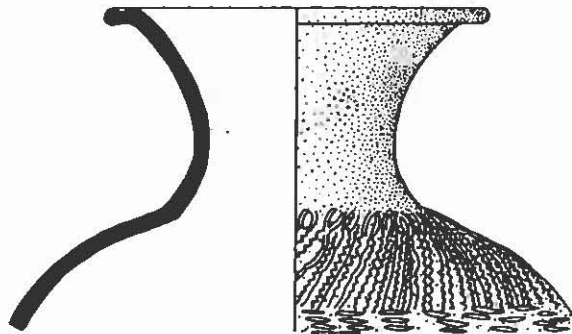
P267
Fragment. Grey body. Flared rim, grooved on upper
surface.



P268
Fragment. Light red-grey body. Flared rim, grooved on
upper surface.



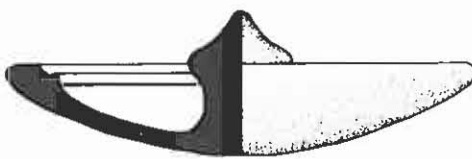
P4
 Fragment. Grey body, interior body black. Flared rim
 grooved on upper surface.



P17 1:4
 Fragment. Brown body, very coarse. Long flaring neck,
 rim grooved on upper surface. This decoration closely
 resembles Frost et al. (1974) Fig.8b.

d) Lids

These lids are commonly found on wreck sites in Thailand. On this site, a number were found with resin attached to the edge of the upper surface. This indicates clearly that they were used as sealing lids for the medium-sized storage jars. The solidified resin suggests that the lid was placed upside down over the mouth of the pot, (domed side upwards), and molten resin poured around the joint to seal it. Lids with a similar method of sealing were found on Sites G and S.



P399
Beige body. Lotus bud-shaped handle.



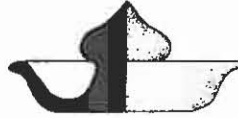
P26
Coarse grey body, hard-baked. Knob handle.



P27
Coarse grey body, soft-baked. Knob handle.



P274
Buff-grey body. Handle recessed below rim of lid.



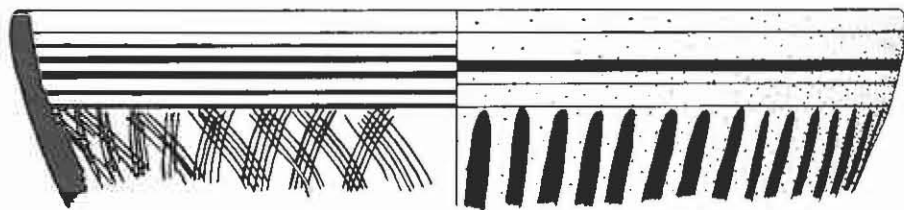
P114/124

Smooth, dark grey body, similar material to Kendi P168. Lotus bud-shaped handles. This lid is distinctively different from the other lids (below). It is thought to be a lid for a kendi such as P168, having similar size and fabric. Refuge (1976) Afb.110 illustrates a lid with a similar style lotus bud, however the rim of the lid projects downwards to form a bell shape.

2. STONEWARE-CELADON

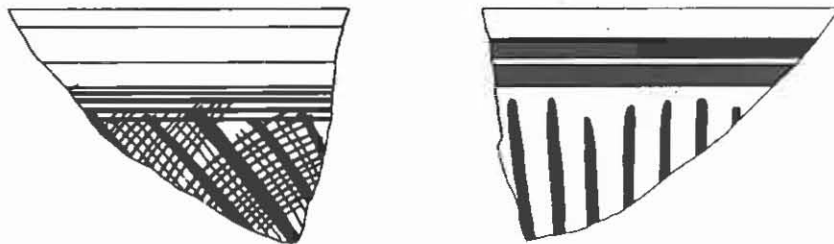
a) Bowls

All the celadons were fragmentary and, as such, it is not possible to draw close parallel since, except for one case, no footrims survived.



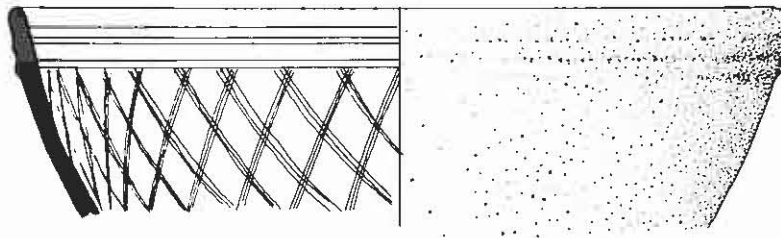
P423

Fragment. Beige body. Green glaze. Outside decoration incised vertical and horizontal lines. Inside decoration incised horizontal lines and cross-hatching.



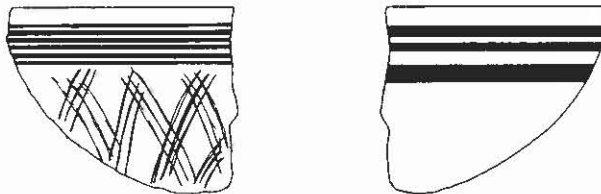
P343

Fragment. Beige body. Green glaze. Outside decoration incised vertical and horizontal lines. Inside decoration incised horizontal lines and cross-hatching.



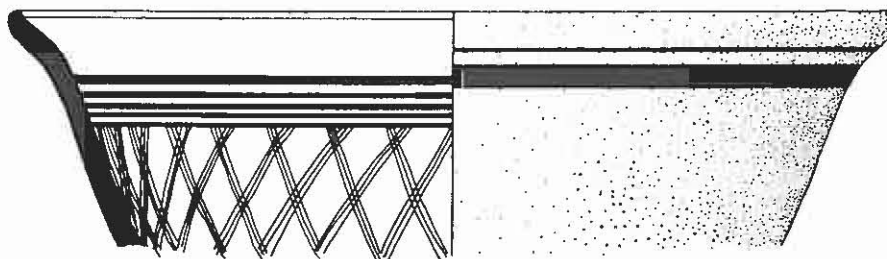
P154

Fragment. Oatmeal body. Green glaze. Two ridges below rim on outside. Inside decoration horizontal lines and cross-hatching.



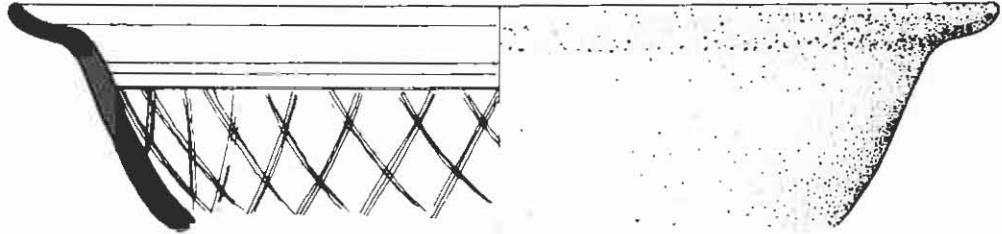
P154B

Fragment. Oatmeal body. Green glaze. Incised lines just below rim on outside. Inside decoration horizontal lines and cross-hatching.



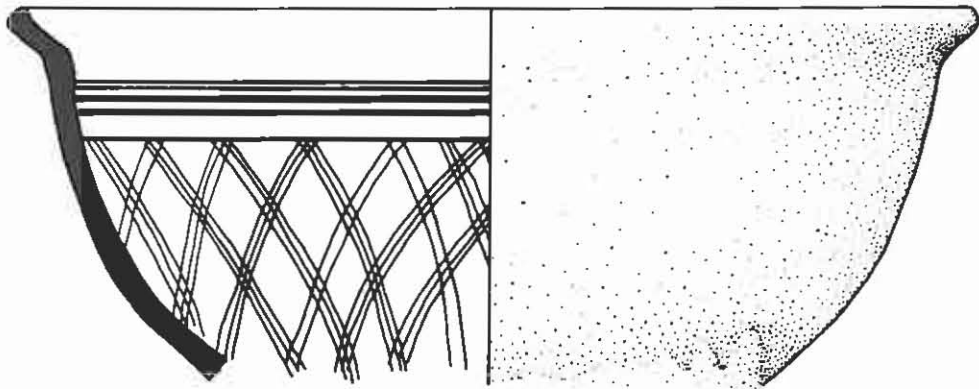
P383

Fragment. Green glaze. Flared rim, two incised lines outside. Inside decoration horizontal lines and cross-hatching.



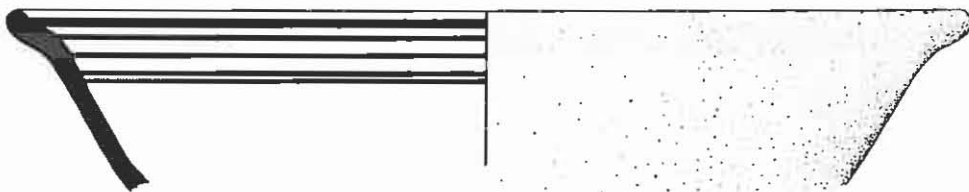
P232

Fragment. White-grey body. Green glaze. Flattened rim. Inside decoration incised horizontal lines and cross-hatching.



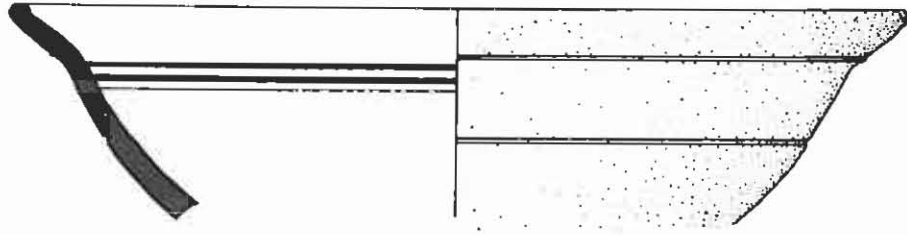
P594

Fragment. White grey body. Green glaze, base unglazed. Flattened rim. Inside decoration incised horizontal lines and cross-hatching.



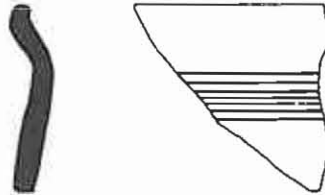
P10

Fragment. Flared rim, grooved on upper surface. Inside decoration incised horizontal lines.



P532

Fragment. Beige body. Green glaze. Flared rim, grooved on upper surface. Ridge just below outside rim to body. Incised lines below. Inside decoration incised horizontal lines.

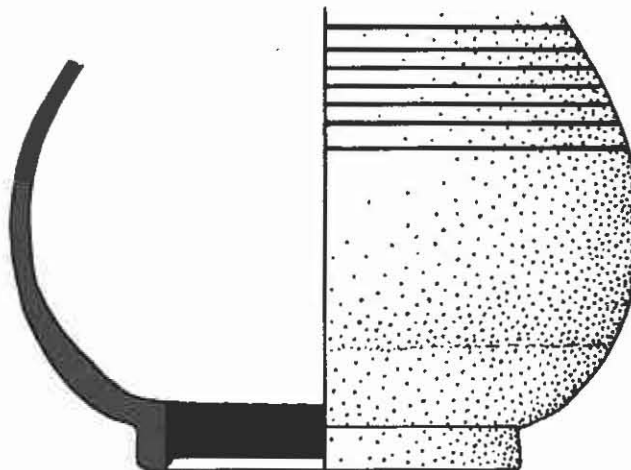


P532B

Fragment. Beige body. Green glaze. Flared rim, grooved on upper surface. Inside decoration incised horizontal lines.

b) Bottle

This bottle is a common type and is likely to have had two ring handles near the squat neck. See: Richards (1977) No.225; Willetts (1971) No.270; Spinks (1959) Fig.45; Volker (1979) Fig.7; Harrison (1950) Plate 11A; and S.E. Asian Ceramic Society (1979) No.306.

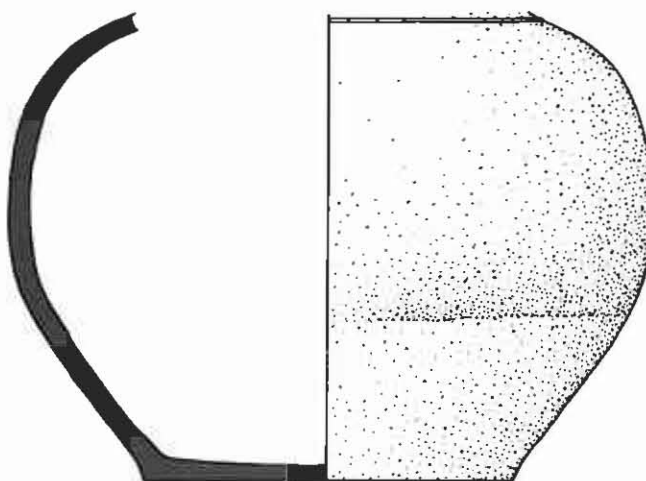


P14

White body. Pale green glaze to upper two thirds of body, footrim unglazed. Seven incised rings visible towards top of bottle. Tubular pontil mark on base.

3. STONEWARE

a) Bottle



P110

Fragment, deep pink body. Thick green-black glaze to upper two thirds of body. No footrim. One ridge visible on upper body.

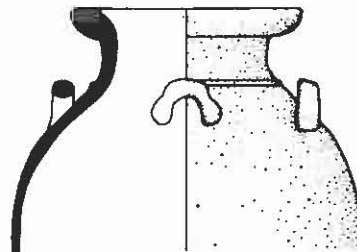
b) Medium Jars

These jars seem to be part of the main cargo of the ship. They are shown prominently in early pictures of the site (Fig.6). The shattered bases of these jars were noted in the concretion area over the keel, between bulkhead 3 and 4 (Fig.7). This type of jar is similar to Spinks (1959) Fig. 51 No.2615 (same height but narrower), said to be possibly Sukhothai. Also Fox (1959) Plate 135 (same height but narrower, as Spinks) said to be Kalong, found at the Calatagan excavation, Philippines. Interestingly, Brown (1975) Fig.8 (left),

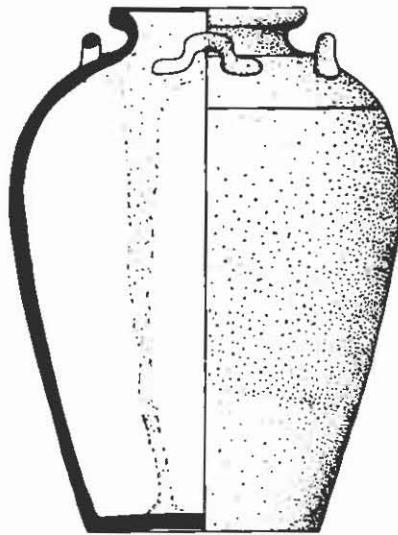
illustrates a similar storage jar from the Ko Khram wreck site, but with a height range of 310 mm to 350 mm (slightly larger than here). Likewise Willetts (1971) No.350 illustrates another taller jar.



Figure 6. Early photograph of site showing medium jars.



P16 1:4
Grey body, inside body brick-red. Dark green-black glaze, everted lip. Ridge at join of neck and shoulder, four lug handles below.



P15

1:4

Red body. Olive-green-brown glaze to upper three quarters of body, glaze run extending inside jar. Everted lip, grooved on upper surface. Ridge at join of neck and shoulder, four lug handles below. Incised line below handles, on shoulder. Roughly formed.

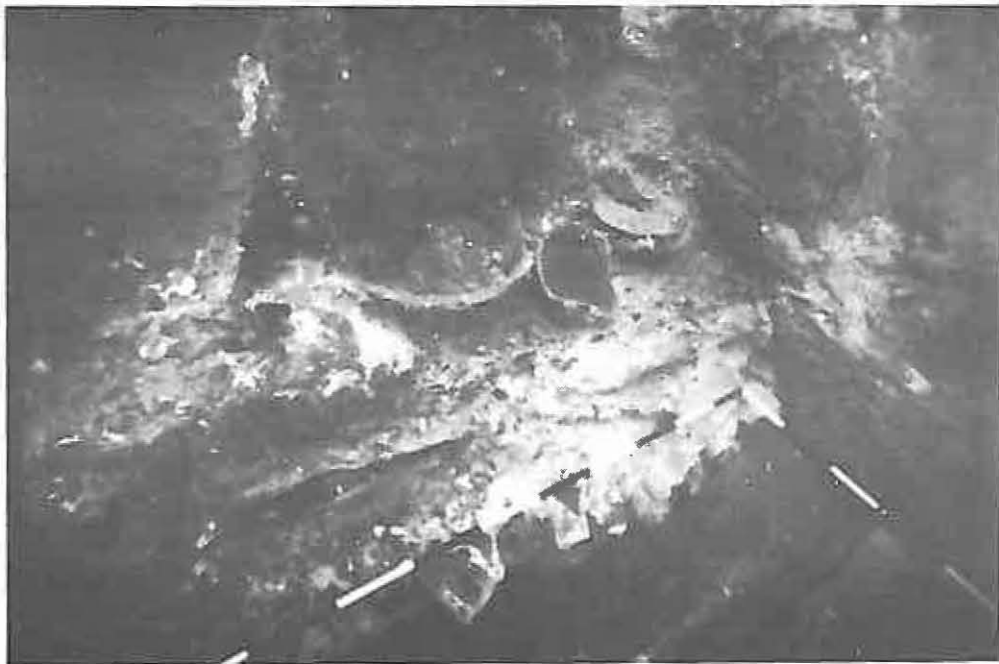
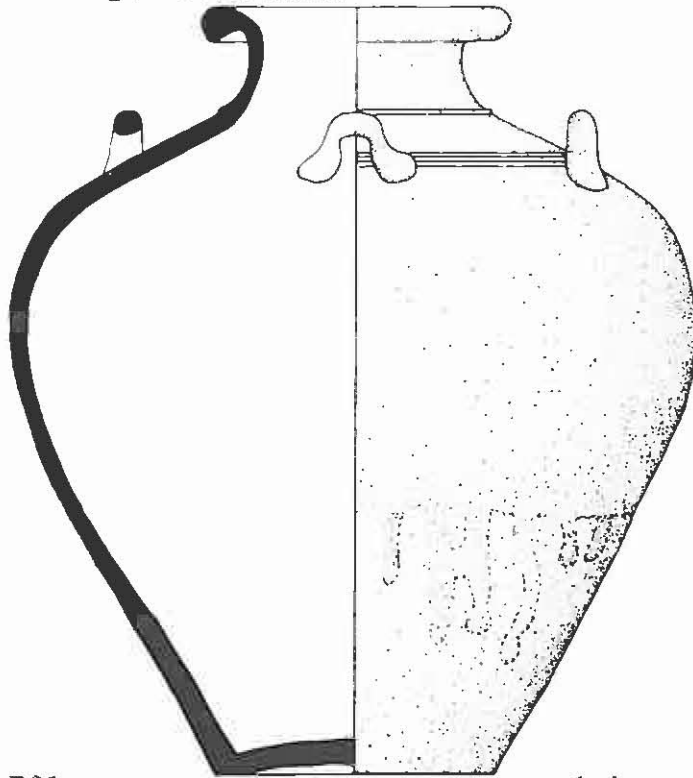


Figure 7. Bases of medium jars concreted to keel.

c) Medium Ovoid Jars

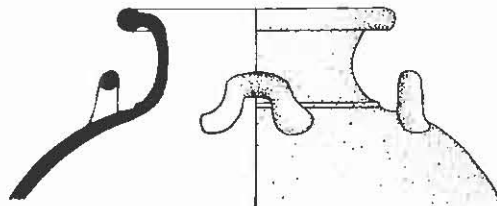
A similar jar is illustrated in Brown (1977) No.127, slightly smaller but with the same shape and glaze. Likewise Guy (1980) No.122, (again smaller but similar glaze run marks) and Loesin (1967) Pl.186, from the Calatagan excavation.



P31

1:4

Grey body. Thick black glaze extending halfway down body then forming long streaks. Everted lip. Ridge at join of neck and shoulder, four lug handles on shoulder applied over four incised ridges. Four ridges where lugs join body.



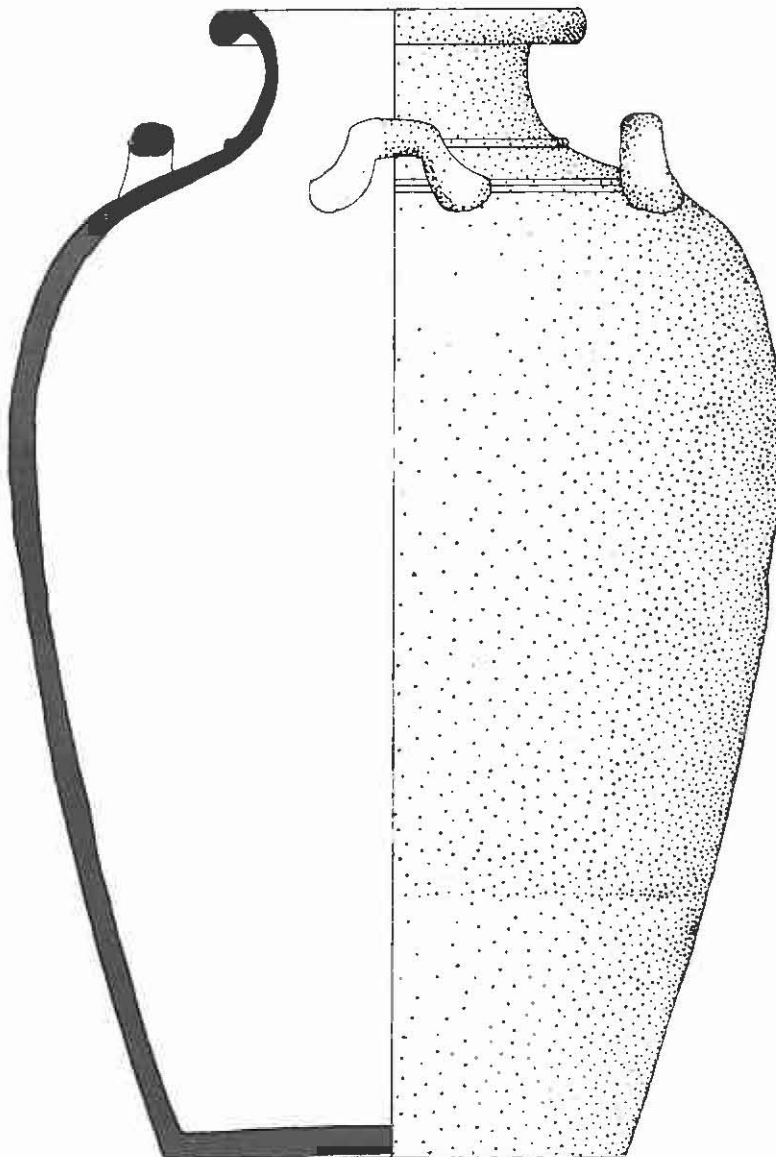
P13

1:4

Grey-pink body. Green-black glaze extending inside neck. Everted lip, grooved on upper surface. Ridge at join of neck and shoulder, four lug handles on shoulder. No ridges or incisions at lug join.

d) Large Jars, Tall Ovoid Shaped

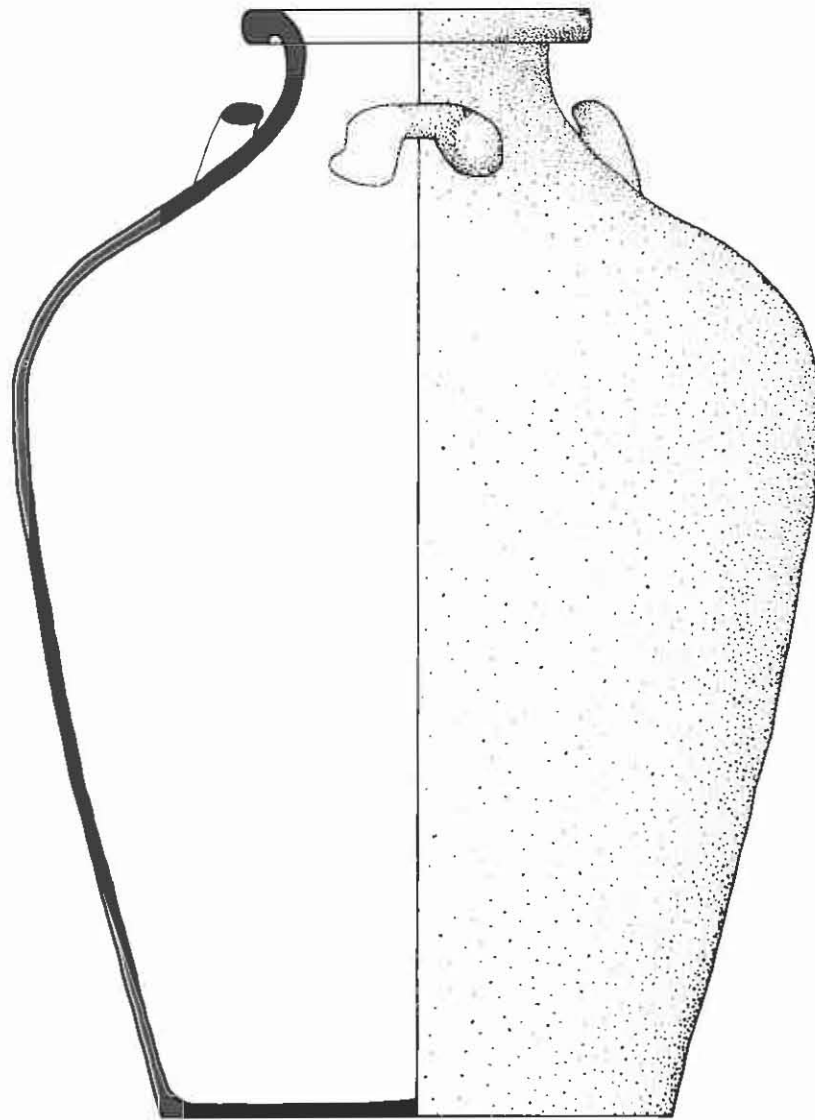
This group of large jars (612 mm high) resembles, in shape, the jars from Ko Khram, Brown(1975) Fig.11, although the Ko Khram jars are smaller, (450 mm). Closer is the bulbous type, illustrated in Adhyatman and Lammers (1977) Type III JI p.73, with a height of 640 mm and a diameter 475 mm, but with a thicker glaze.



P9

1:4

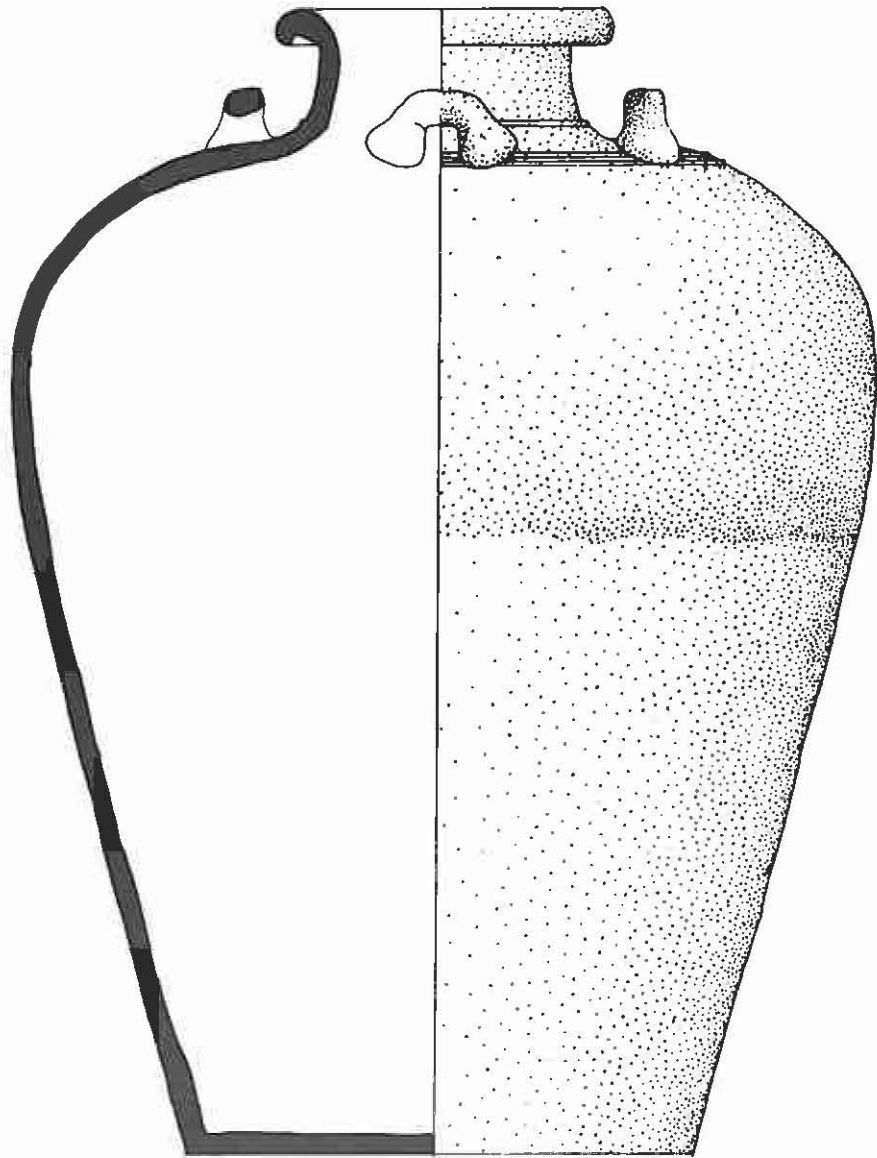
Green-black glaze extending three quarters of the way down the body. Everted lip, grooved on upper surface. Ridge at join of neck and shoulder, four lug handles on shoulder applied over two incised lines.



P569

1:4

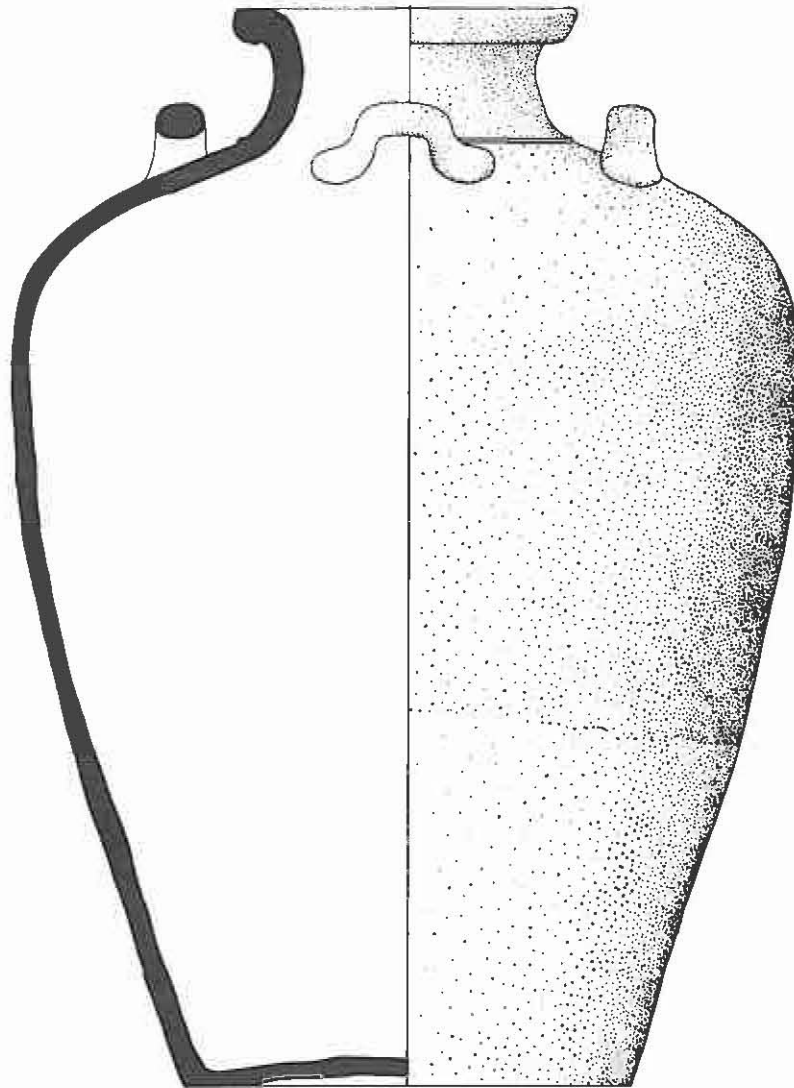
Pink body. Degraded green-black glaze. Everted lip. No ridges or incised lines apparent, possibly because of the state of degradation of jar. Four lug handles.



P166

1:4

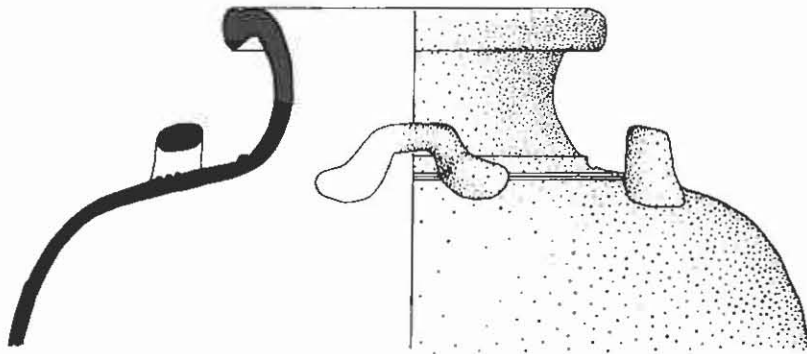
Green-black glaze extending halfway down body. Everted lip, ridge at join of neck and shoulder, four lug handles on shoulder, applied over two incised ridges.



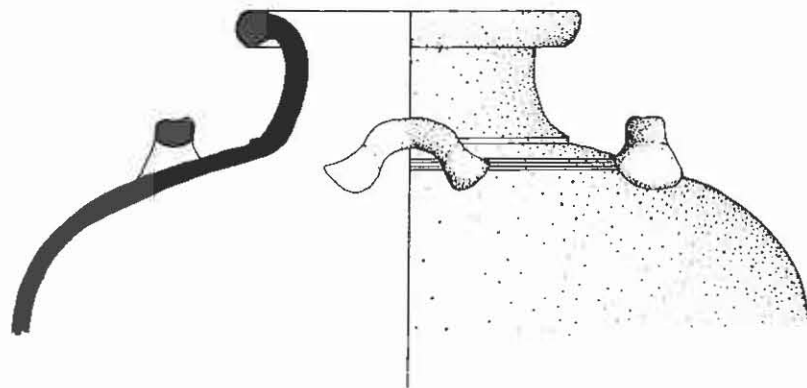
P30

1:4

Grey body, inside body is red. Degraded green-black glaze extending two thirds of the way down body. Everted lip. Ridge at join of neck and shoulder, four lug handles on shoulder.

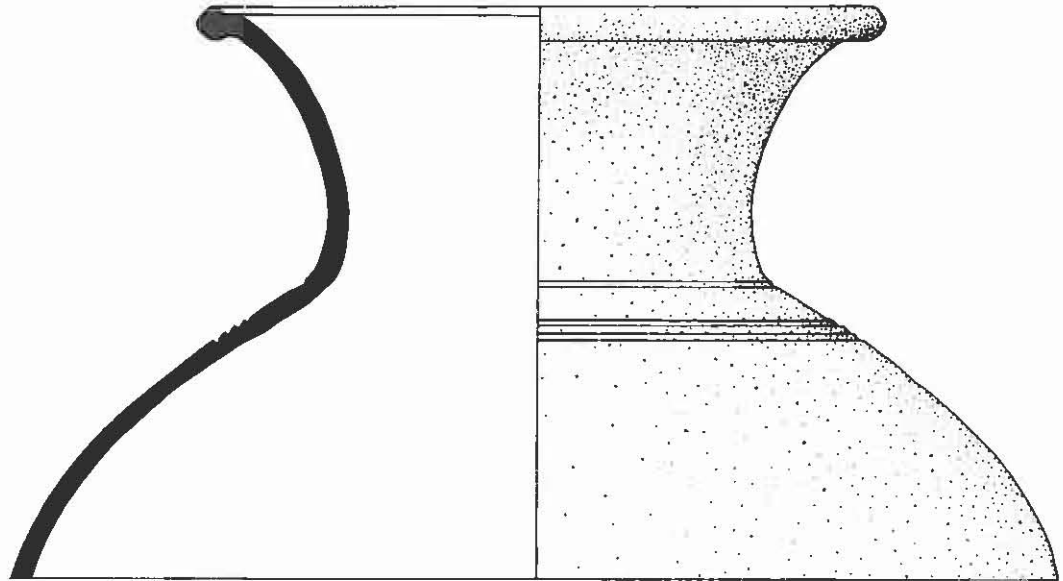


P1 1:4
 Grey body. Green-brown glaze with upward run. Everted lip, grooved on upper surface. Ridge at join of neck and shoulder, four lug handles on shoulder applied over three incised ridges where lugs join body.



P3 1:4
 Pink body. Green-black glaze. Everted lip. Ridge at join of neck and shoulder, four lug handles on shoulder, applied over four ridges.

e) Miscellaneous Stoneware

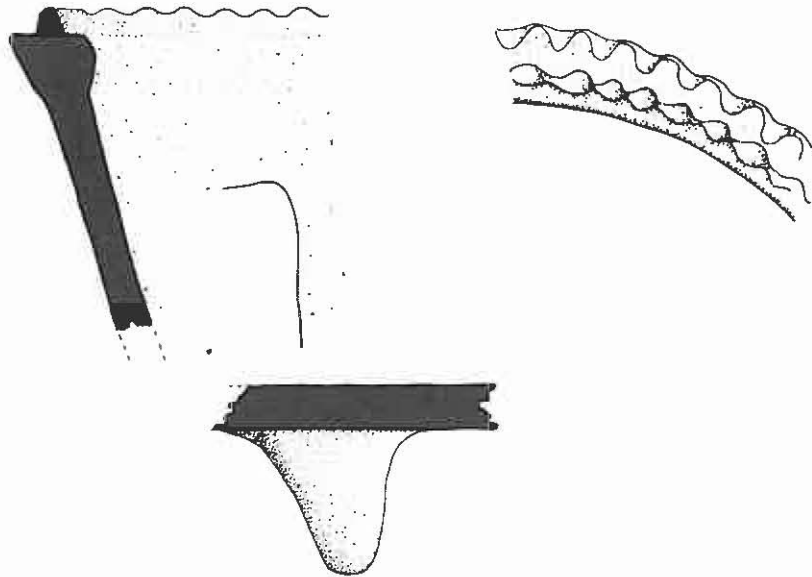


P129

Pink-red body, no glaze apparent. Elongated, flared neck, rim grooved on upper surface. Ridge at join of neck and shoulder, four incised ridges below this.

4. MISCELLANEOUS CERAMIC

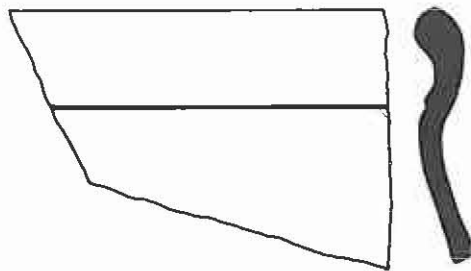
Fragments of Stove



P277/323

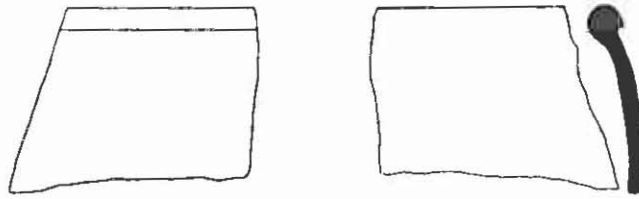
Fragments of base and bulbous foot, and curved wall. Fragment of irregular diameter with pastry crust scalloping. Right-angled section deliberately cut from the object. It is possible that this is some form of stove.

5. EARTHENWARE-STONEWARE



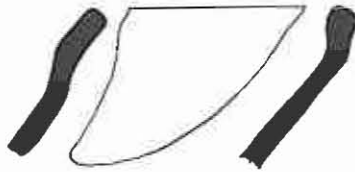
P332

Fragment, reddish body. Slightly everted rim. Incised line on shoulder.



P509

Fragment. Light brown body. Degraded black glaze on what is probably the inside of bowl.



P459

Fragment. Probably rim of plate/bowl. Possibly twisted in the firing. Smooth dark purple-grey body, unglazed.

6. PORCELAIN



P494

Rim fragment, blue and white decoration.

7. LEAD

A number of these lead ingots were found on the site. They have been previously described by Howitz (1977) Fig. 20 and Howitz (1978) Fig. 33. Howitz reported that many tonnes were salvaged from this site by treasure-hunters and that they were a common find on wreck sites in Thailand. Interestingly, similar lead ingots were found on Site G, (see below).



Ingots (262), pyramidal-shaped. Average approximately 20 mm high, 42 mm wide. Maximum 24 mm high, 47 mm wide.

8. DUNNAGE

A section of what is thought to be dunnage was found in the area between bulkheads 3 and 4. Here, on the western side of the site, between bulkheads 3 and 5 was a large area of concretion. This presumably was some type of iron cargo. The division of this was exactly along the keel, thus the division of the compartments was longitudinal as well as lateral. Here, trapped under the

concretion were some medium-sized jars (see Section 3b above). Also, a number of bamboo poles had been layed across the keel. These extended into the western side of the site, under the concretion (Fig.8). Interestingly, the interior of these bamboo poles were crystals which when analysed, were found to be calcite. See Appendix 1.

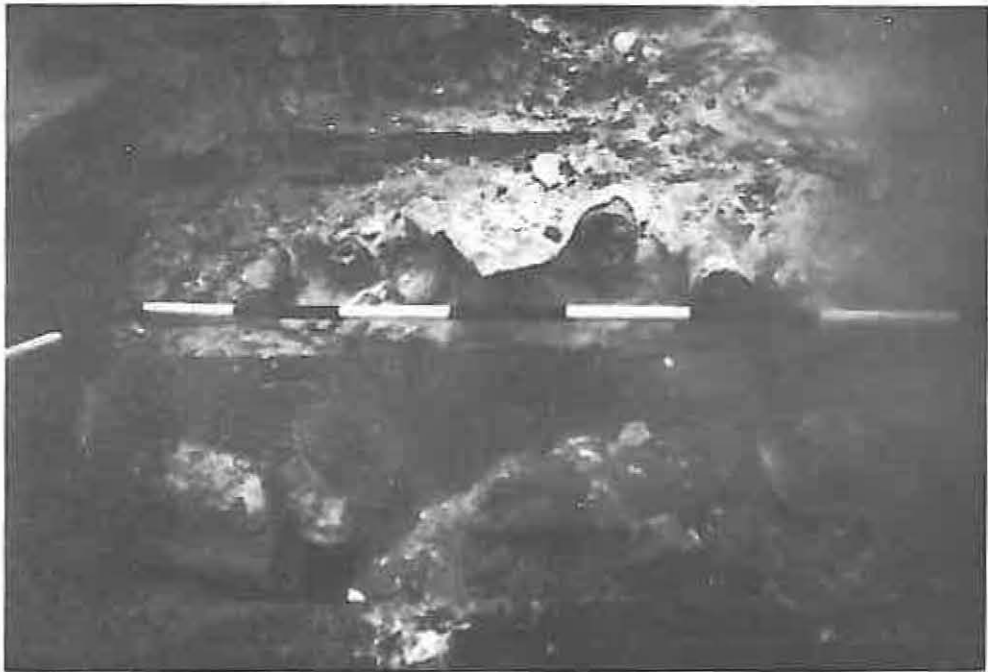


Figure 8. Bamboo dunnage lying across the keel.

9. SHIP'S TIMBER

a) The Hull Structure

In all, a 9 m length of the hull was uncovered, with a maximum width of 4.5 m. In this section, six bulkheads were uncovered together with eight strakes on either side of the keel. The hull profile had a marked V-shape next to the keel. This flattened out, finishing in an upward curve at the turn of the bilge. Here, obviously, the continuing sides of the ship had broken away and disintegrated (Fig.9).



Figure 9. Pattaya wreck showing hull profile.

A sample of wood from a bulkhead was brought back to the Western Australian Maritime Museum for identification. The identification was carried out by Mr. Nicholas Clark using wood histological techniques. The sample was identified as *Fagus* (Beech), unfortunately identification beyond the generic level (i.e. to species) was difficult for the type of sample provided. *Fagus* is found across Laurasia (central and northern Europe, Baltic, Asia). *Fagus obliqua* (Japanese Beech) having a Southeast Asian distribution, including Southern China, Japan, Thailand and Korea.

b) The Keel

The keel consisted of a large, apparently single timber, 300 mm wide, with 45° bevels on the upper edges, giving an upper keel surface of 200 mm. The actual vertical thickness of the keel was hard to determine, as it was only accessible at the southern end of the site where the other planking was broken away, revealing a short section of the keel itself. At this point, the lower surface was badly eroded. At a rough estimate it was thought to be about 300 mm thick.

The question of a joint in the keel was complicated because of an additional keel section sitting on top of the keel, starting between bulkheads 1 and 2 and continuing to bulkhead 4. It may be that this covers, and thus obscures from view, a scarph in the keel. This additional keel member was 200 mm wide by 150 mm thick, with bevels 30 mm wide. The northern end of this timber was rebated into bulkhead 4. Between bulkhead 5 and 6 was some form of wedge or notch set into the keel, flush with the upper surface. What significance or function this has is uncertain.

The bevel on the top surface of the keel forms a rebate for the garboard strake.

c) The Planking

The planking at the edge of the site (Fig.10A), consisted of three layers, the inner was 70 mm thick, whilst the second and third layers were 40 mm thick. Unfortunately, it was not possible to confirm if this outer planking extended to the keel. The garboard strake of the inner layer of planking was attached to the bevel on the upper part of the keel by a series of dowels, 20 mm in diameter, spaced 160 mm apart. There was evidence that only the inner planking was attached to the keel, and it was not clear what happened to the two layers of outer planking, if indeed they reached as far as the keel. Each strake of the inner planking was edge-joined on both sides, in addition the edges of the strakes were not cut square, i.e. the cross-sectional shape of the plank was trapezoidal rather than rectangular (Fig.10B).

In the midships section of the ship the garboard strake is quite wide, but proceeding from the centre it becomes progressively narrower, see wreck site plan (Fig.11). Eventually, the garboard becomes a stealer and is

checked into the keel. It is thought that the second strake which now becomes the garboard, is treated in the same way, the checking however occurring outside the surviving timber area.



Figuer 10A. Planking at edge of site showing layers.

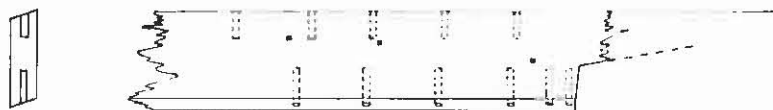


Figure 10B. Drawing of plank showing dowelling and cross-section.

It is interesting to note that the strake-scarph joints all occur under bulkheads and do not have any logical system to them. Thus, the first strake is scarphed by checking into the keel at the first bulkhead; the second is scarphed at the fifth bulkhead; the third does not appear to have a scarph; the fourth has a stealer at the third bulkhead; the fifth has a scarph at the fifth bulkhead, but this scarph is set in the opposite direction (lower edge of scarph projecting towards midships). The sixth strake is scarphed at the

second bulkhead (lower edge scarph projecting away from midships); the seventh strake is scarphed at the third bulkhead (lower edge towards midships) (Fig.11).

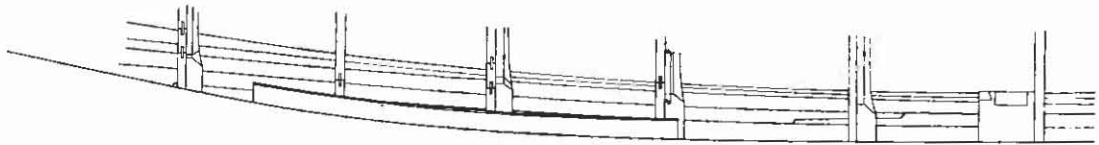


Figure 11A. Pattaya wreck site side elevation.

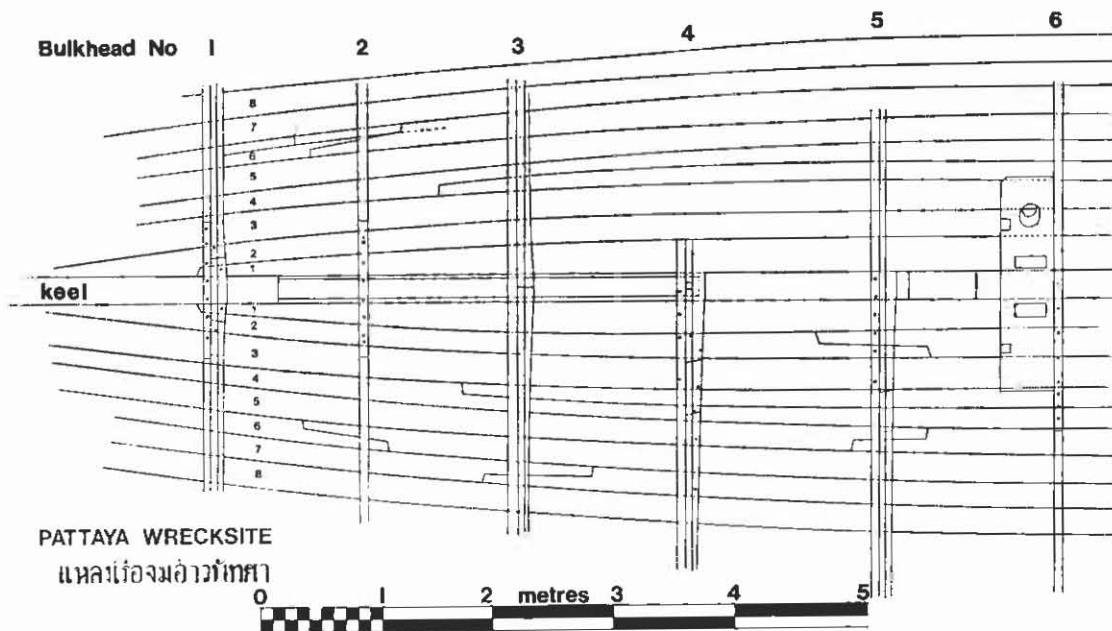


Figure 11B. Pattaya wreck site plan.

In general, the strakes are reasonably uniform in width, except for the fourth strake, which has the stealer, and of course the first and second strakes where they check into the keel.

The two outer layers of planking seem to be butt-jointed rather than scarphed. A small section of the second layer of planking was revealed where a part of strake 6 on the west side of the site was missing. Here, a flush-faced butt joint was revealed. It is interesting that there was no evidence for dowel edge-joining. It is assumed that this planking is nailed onto the inner planking as a type of skin. Some evidence that nails were driven from the outside into the inner planking, was noted. Resin-lime luting was noted on the outside surface of an inner plank fragment (Fig.12).

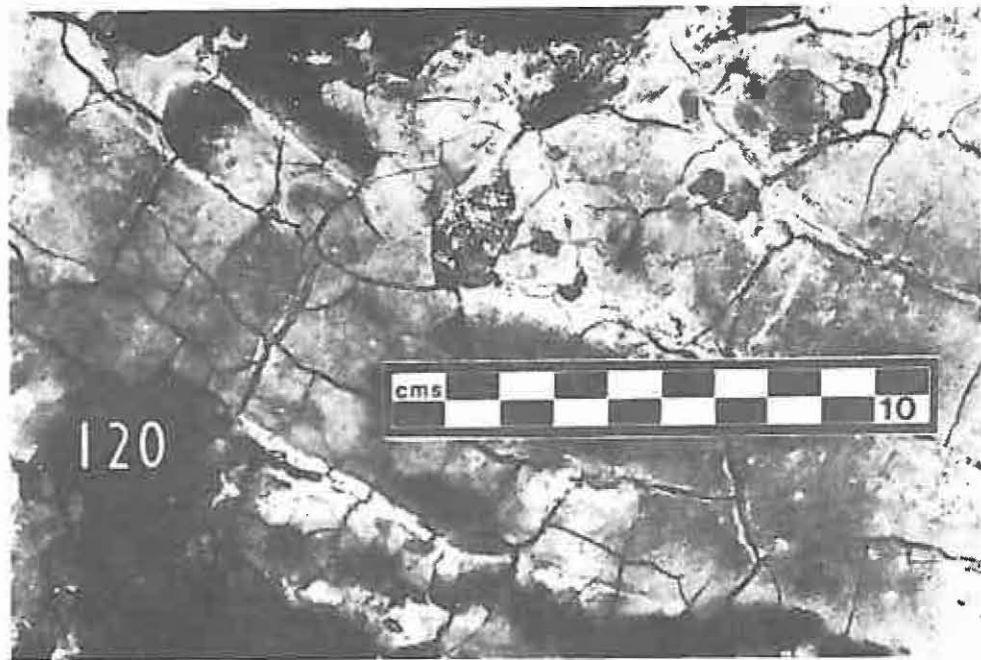


Figure 12. Luting on outside surface of inner plank fragment.

d) The Bulkheads

Traces of six bulkheads were found on the site. Remains of dislodged sections of bulkheads were found lying around the wreck site enabling a reconstruction of bulkheads 1 and 2 (Fig.13).

The bulkheads consist of two components; the bulkheads themselves and a lightly constructed, bevelled frame, locating and securing the bulkhead to the hull. In all cases, the bulkhead frames were on the side of the bulkhead nearest the midships.

The construction of the bulkhead was as follows, the bulkhead consisted of a number of parallel planks 70 mm thick, dowelled together with round pegs in the same manner as the strakes of the hull planking. The ends of the planks were shaped so that they fitted flush with the hull planking, and appeared to be lightly nailed to the planking at the narrow ends. There was no evidence of dowels being used to join the bulkheads to the hull. The lowest bulkhead plank is triangular in section, lying symmetrically over the keel. The extreme ends of the planks were also trimmed in the same way as the scarp-joint of the planks.

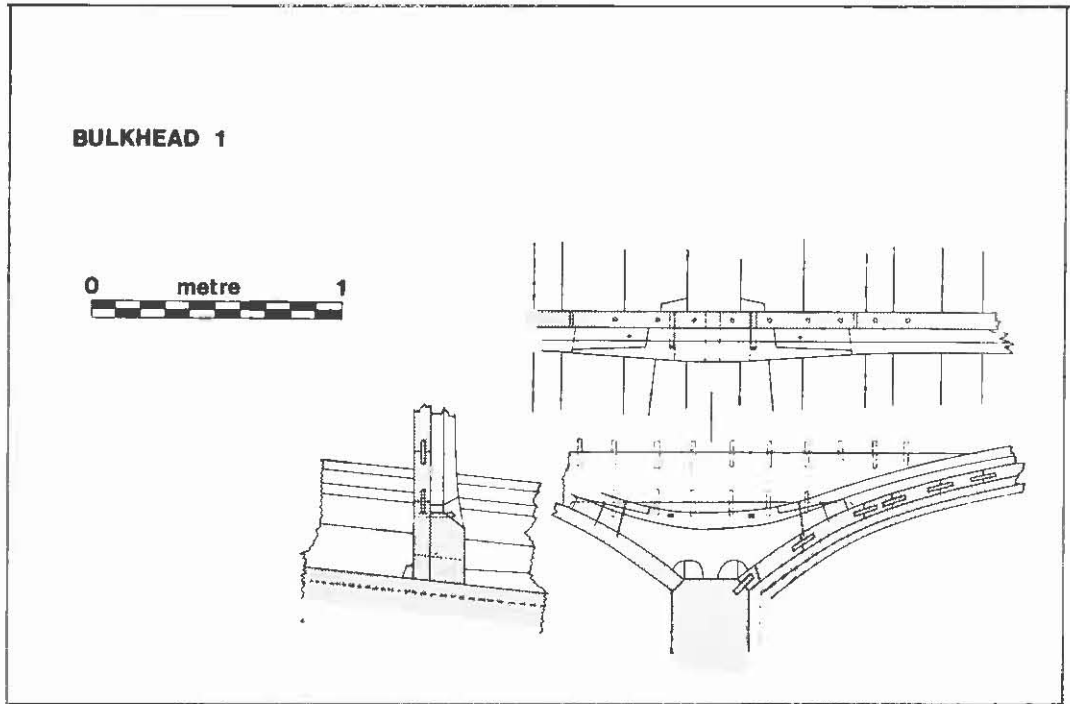


Figure 13A. Bulkhead 1.

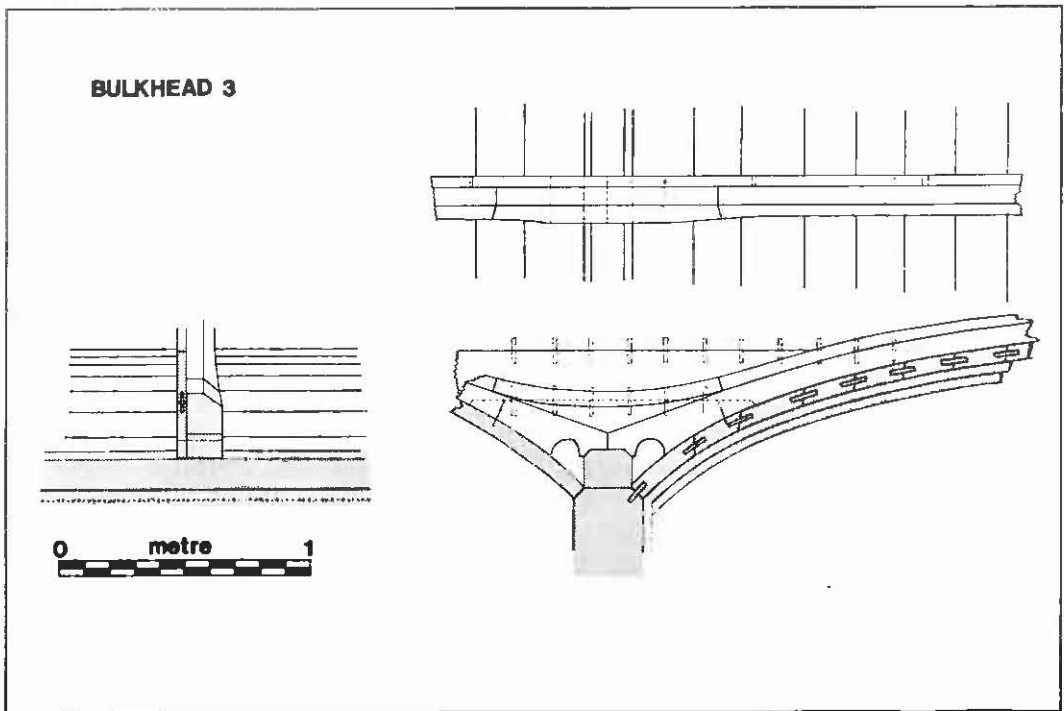


Figure 13B. Bulkhead 3.

Because of the additional keel member on top of the keel, the shape of bulkheads 1 and 5 were different from bulkheads 2, 3 and 4.

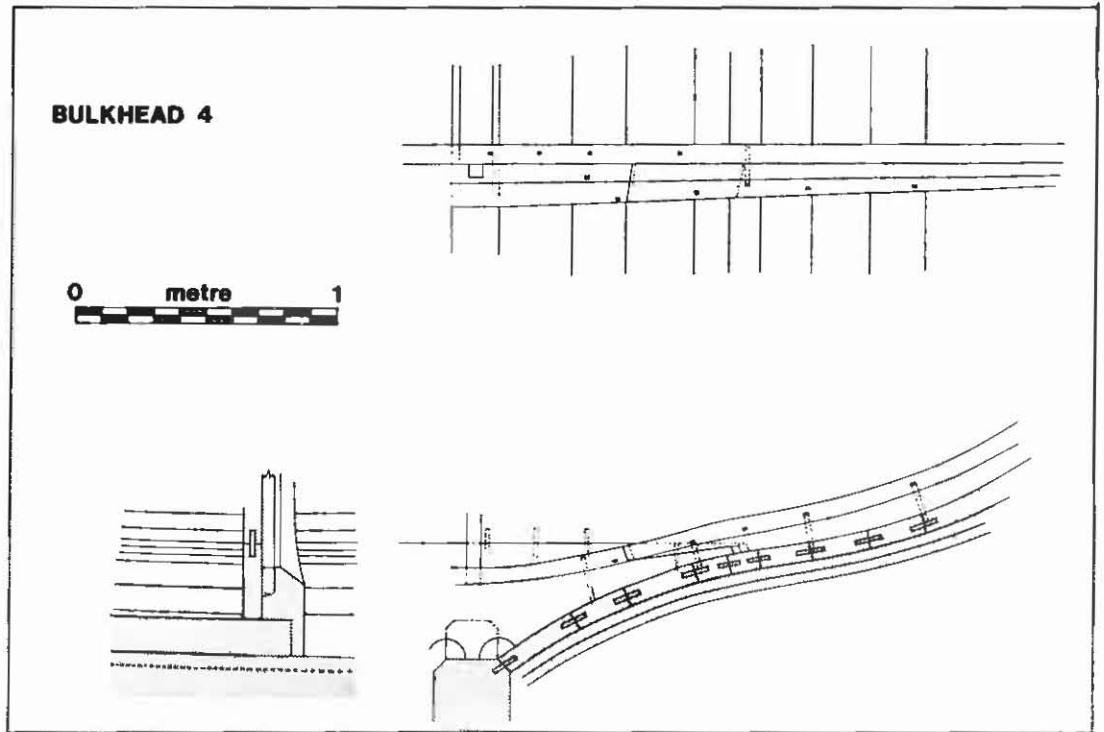


Figure 13C. Bulkhead 4.

In the latter case, the water-ways consisted of two circular holes, 110 mm in diameter, lying on either side of the additional keel member. In the former case, interestingly, there were still two water-ways of the same shape, but the section between the water-ways extended down to meet the keel, separating the two holes.

The frames lodge against the side of the bulkhead nearest the midships. The central frame was a floor in all cases except for bulkhead 3, where it was a half frame. In this case the two half frames were clamped with a chock (Fig.13). In all other frames, the first futtocks were scarphed to the floors.

The frames were nailed to the bulkhead and to the hull, with lateral and vertical nails. There was no obvious pattern to the nailing, but in general, the lateral nails ran from the bevelled surface through to the bulkhead, whereas the nails securing the frames to the hull were nailed from the top surface.



Figure 14. The mast step.

e) The Mast Step

On the southern side of bulkhead 6 was a large block of wood, shaped to fit the bottom of the ship, sitting symmetrically across the keel against the bulkhead (Fig.14). On the flat top surface, a number of holes or recesses had been cut. It is thought that this is a mast step, of sorts. Two large rectangular holes, 110 mm by 260 mm, are cut 90 mm deep, equidistant from the mid-line. On the west side is a round hole 110 mm in diameter which is inclined at about 50° towards the centre. A further two small notches, 90 mm by 80 mm, are located on the southern edge of the top surface. The mast step has two water-way holes similar to the other water-way holes in the other bulkheads.

Discussion

The Pattaya wreck site is clearly an Oriental type ship with bulkheads and dowel edge-joined planking. As such, it is a complete departure from the European skeleton-first tradition. It is only slightly more closely related to the shell-first technique of the Graeco-Roman Period. The major difference is that the European tradition relied on regular frames to provide some or all of the lateral strength of the ship. These frames were clamped to the keel with a keelson, and in some cases, additionally strengthened with a layer of internal planking known as the ceiling.

Oriental ships obtained much of their strength from a series of regular bulkheads which compartmentalised the ship. This is the fundamental difference. The edge-joining with dowels implying a shell-first technique is similar to the shell-first mortise-and-tenon edge-joining of the Graeco-Roman tradition.

Unfortunately, little is known of Oriental ship construction and there is a widely held view that all or most Chinese vessels are flat-bottomed and have no keel. However, there is a growing body of evidence from archaeological sources that this is not always the case.

In 1975, a ship was discovered and excavated from the side of a river bank at Quanzhou, in Fukien Province, China. A series of reports were published in *Wen Wu*. The first report, by a group of archaeologists, describes the excavation, in 1974, and the finds. They conclude that the date of the loss of the ship was around 1274 (Song Shipwreck, 1975a). The second report, by the Department of History at the University of Xiamen, describes the ancient port of Quanzhou in the Song and Yuan Dynasties (Song Shipwreck, 1975b). The third report, discusses the naval construction in the Song Dynasty (Song Shipwreck, 1975c). The fourth report discusses the reconstruction of the ship (Song Shipwreck, 1975d). Other authors have discussed this site, notably Keith & Buys (1981) and Salamon & Lombard (1979).

There are a number of interesting features about this ship which help in the interpretation of the Pattaya hull structure. Firstly, the Quanzhou ship has triple planking. This runs from the main wale down to about one third of the way to the keel where the planking reduces to a double layer. The inside layer of planks is 203 mm thick, the two outer layers 137 mm; a much heavier construction than the Pattaya site with an inside thickness of 70 mm and an outside thickness 140 mm. It appears on the Quanzhou ship that one of the outer layers continues around the keel, suggesting that the outer layers may be non-structural sheathing. The hull has a rather unusual treatment of the planking, having

stepped layers of strakes; thus a series of strakes is broken by a step, so that some strakes resemble carvel construction and some clinker. Furthermore the planks are joined in a narrow rebate (Song Shipwreck, 1975d Fig. 3 (top), between pp. 30 & 31). The lower part of this figure shows the mast step. The mast step clarifies a number of problems in interpretation of the Pattaya shipwreck. On the Pattaya site, it was initially far from clear which was the bow and which was stern, and the discovery of the mast step did not resolve this; it was tentatively thought that the bows were to the north, because the mast step sockets gave the greatest strength to the south. The Quanzhou ship mast step shows that the step is braced against the bulkhead on the aft side. Thus, the leverage on the mast caused by the sails is exerted forward at deck level and aft on the step. Thus, the step is located against the bulkhead, with two longitudinal, square-section wooden braces or chocks running between the step and the next bulkhead forward. This explains the two small notches on the leading edge of the step; these are almost certainly to locate these braces.

A similar mast step has been found on the Bukit Jakas site at Pulau Bintan in the Riau Archipelago, Indonesia (see Manguin's report in Appendix 2). The mast step, in this case, seems to be at the stern, with the step on the side of the bulkhead away from midships. This step also has similar notches, but these are orientated away from midships. The frames in the bow section of the site are on the midships side of the bulkhead, indicating that this arrangement changes somewhere in the centre of the site (as yet unexcavated).

Thus we may conclude, from the evidence of the Quanzhou ship that the bows of the Pattaya site are to the south, and it was the bow section that was excavated. It is also suggested, from the evidence of the Bukit Jakas site, that the frame bulkhead orientation may reverse in the stern. The Quanzhou ship and the Bukit Jakas site have many similarities to the Pattaya ship, including a water-way through the bulkhead, which again strongly indicates that compartments were not necessarily watertight. Both sites also had two large sockets on their mast steps, but unfortunately the mast did not survive in either case.

Worcester (1971) illustrates a number of vessels from the Yangtze, which have similar mast steps. These examples explain the function of the double sockets, which are used to locate the tabernacle partners. These consist of a pair of cheeks, flanking the mast, which are braced against the side of the ship at deck level to prevent lateral movement of the mast. The fore and aft movement is restrained by lateral cross beams, and the bulkhead itself. The advantage of the system is that the mast can be either lowered, or its rake altered from the vertical to take advantage of the sail characteristics which depend on the direction of the wind.

Whilst the Quanzhou wreck site is the closest parallel site to Pattaya, other sites have been discovered that also bear similarities. The Shinan (or Sinan) wreck site was located in 1976 and since then has been systematically excavated by the Korean Cultural Property Division. To date, a large quantity of ceramics has been recovered and has been the subject of numerous publications and exhibitions: National Museum of Korea (1977 & 1978), Ayres (1978), Valenstein (1979), Zainie (1979), Keith (1980), Kim (1980) and Hahn (1980).

Recently, excavation work has started on the hull structure, and this has been reported by Kim (1980) and Green (1983). The Shinan ship has a rebated clinker hull structure, a strong "V" cross-section, and a bulkhead construction. This is a major departure from the normally accepted Asiatic hull construction. Kim argues that this is a form of South Chinese ship construction, based on the fact that both North Chinese and Korean ships were flat-bottomed, whilst Korean and Japanese ships were box-like, without bulkheads. The box-like structure was a reflection of crude shipbuilding technology, the shape resembling a modern tank-landing craft. The individual bulkheads were replaced with a vertical series of cross beams which penetrate the side of the ship. This technique could still be seen in Korea up to a few decades ago (Underwood, 1934). One important similarity the Shinan site has with the Pattaya wreck site is that the bulkheads have a water-way which allows water to pass from one compartment to another.

Other sites with edge-joined planking include the Sha Tsui site in Hong Kong (Frost *et al.*, 1974), where there was reference to double planking. The one bulkhead recovered had no trace of a water-way. The ceramic finds were predominantly Thai, indicating that it may in fact have originated from Southeast Asia, possibly Thailand. Manguin (1980) refers to another site found in Pontian, near Pahang, said to date from the 1st millennium A.D.

The only other site to have been published with hull structure is the Sattahip wreck site (sometimes called Ko Khram) Howitz (1978). The illustration showing the plan and cross-section is a little confusing, but clearly shows a bulkhead construction, with edge-joined planking, see Green & Harper (1982b).

In the body of literature relating to relatively modern Chinese ship construction, there are numerous references to different types of junks. In these examples, most hull planking is edge-joined with nails as well as being secured with nails to ribs or bulkheads. Waters (1946) notes that this method of securing adjacent strakes with nails, is used by all Chinese junk builders, except those in the extreme north of China. In the latter case, planks and timbers are secured with wrought-iron clamps (Waters, 1938), as in the Andong Trader. However, some northern built junks, such as in the Pechili Trader, used the edge-joining system

(Waters, 1939); this type of junk was said to be one of the oldest class of ocean-going vessels. Whilst this body of written evidence from modern (usually European) writers, records many similarities with the archaeological evidence discussed above, it does not mention the dowel edge-joined planking nor the water-ways in the bulkheads. Needham *et al.*, (1971) does not mention hull construction in detail, nor methods of edge-joining (nailed or dowelled).

It is clear that there is a lot of confusion in the area of Asiatic shipbuilding. Firstly, there is much regional variation. North China, Korea and Japan appear to have shallow-bottomed ships in either the box-like construction or the whale-backed turret design. The Southern Chinese construction was with a keel (in some cases) and was a more seagoing design. What the situation was in Southeast Asia is not clear, although Manguin (1980) advocates a hybrid type of ship, used in Southeast Asia and Southern Chinese waters. Such a type would have been built for the Chinese traders in Thailand.

There is little written material on early Chinese ship construction, and what there is, is obscure. Unfortunately, much of the modern observations of junks were by Europeans in the 15th century and onwards, in a period when the construction of these vessels may have been modified by European contact. It is hoped that the growing body of evidence from archaeological sources, will expand our knowledge of early Asiatic ship construction, and fill this gap.

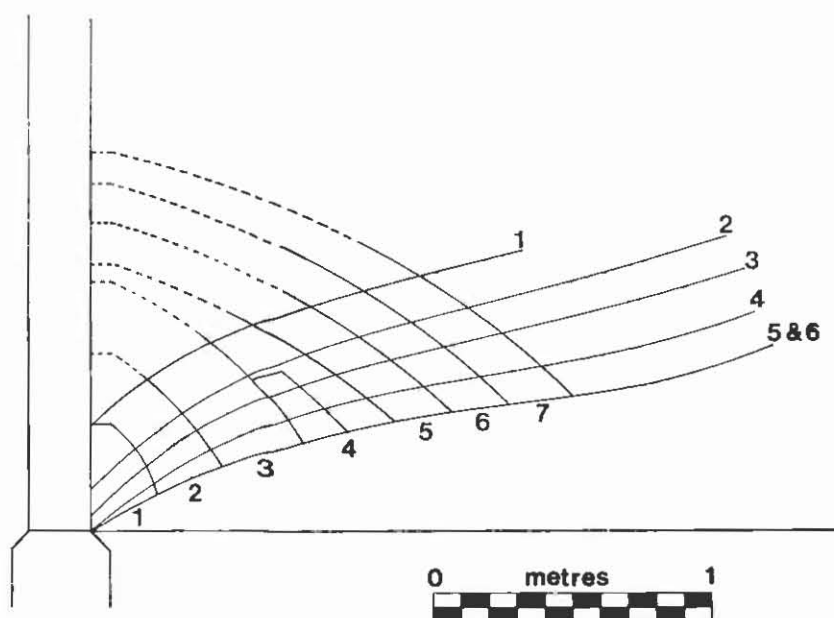


Figure 15A. Body plan showing strake lines.

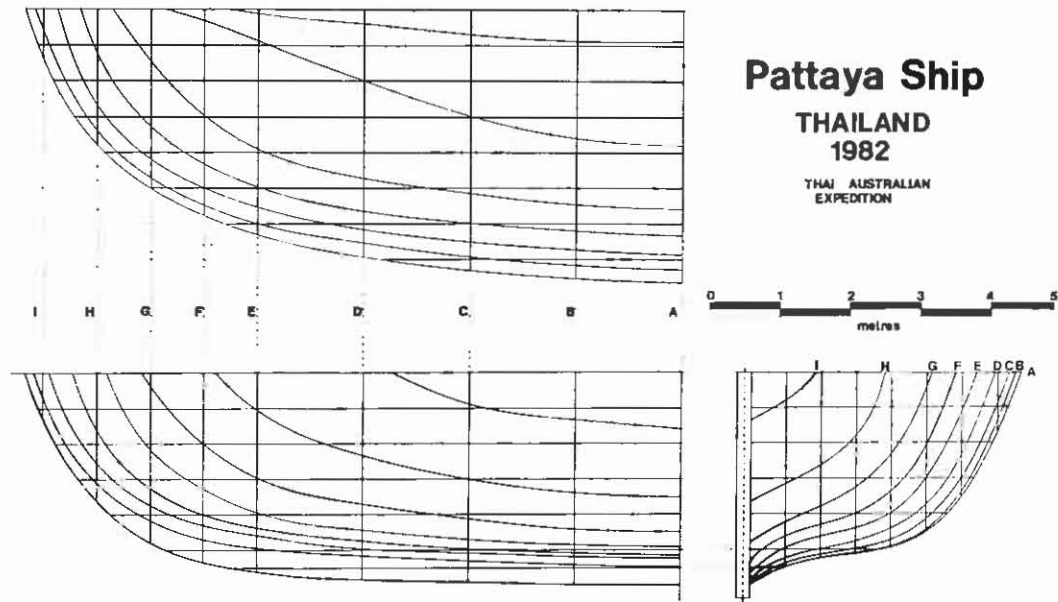


Figure 15B. Pattaya wreck site lines drawing.

The lines drawing of the hull (Fig.15), is an attempt to project what the missing hull structure looked like. Unfortunately, only a small portion survived, and the recording was insufficient to make an adequate reconstruction. In view of the fact that the stern section is still to be excavated, these plans should be considered tentative.

During the 1982 expedition, we were informed of a wreck site to the north of Pattaya. It was decided, towards the end of the excavation, to visit this other site with the aim of carrying out a brief investigation. The visit was made as a day trip, in company with one of the T.F.A.D. staff who knew of someone who could locate the site. The guide was found and he led us, in his small motorised flush-decked boat, to a site several kilometres off-shore where the depth of water was about 35 m. Here, looking back on an almost featureless island, the fisherman indicated the location of the site.

With considerable scepticism, the first diver was sent over the side to carry out a circular search to try and locate the site. All our doubts were completely confounded. The diver surfaced with a set of blue and white porcelain plates and dishes, and informed us that there was indeed a wreck site below. Unfortunately, the diving time was limited to twenty minutes. However, more artifacts were raised in that short time than in the whole of the excavation of the Pattaya pottery site. The artifact catalogue (below) speaks for itself.



Figure 16. Wreck site G, basins stacked in a row.

Most of the ceramics were found in localised areas. It is noteworthy that of the five divers who inspected the site, each came to the surface with different selections of material. Three

basins or bowls (G43) were found as part of a series, stacked together and lying on their sides (Fig.16). The kendis were found in a group, some on the surface (Fig.17), and the blue and white porcelain was located by one diver. Large structural timbers were also noted and photographed on the seabed.



Figure 17. Wreck site G, kendi sitting on site.

This is an extraordinary find, since one would expect, particularly in such warm water, that exposed timber would be completely eaten away by toredo worm and marine organisms. Two timber areas were noted. One small area, about 1 m x 1 m, where seven round, unshaped timbers, about 100 mm wide were found lying side by side, butting against some longitudinal timbers (Fig.18). In the other area, square shaped timbers, about 200 mm wide and 200 to 400 mm apart, were noted extending over an area about 2 m square (Fig.19). There is no doubt that this represents some form of integral hull structure, but from such a superficial survey it is not possible to draw any positive conclusions as to what part it represented on the ship.

Thus the site is relatively undisturbed, and whilst it was obvious that its location was known, it was clear also that the site had not been extensively dived upon, nor had it been looted. The ceramic material is most interesting, particularly as we can speculate on the origin of the ship. The most obvious indication of the origin of the ship is the porcelain cargo, which is Chinese. Four plates were found, two were decorated with a gourd in the central medallion, the other two with a fan. The plates are what is commonly called Swatow Ware, identified by the sand grains

adhering to the footrim, and their general style and shape. The decorations in the interior centre are the Daoist emblems of the Eight Immortals. As such, we would expect to find six other types of plate designs bearing the other six emblems. This is, therefore, a strong indication that the plates are cargo. The other porcelains are not Swatow ware. The most important piece is a bowl with the Wanli reign date. This clearly dates the site to the period 1573-1620. The other pieces include fragments of eggshell porcelain with interesting and curious decorations.



Figure 18. Unshaped timbers butting against longitudinal timbers.

Because of the paired plates, there can be little doubt that the ship was carrying trade porcelains. This and the lacquer ware point to a Chinese origin for the ship. However, the lids G34-38 are certainly Thai in origin, and have been found on a wide variety of sites: Ko Kradat (Green *et al.*, (1981), Green (1981a & c), Green & Harper (1982a), Howitz (1977, 1978 & 1979)); Ko Khram (Howitz (1978)); Sha Tsui (Frost *et al.*, (1974)); and Pattaya site (see above).

Likewise the large storage jars (G50), are thought to be Sawankhalok ware and have been found on a number of wreck sites: *Batavia* (Stanbury (1979) BAT545, Green (1982)); *Vergulde Draeck* (Green (1977) GT913, Green (1981a and c); *Witte Leeuw* (Pijl-Ketel (1982) 5.10); and Ko Khram (Brown (1975), Green (1981c). They are also known from the Indonesian collections (Adhyatman & Lammers (1977) 3M 1 and 2), from Sarawak (Moore (1970) 6c (not illustrated)), and even as far away as Fort Jesus in Kenya (Kirkman (1974) Fig.70-16) and on the Portuguese ship *São Bento*, wrecked in 1554 on the Pondoland coast, South Africa, (Auret & Maggs (1982) Fig.36).



Figure 19. Wreck site G, square shaped timbers.

Large quantities of fish vertebrae were found in one jar together with a wooden bung. This bung had resin remains around the edge, indicating the shape of the neck and the way in which the jar was sealed. It is therefore possible that the jars may have contained food or provisions for the voyage.

The large group of kendis, seven in all, again clearly indicate cargo. In this case there is some doubt as to their origin of manufacture. A very similarly shaped kendi to type B, with the same type of fluting, but green glazed earthenware, is illustrated in *Oriental Ceramic Society (Hong Kong)*, (1979) No.159, and is said to come from South China. Other fluted kendis are illustrated in Sullivan (1957) Figs.17, 18 & 21, and Sullivan (1958) Fig.27. Also Sullivan (1963) illustrates a sixteenth century porcelain kendi (Fig.48a) and a Fukien Ware kendi from Indonesia (Fig.52b). Fluted kendis are also illustrated in Evans (1923) Plate 6 and 9

and also in Wai-toon (1951). Whilst no better parallel for this kendi can be found from a Southeast Asian source, fluting being rare, there are numerous examples of Thai kendis of the same general shape (without fluting), Brown (1977) Fig.21, Sullivan (1957) p.44, and Refuge (1976) Afb.110. The evidence for the origin of these fluted kendis, thus on balance, slightly favours a South China source.

The stove is similar to the stove No.40 from Ko Kradat, Green *et al.*, (1981), having much the same dimensions and shape. The only major differences being the more pronounced forward prong on the pot holder and the two holes in the pot stand.

Only one other ceramic oven to our knowledge, has been illustrated. Guy (1980). This was found in a grave at Santa Ana in the Philippines and has a different type of chimney pot stand.

The three other items, a jar (G40), a squat pot (G41) and a bowl (G43), all have similar base finishes. The base appears to be bevelled and is most uneven, appearing not to have been cut from the wheel, but roughly carved. The jar G40 is closely paralleled to a jar from the *Witte Leeuw: Pijl-Ketel* (1982) 5.14, which is attributed, by its shape, to Sawankhalok ware. This attribution is unfortunately not referenced. One would expect Sawankhalok material to be attributed more by the fabric of the body, rather than by shape. The *Witte Leeuw* jar has the incised grooves, which are a feature of a number of Thai wares (for example G50 here). These grooves are used to help in the application of the handles, although on G40 there is only a small ridge, which itself is a feature of many large Sawankhalok jars. The squat pot resembles the Chinese ginger jar and is unusual, with no parallels at all. The basin G43 is commonly found, and as a basic utilitarian domestic item, cannot be easily attributed to any one area. Similar types are illustrated in Green *et al.*, (1981) No.31, Howitz (1977) Fig.4, from the Ko Kradat site, and Howitz (1978) Fig.7. With these three items, normally one would tend to favour a Thai source, however the unusual treatment of the foot is worrying and tends to favour a non-Thai source.

Finally, twelve pyramidal lead ingots were recovered from the site. These were flatter than those found on the Pattaya site (see above) and again strongly indicate a Thai origin for the vessel.

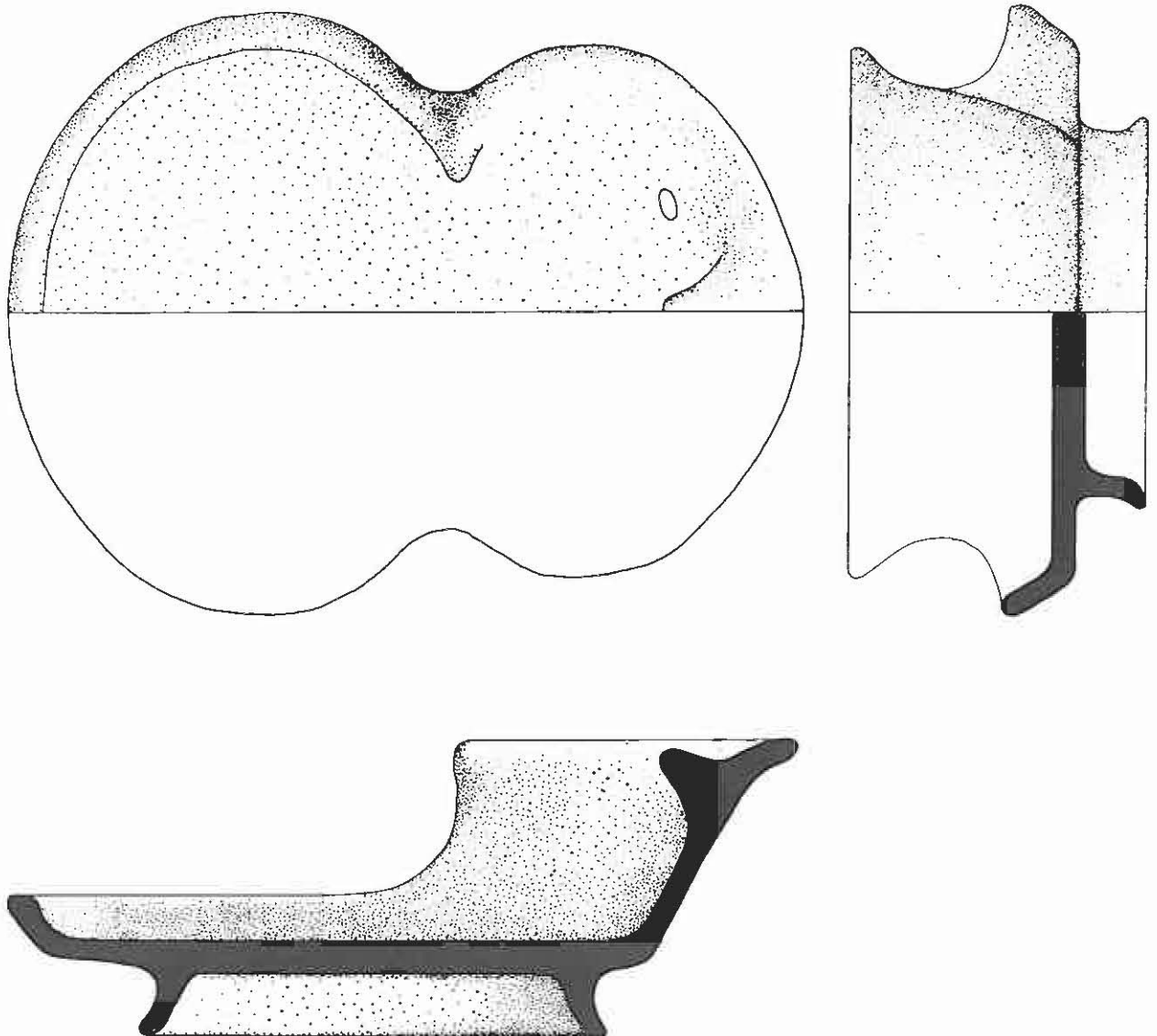
Only thorough and systematic excavation of this site will resolve these problems. Clearly the site is of great significance and it is hoped that an excavation will commence on this site in 1983.

CHAPTER 4.

WRECK SITE G ARTIFACT CATALOGUE

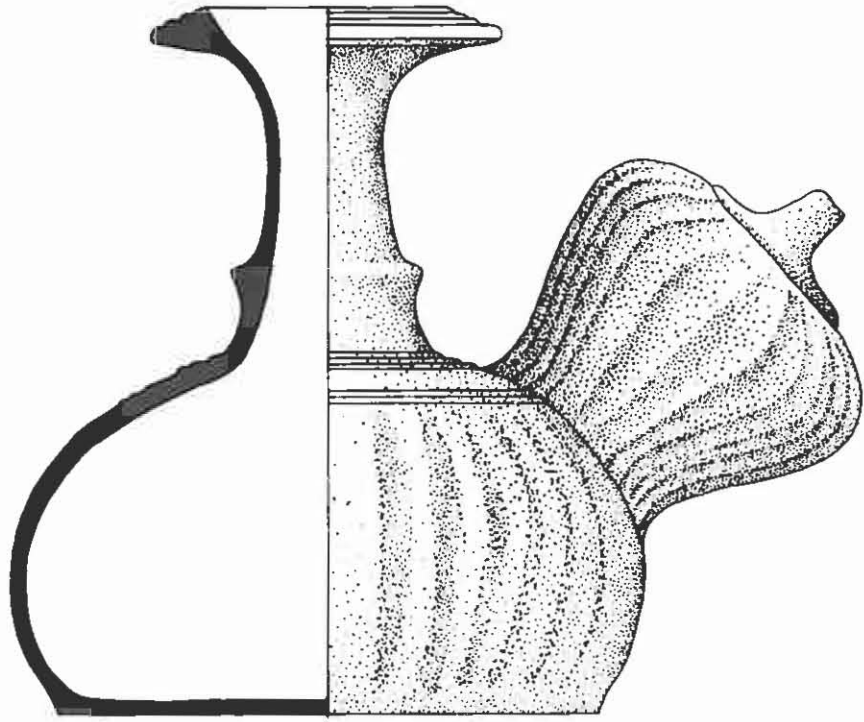
NOTE ALL ARTIFACT
DRAWINGS SCALE 1:2
EXCEPT WHERE OTHERWISE STATED

1. EARTHENWARE



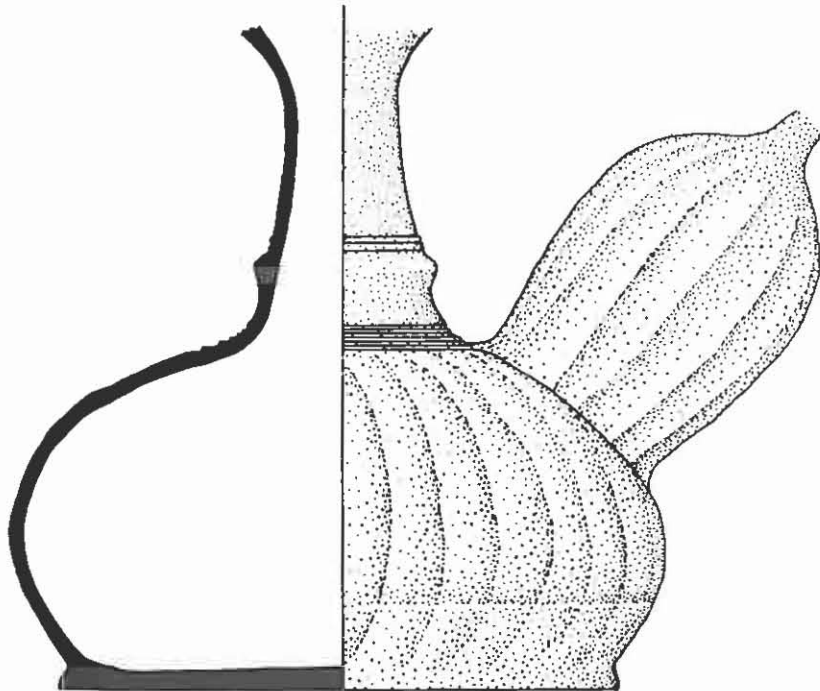
- a) Stove G39 1:4
Roughly oval footrim with large flat firehearth. Raised section at one end forms a type of chimney, with three projections at the top, forming a pot stand. Closely resembles the stove from Ko Kradat, Green *et al.*, (1981) No.40 and similar to Guy (1980) Fig. 9 and front paper.

b) Kendi



G10

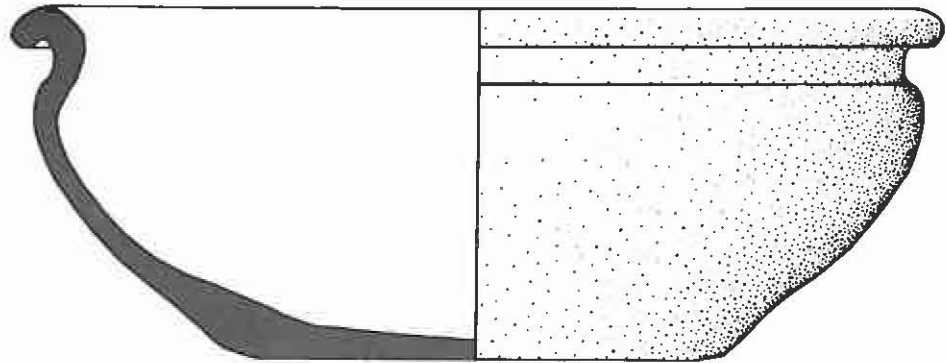
Black body. Fluted vessel with bulbous mammiform spout. Ridged disc-like collar and trumpet-shaped neck, ridged on shoulder. Flat base.



G15

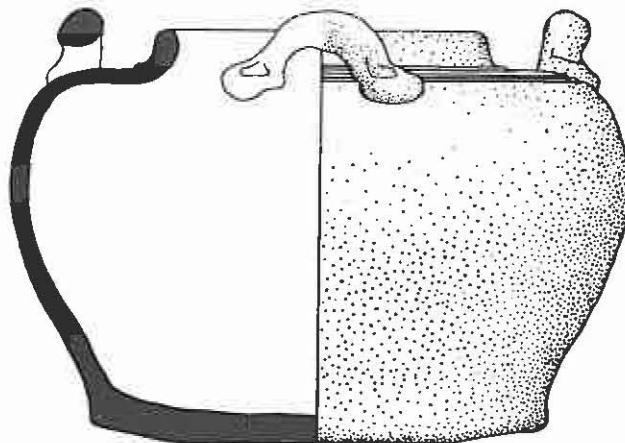
Black body. Fluted vessel with elongated mammiform spout. Ridged disc-like collar and trumpet-shaped neck, ridged on shoulder. Flat base. This resembles Kendi No.159 Oriental Ceramic Society (1979).

c) Bowl



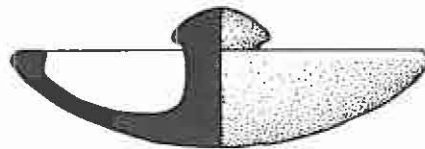
G43
Orange-grey body. Everted rim, carved base. Bowl is roughly formed.

d) Squat Pot

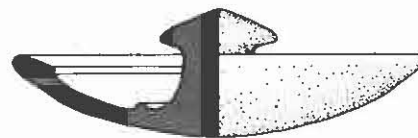


G41
Orange body. Four lug handles, one ridge at join of neck and shoulder, three ridges where lugs join body. The base is roughly carved.

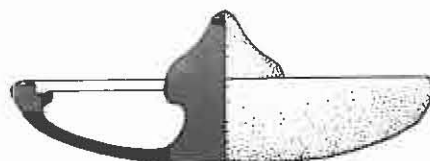
e) Lids



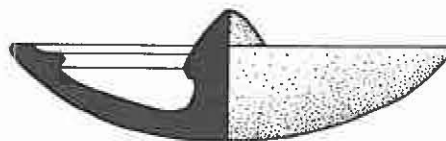
G34
Buff body. Elongated neck with knob handle.



G35
Grey-buff body. Knob handle, more flared at base than above. Ridge at base of neck.



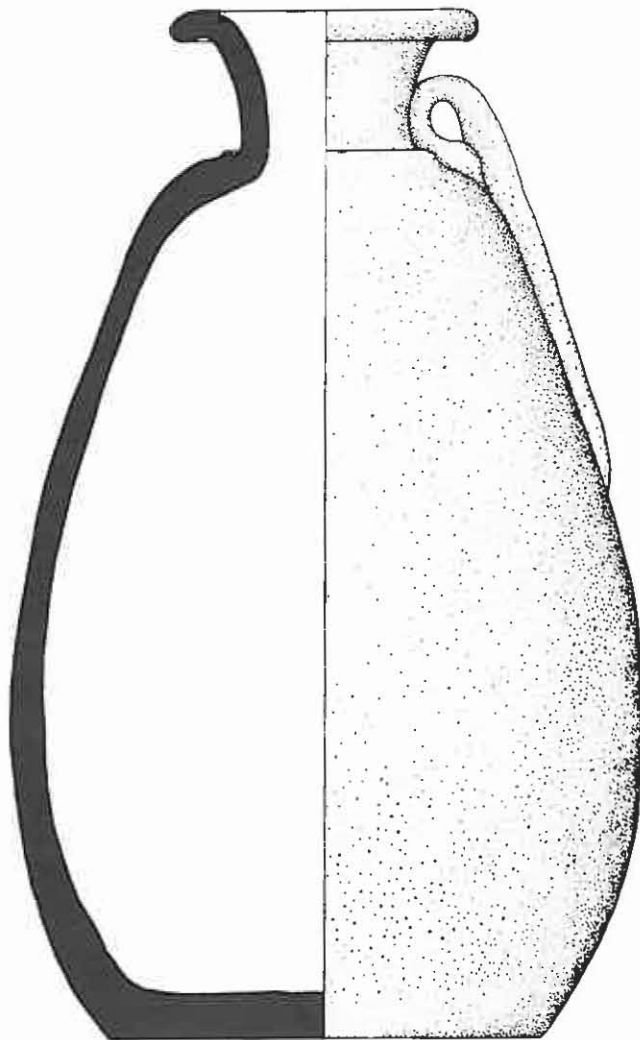
G37
Buff body, lotus bud-shaped handle.



G38
Dark grey body. Lotus bud-shaped handle.

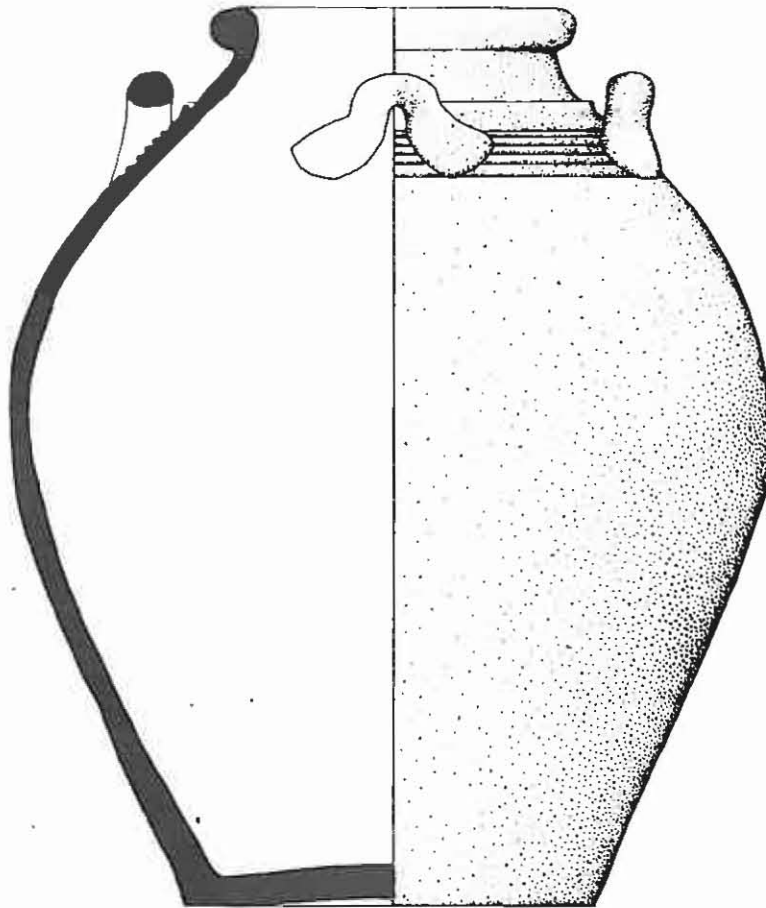
2. STONEWARE

a) Medium Jar



G40
Pear-shaped, blue-grey body. Everted lip, two handles with long tongues joining body. Ridge at join of neck and shoulder. Very rough base with clay and sand adhering. See Pijl-Ketel (1982)5.14.

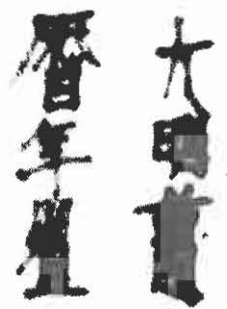
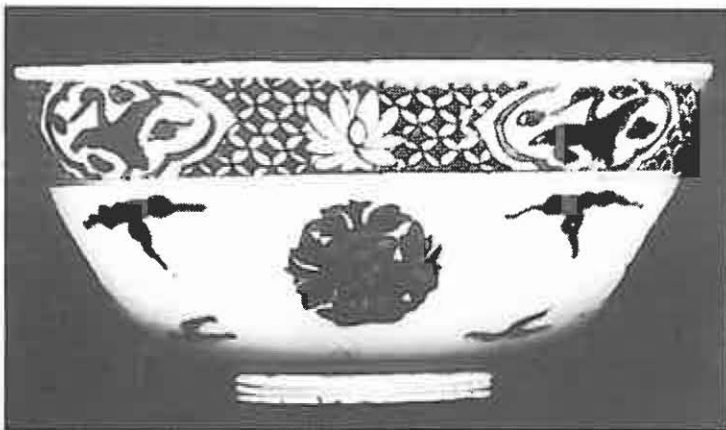
b) Large Jar



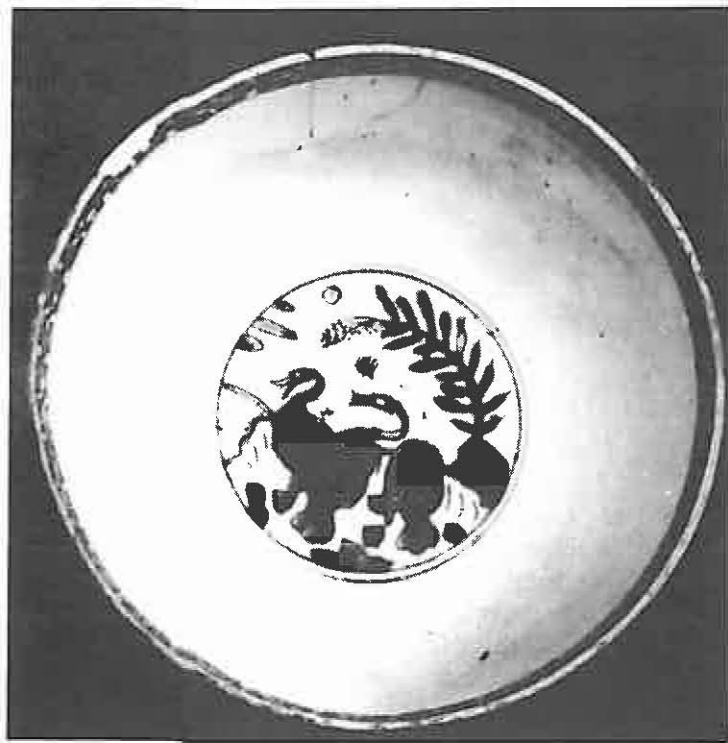
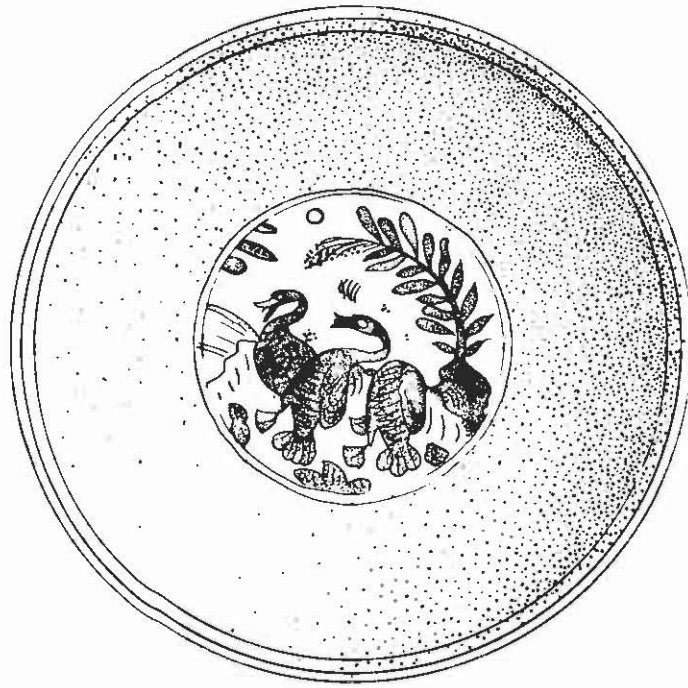
G50 1:4
Ovoid form. Red body. Degraded yellowish glaze, possibly ash. Everted, rolled lip, four lug handles, one ridge at join of neck and shoulder, five incised lines where lugs join body. This jar was full of fish vertebrae, and contained the wooden bung G51.

3. PORCELAIN

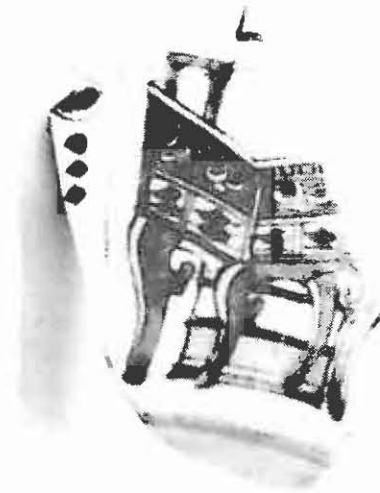
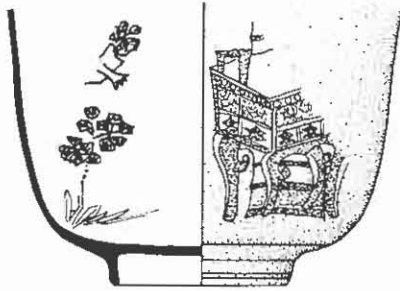
a) Bowls



G1
Blue and white. Central medallion has scene with three geese. Diaper decoration on rim of cavetto. Exterior outer rim - open lotus, alternating with fish scale and floral diaper. Four cranes in flight and cloud scrolls within a four-sided, scalloped medallion. Below are floral medallions and cloud scrolls. Chinese inscription under base reads "Da Ming Wanli Nian Zhi" (Made in the Great Ming Year Wanli). Wanli reigned from 1573-1620.

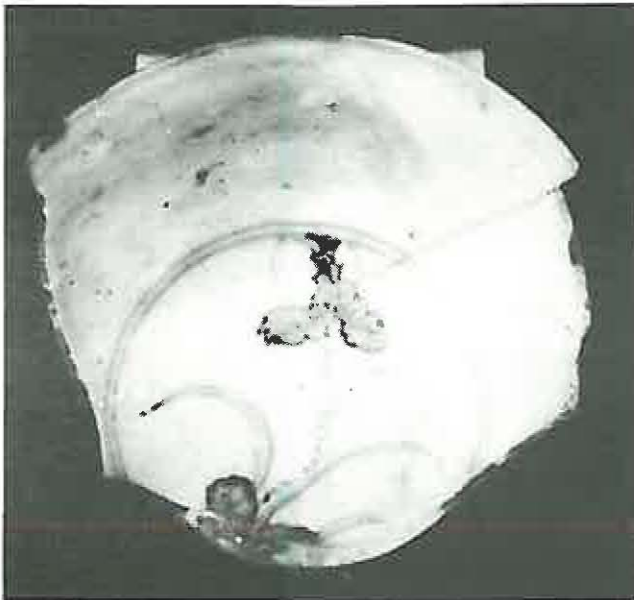
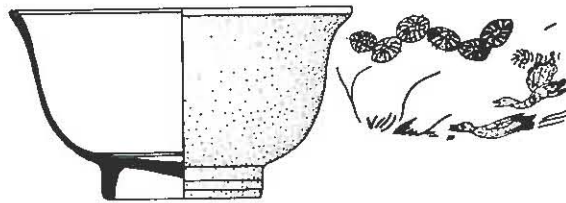
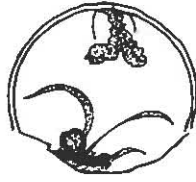


b) Small Bowls



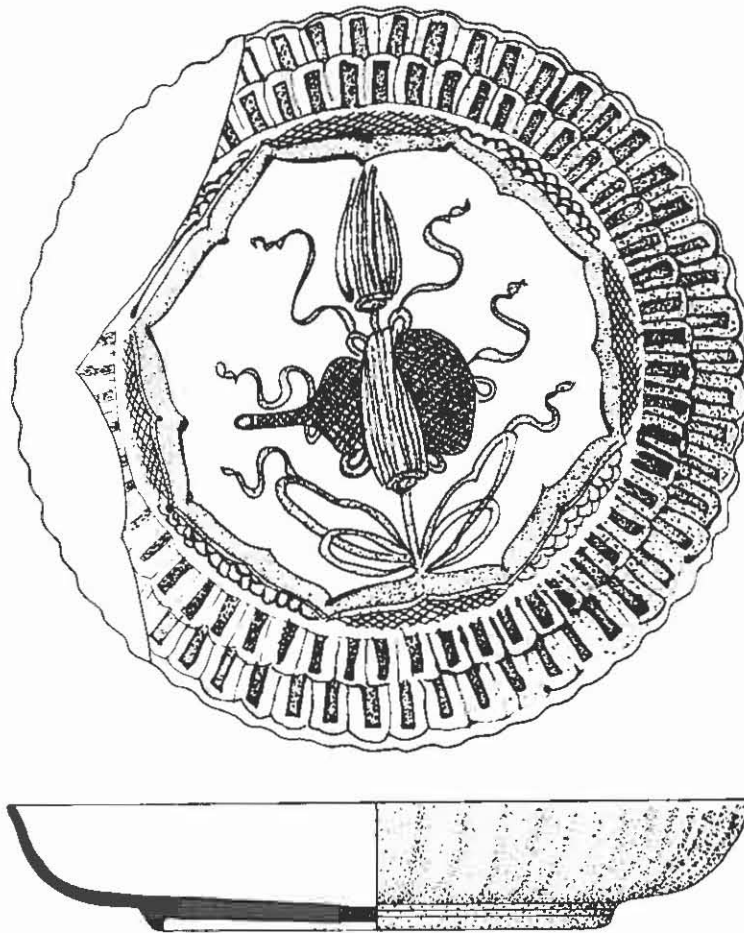
G7/8

Eggshell thin body with vertical ribbing. Blue and white decoration - furniture, possibly an altar on outside and vegetal inside. Glazed on base.



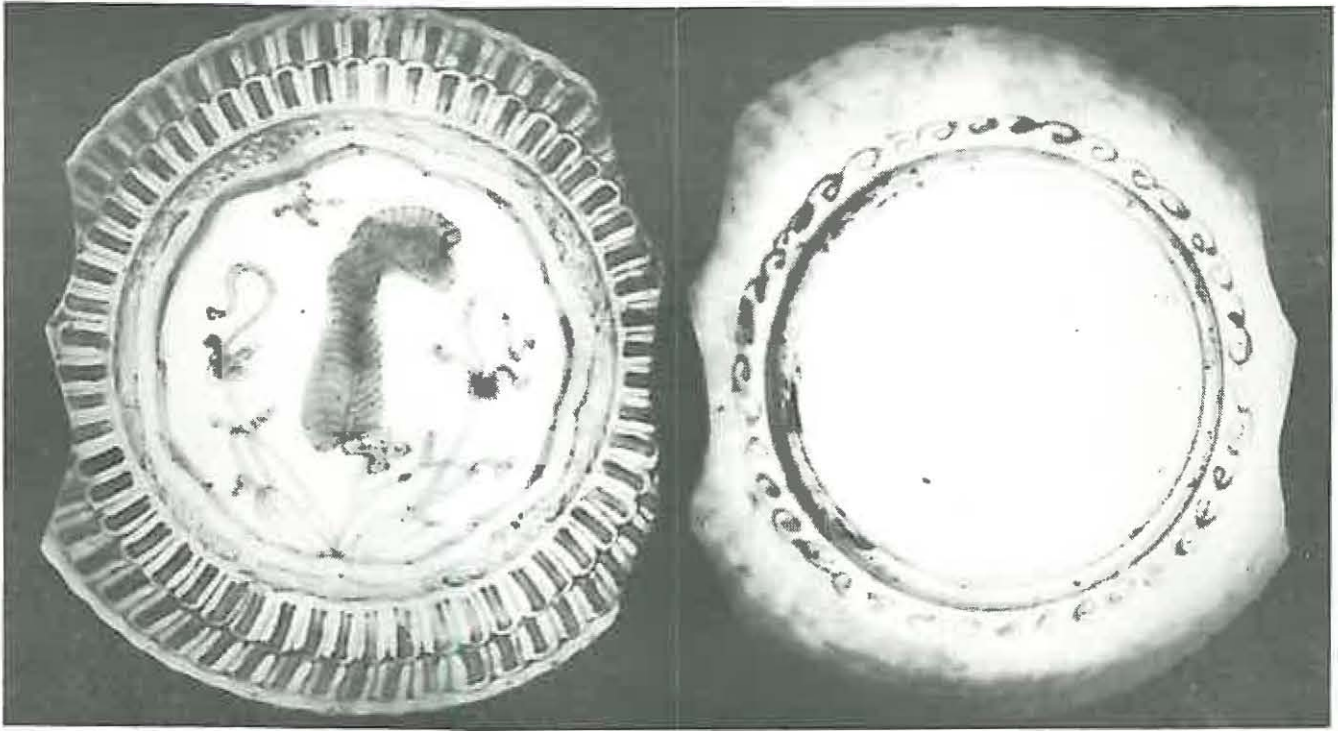
G6
Eggshell thin body, blue and white. Decoration - geese swimming, possibly underwater, and lotus leaves. Interior medallion with foliage. Glazed on base.

c) Shallow Bowl/Plate



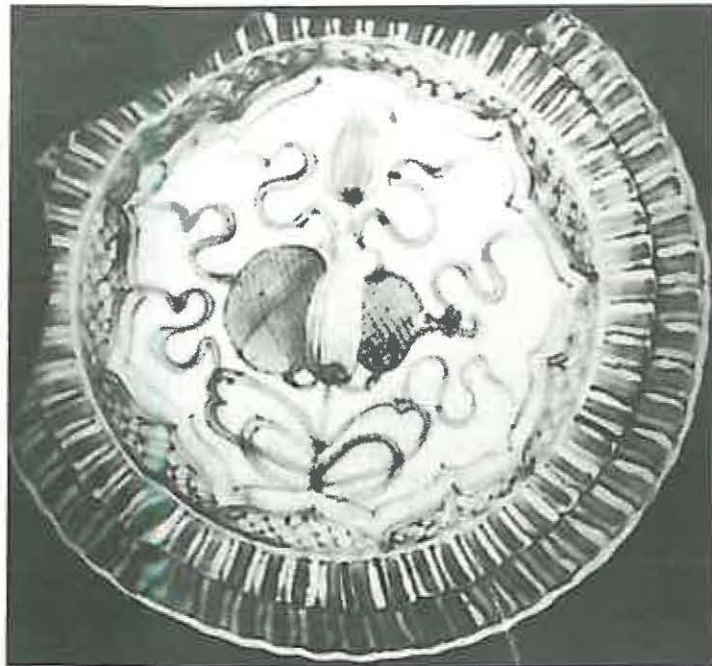
G5

One of a pair. Walls vertically ribbed. Blue and white. Decoration, a gourd inside an eight-sided scalloped medallion, with various diaper and trellis patterns. The gourd is the Daoist emblem of the sick, representing longevity. Attribute of Li Tie Guai. Glazed on base.



G2

G2



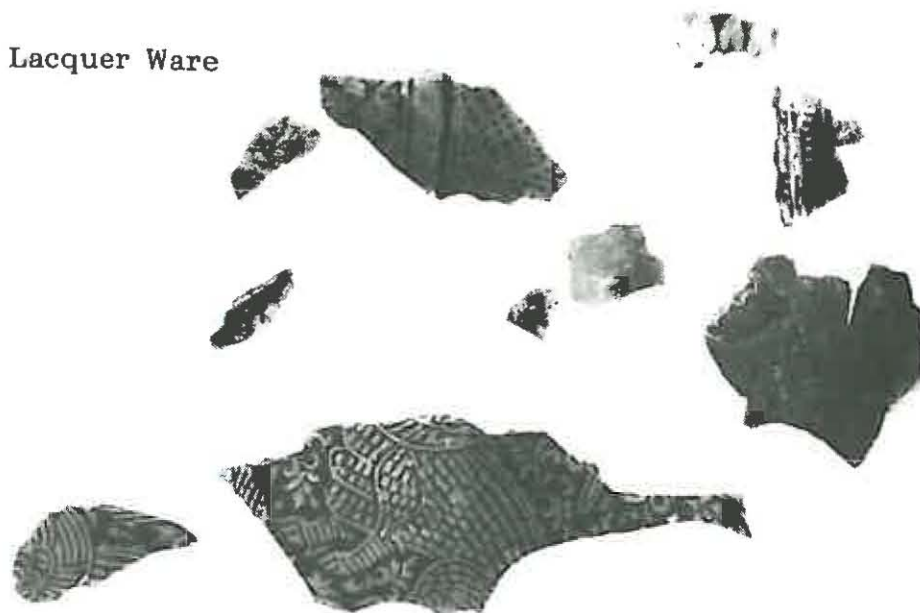
G4



G3
One of a pair. Body vertically ribbed. Blue and white.
Decorated with a fan, which is the Daoist emblem
attributed to Zhong Li Zhuan representing the military
soldier. Glazed on base.

4. MISCELLANEOUS

a) Lacquer Ware



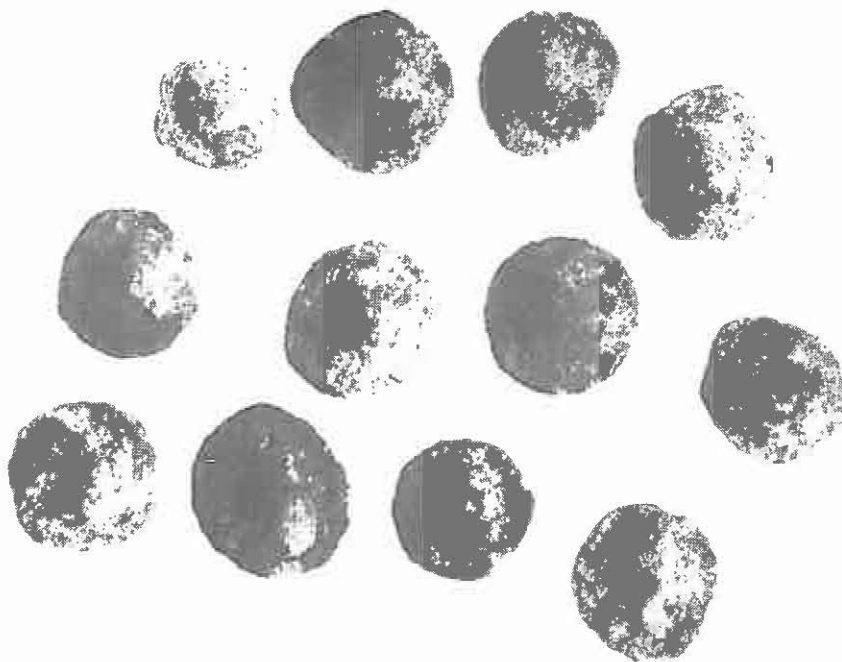
G48
Black background with decoration in red. Design includes dragon, foliage and geometric arrangements. Small fragments of a wooden container are still attached.

b) Wood



G51
Wooden bung, roughly carved. Resin on the rim of largest diameter. From G50.

5. LEAD



Ingots (12), flat pyramidal-shaped. Average 15 mm high,
41 mm wide.

CHAPTER 5. WRECK SITE S

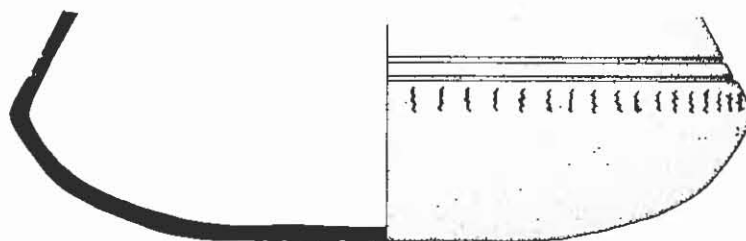
Following the visit to Site G, our guide advised us that there was another wreck site nearby. The site was about a kilometre away. The wreck was again quickly located, in a depth of 30 m. It was quite localised, about five metres in diameter. The wreck material consisted of a number of small bowls of black underglaze or celadon, together with very large storage jars and some miscellaneous finds. A fairly deep hole had been dug in the centre of the site, indicating that the site may have been excavated at some time in the recent past.

WRECK SITE S ARTIFACT CATALOGUE

NOTE ALL ARTIFACT
DRAWINGS SCALE 1:2
EXCEPT WHERE OTHERWISE STATED

1. EARTHENWARE

a) Rice Pot

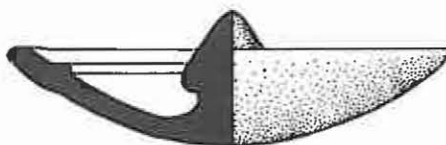


S12

Lower section of pot. Buff body, pressed decoration, two incised lines. No decoration on base.

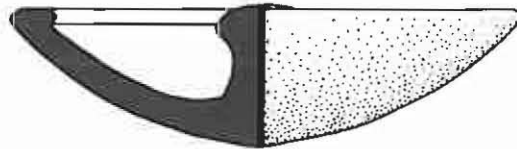
b) Lids

These lids have been found on other sites and are discussed in the Pattaya Wreck Site Catalogue above.



S14

Buff-grey body. Lotus bud shaped handle.

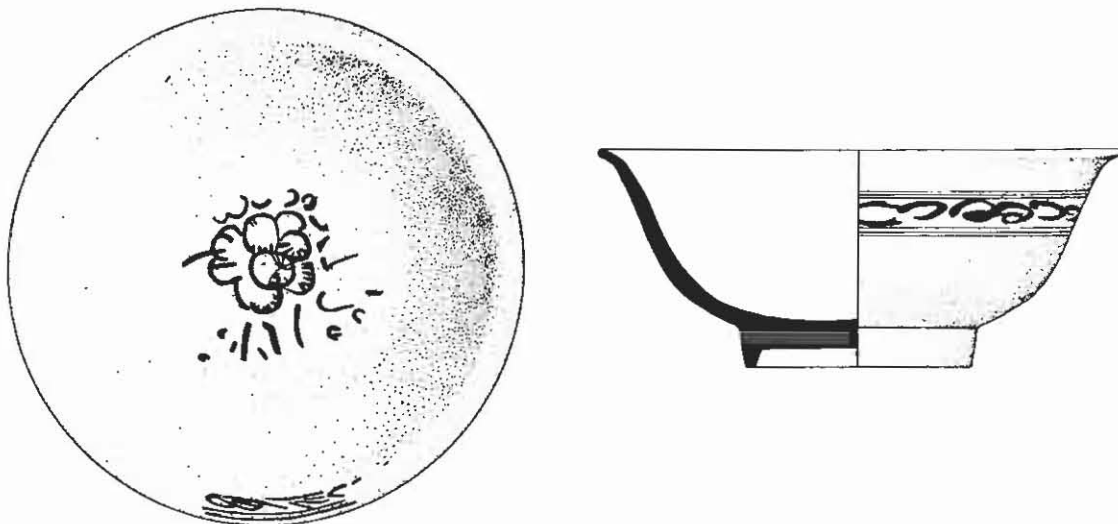


S13
Buff-grey body. Knob handle.

2. PAINTED UNDERGLAZE STONEWARE (bowls and shallow bowls)

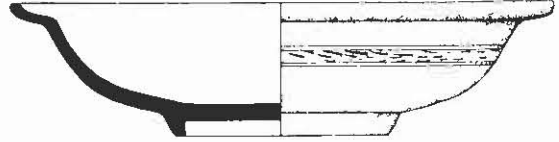
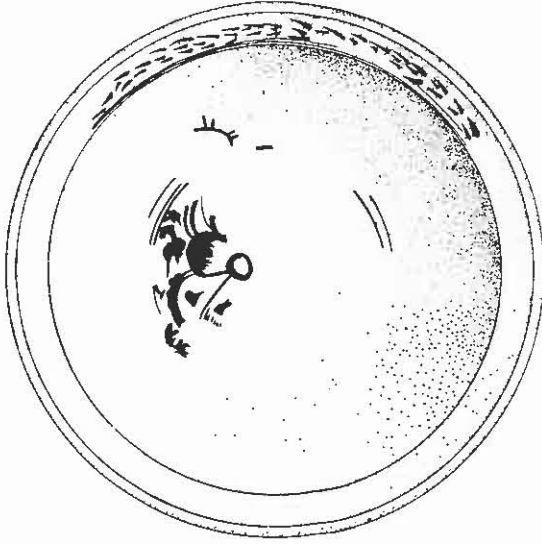
These bowls have a rather degraded glaze so that the black underglaze decoration is difficult to identify. Refuge (1976) attributes these bowls to Sawankhalok, whereas Spinks (1959) and Richards (1977) attribute this material to Sukhothai. Brown (1977) attributes bowls with floral central medallions to Sukhothai and similar floral bowls with decorated cavettos to Sawankhalok.

a) Bowl



S1 1:4
Flared rim. Grey body. Degraded glaze. Black underglaze floral design interior, brush decoration on lip and outside of bowl. Tubular pontil mark on base. The exterior decoration on this bowl resembles Refuge (1976) Afb.49, but it is hard to tell from the interior central decoration how close is the parallel.

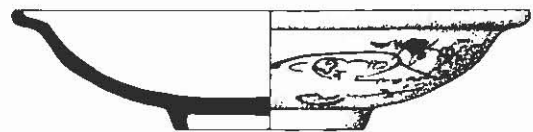
b) Shallow Bowls



S2

1:4

Shallow bowl, flared rim. Grey body. Degraded glaze. Black underglaze floral design interior, brush decoration on lip, brush decoration and four lines outside.



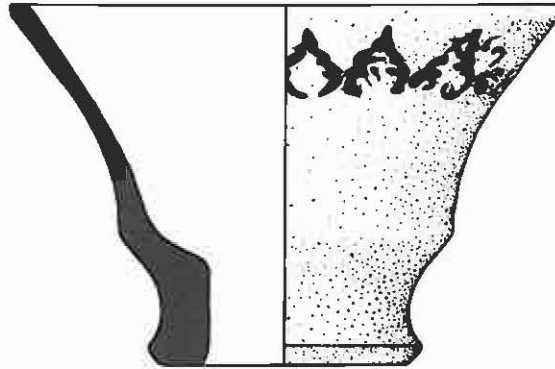
S3

1:4

Shallow bowl, flattened rim. Grey body. Celadon green glaze, degraded. Black underglaze floral design interior, brush decoration on lip, floral scroll decoration outside. Tubular pontil mark on base.

c) Unidentified Object

Possibly some form of funnel, roughly made. There is little doubt that the base has a hole carved in it.



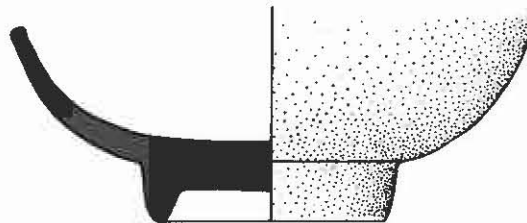
S10

Grey body. Degraded glaze, white and powdery. Iron red brush decoration outside.

3. CELADON

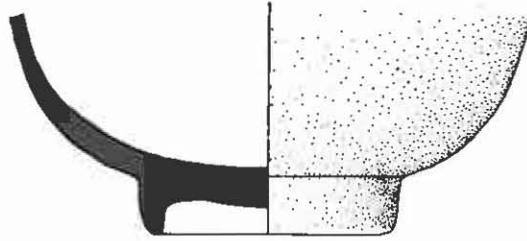
a) Bowls

These bowls are commonly found on wreck sites in Thailand. They resemble celadons illustrated in Fox (1959) Pl.133 and 134, Spinks (1959) Fig.5 (Nos.2549 and 2628) and Willetts (1971) Figs. 313 and 314.

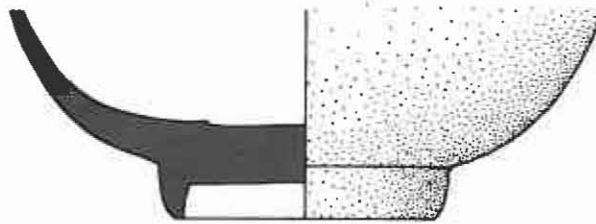


S4

Upper section missing. Red body. Thick green, crazed glaze extending over base of footrim, unglazed base. No pontil mark evident.



S5
Upper section missing. Body red in some areas, white in others. Thick green glaze extending just over base of foot rim, base unglazed except for centre. Possibly underpainted. No pontil mark evident.



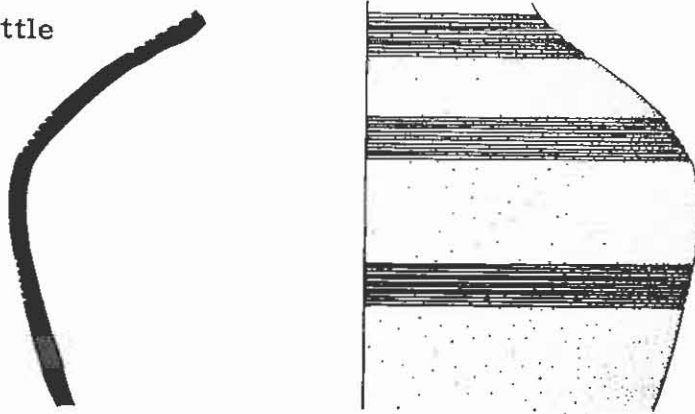
S6
Upper section missing. White body. Thick green, crazed glaze extending to base of footrim, centre of interior unglazed and recessed slightly. No pontil mark evident.



S9
Rim fragment. Light grey body. Green glaze, incised vertical line decoration inside. Undecorated outside.

4. FINE WARE

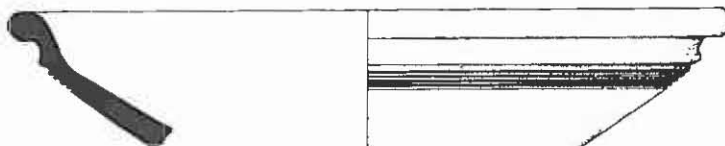
a) Bottle



S11
Fragment. Grey body. No glaze evident, three groups of incised horizontal lines.

5. COARSE WARE

a) Bowl

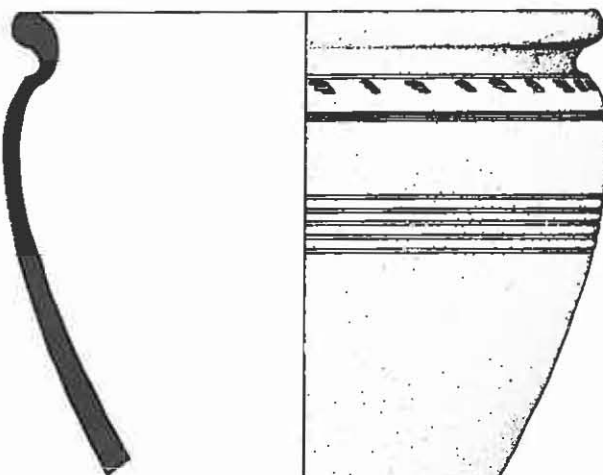


S16

1:4

Fragment. Dark grey body, interior fabric grey. Everted mouth rim, ridge under the neck below which are a set of incised horizontal lines.

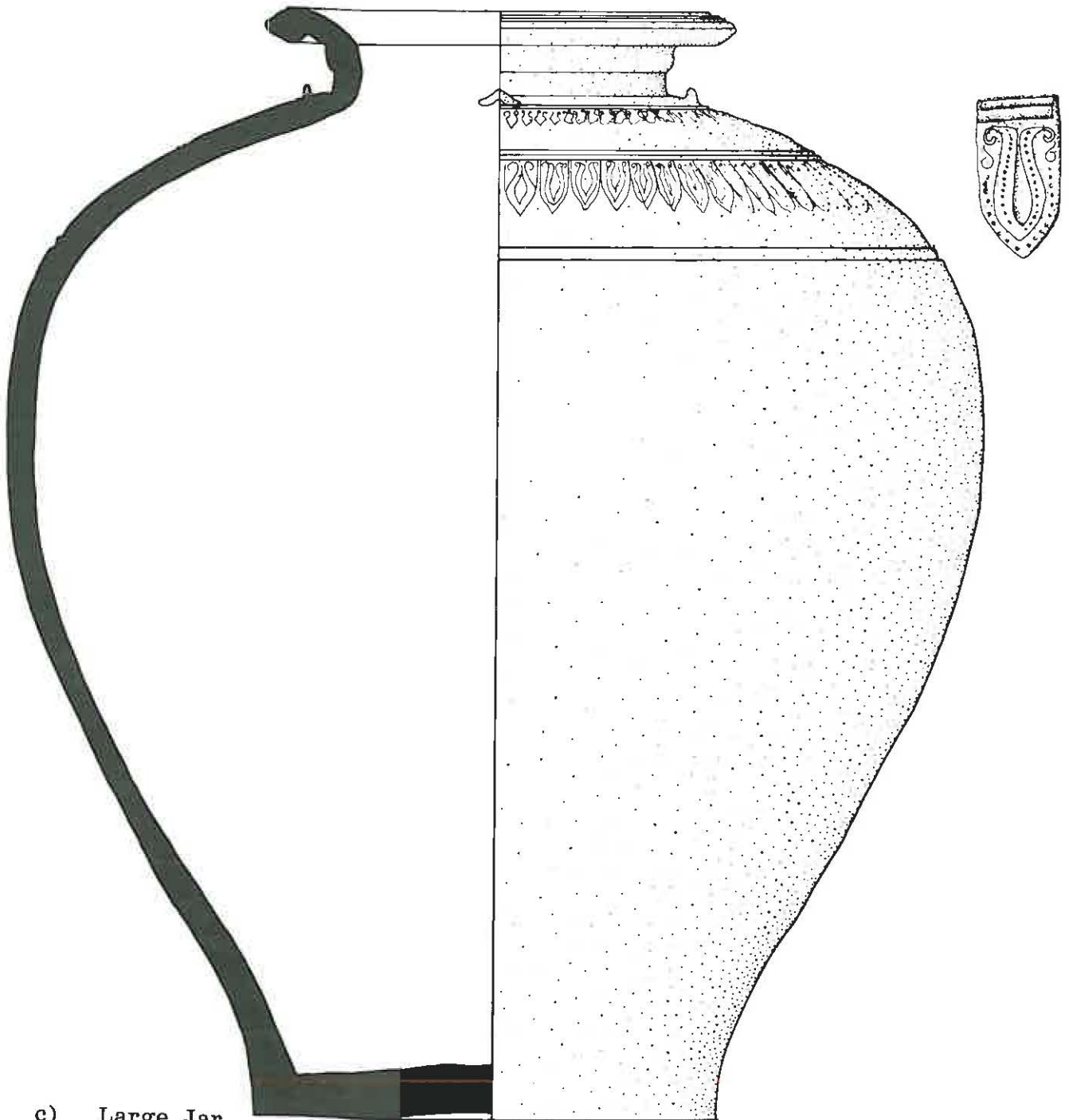
b) Jar



S15

1:4

Fragment. Grey body. No glaze evident. Poorly made resulting in asymmetrical ridge at base of neck, below which is an incised pattern, then two sets of incised horizontal lines.



c) Large Jar

S25

1:4

Dark grey body. Flared and ridged mouthrim, four small vestigial, lug-eared handles below neck, under which are two bands of impressed *Sayma* design medallions and ridges. This jar would have a capacity of about 120 litres. Other similar jars were found on the Rang Kwien wreck site (personal communication, V. Intakosi), excavated by the T.F.A.D. over the past few years. The closest parallel found is in Brown (1977) No.85, but in this case the foot treatment and the incised decorations are different, although it has roughly the same size and similar vestigial handles.

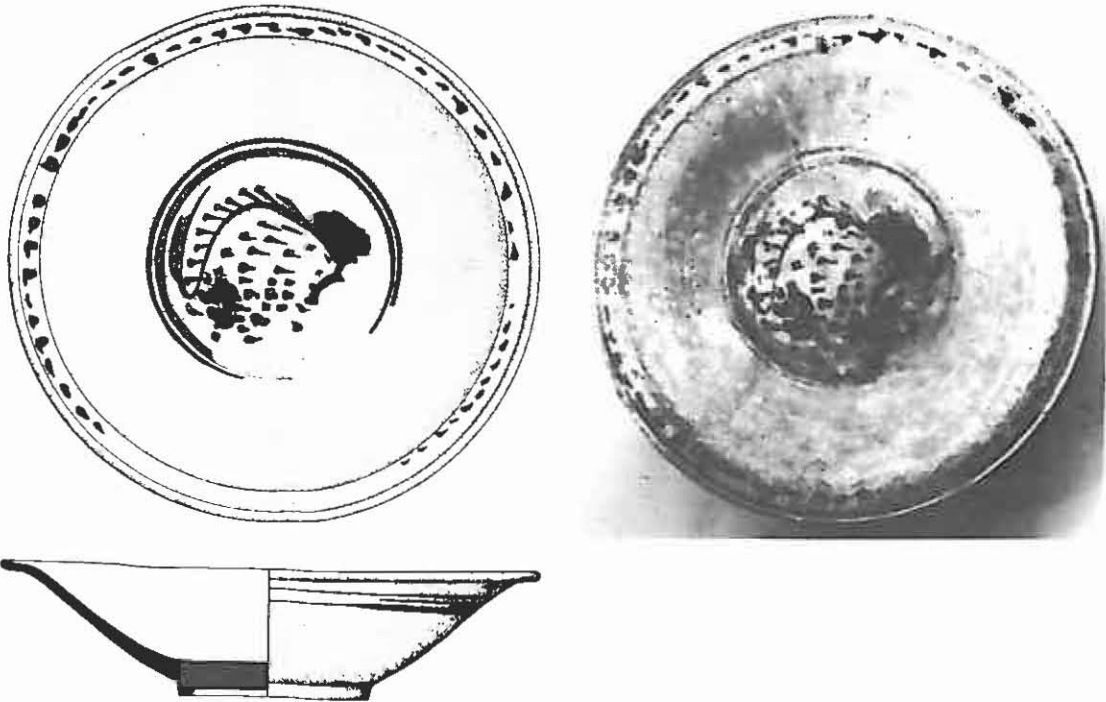
During our stay in Thailand in 1982, we were shown a collection of material said to have come from a wreck site near Rayong. Because the material is unique and extremely interesting, it was thought worthwhile to illustrate and discuss it here. There were nine pieces: five black underglazed bowls, three celadon bowls and a single, brown-glazed cover box lid. Whilst there are no exact parallels to the fish plates or celadons, the cover box lid is exactly parallel to an illustration in *Oriental Ceramic Society* (1979) No.29 and said to have come from a wreck site in Thailand. These cover boxes are believed to be from South China and to date from the fourteenth to fifteenth century. They have also been found in the Philippines at Puerto Galera and Verde Island, Mindero, Locsin (1967) No.152. Of the fish bowls with the floral decoration on the cavetto, the two closest parallels are Howitz (1978) Fig.12 and Refuge (1976) Afb.15. Otherwise there are numerous illustrations of Sukhothai fish plates. It is not certain if the cover box lid, in fact came from the same site as the other material, but both owners affirmed this.

RAYONG WRECK SITE CATALOGUE

NOTE ALL ARTIFACT
DRAWINGS SCALE 1:2
EXCEPT WHERE OTHERWISE STATED

1. EARTHENWARE
Black Underglaze Ware, Bowls and Shallow Bowls

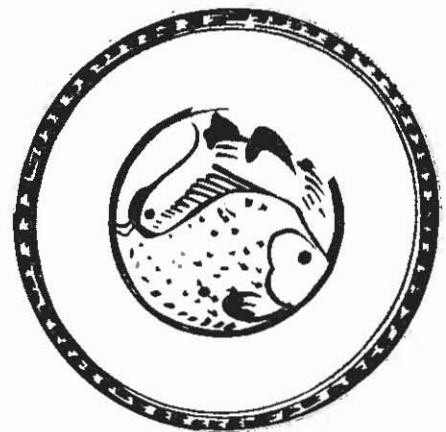
a) Fish Decoration: inside, undecorated cavetto



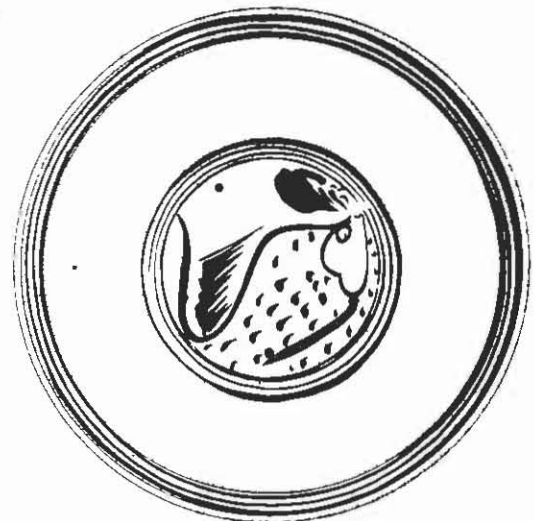
R2
Shallow bowl, flattened rim, carved footrim. Pink-beige body, fairly coarse but not as much as R1. Light olive-green glaze. Brush decoration on rim, iron bleeding. Three line decoration outside. Thick blobs of glaze inside. Five spur marks inside.

1:4

- b) Fish Decoration:
undecorated cavetto,
possibly reversed a cockerel.

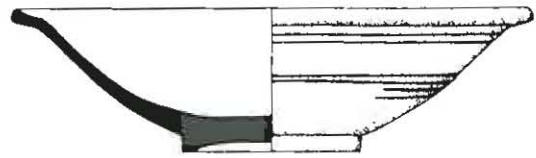


R1 1:4
Bowl, flared rim, carved footrim. Coarse pink-red body with sand particles 1 to 1.5 mm in diameter. Degraded glaze. Brush decoration on lip, three line decoration outside. Five spur marks inside.



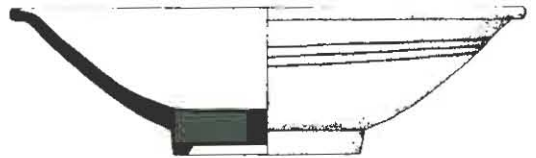
R5 1:4
Shallow bowl, flattened rim, carved footrim. Pink-red body much finer than R1, R2. Degraded glaze, three lines on rim, three lines outside. Five spur marks inside.

c) Fish Decoration:
floral decoration on cavetto,
possibly reversed a cockerel.



R3
Shallow bowl, flattened rim,
carved footrim. Grey body.
Degraded light green-white
glaze. Brush chevron
decoration on rim, line
decoration outside. Five spur
marks inside, tubular pontil
mark on base.

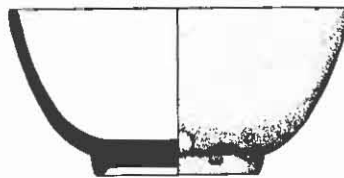
1:4



R4
Shallow bowl, flattened rim, carved footrim, floral
decoration vegetal scroll. Pink-beige body. Degraded, light
green-white glaze. Five spur marks inside. References: Brown
(1977) No.91, Howitz (1978) Fig.12, Refuge (1976) Afb.15,
Spinks (1959) Fig.10, No.443, Willetts (1971) No.162.

1:4

d) Decoration Unidentified



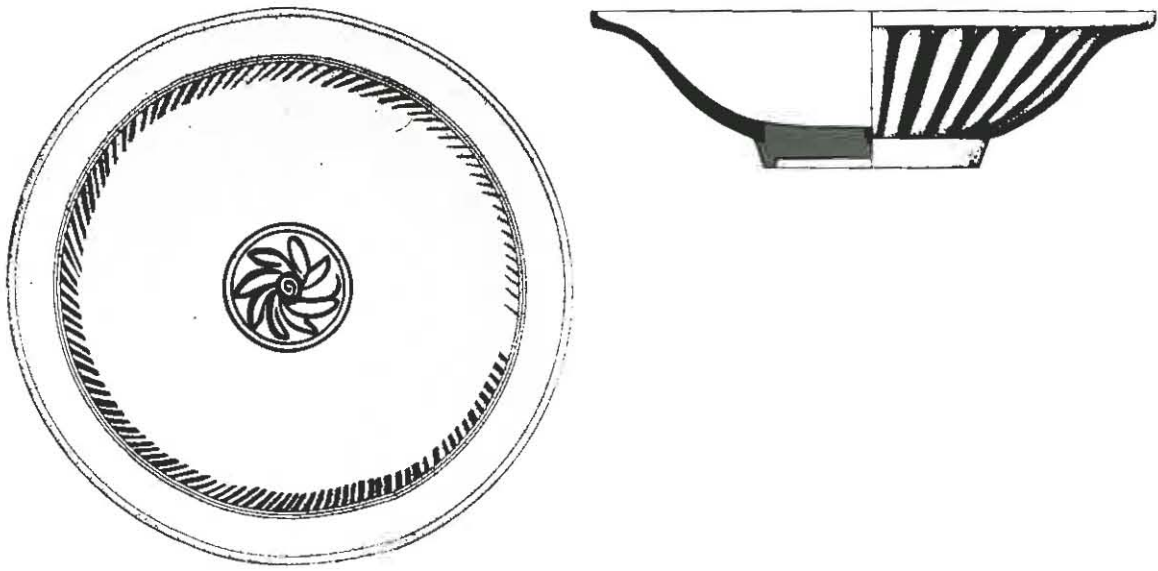
R7 1:4
Bowl with carved footrim. Light pink-grey body. Thick green-blue glaze, possibly celadon. Crawling occurs, forming an unglazed, incomplete circle where inside base joins cavetto. Underpainted but pattern indistinct. Lightly crazed. Tubular pontil mark on base.

2. CELADON

a) Bowls



R8 1:4
Bowl with carved footrim. White-pink body. Degraded green glaze. Incised decoration, flower medallion interior, three open lotus and three lines on cavetto. Thick, incised vertical lines outside. Tubular pontil mark on base.



R6 1:4
 Shallow bowl, flattened rim. Light pink-grey body. Green glaze. Incised decoration, floral medallion interior, angled lines on cavetto, thick incised vertical lines outside. Tubular pontil mark on base.

3. BROWN GLAZE COVER BOX LID



1:1
 Thick light buff body. Smooth brown glaze surrounds moulded decoration. Thin layer of glaze over decoration. Press-moulded, finger impressions inside.
 References: Loesin (1967) No. 152, Oriental Ceramic Society (Hong Kong) (1979) No.29.

CHAPTER 7.

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APPENDIX 1.
REPORT ON THE CRYSTALS FOUND ON METAL FRAGMENTS AND
ON BAMBOO FROM THE PATTAYA WRECK SITE

Ian D. MacLeod

Department of Conservation and Material
Restoration, Western Australian Maritime Museum.

The metal fragments showed pustular upper and lower surfaces which is characteristic of aerobically corroded tin alloys. Inspection of the broken edges showed up some lustrous dark grey material that has apparently little mechanical strength. Although extensively corroded and partly concreted, the artifacts still retained their original shape. Examination under a Scanning Electron Microscope (S.E.M.) of uncoated samples, showed up many interesting features of the corroded metal. Qualitative analysis of the material being examined was obtained using the E.D.A.X. system (Energy Dispersive Analysis of X-rays) attached to the S.E.M. The micrographs shown below were taken directly from the T.V. viewing screen and are obtained using the back scattered electron low vacuum mode of S.E.M. operation. The intensity of images are based on atomic number contrast, with heavy elements such as lead giving a light image while light elements such as calcium give a dark grey to black image. For more details of the S.E.M., see Robinson & Nickel (1979).

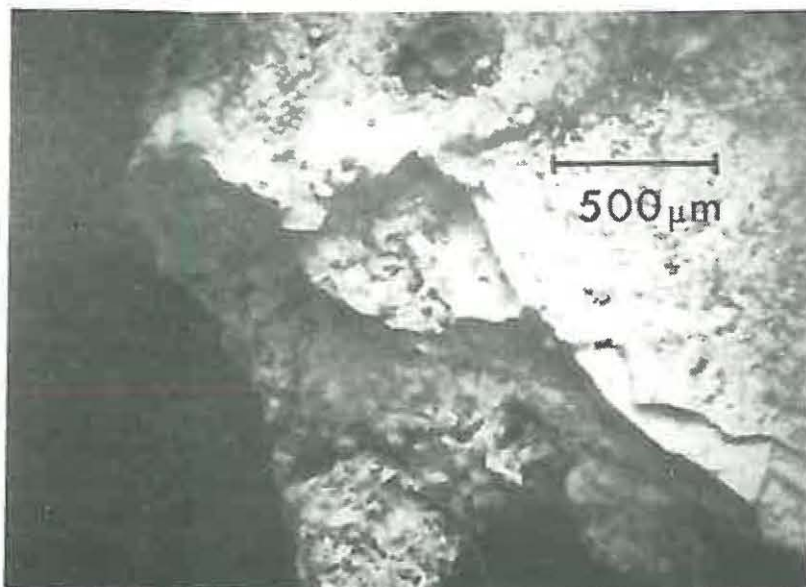


Figure 20A. Overall view of the corroded metal.

An overall view of the edge of the corroded metal is seen in Fig.20A. The dark, crater-like area in the upper centre is a calcareous marine organism, and the layered nature of the corroded metal can readily be seen in the lower, right-hand corner. The major elements present are chlorine, tin, antimony and lead. A more detailed view of one of the crystalline growths is seen in Fig.20B. The larger crystals are approximately 75 μm , and their morphology and the E.D.A.X. analysis is consistent with them being the orthorhombic mineral Nadorite, which is the lead antimony oxide chloride, PbSbO_2Cl .

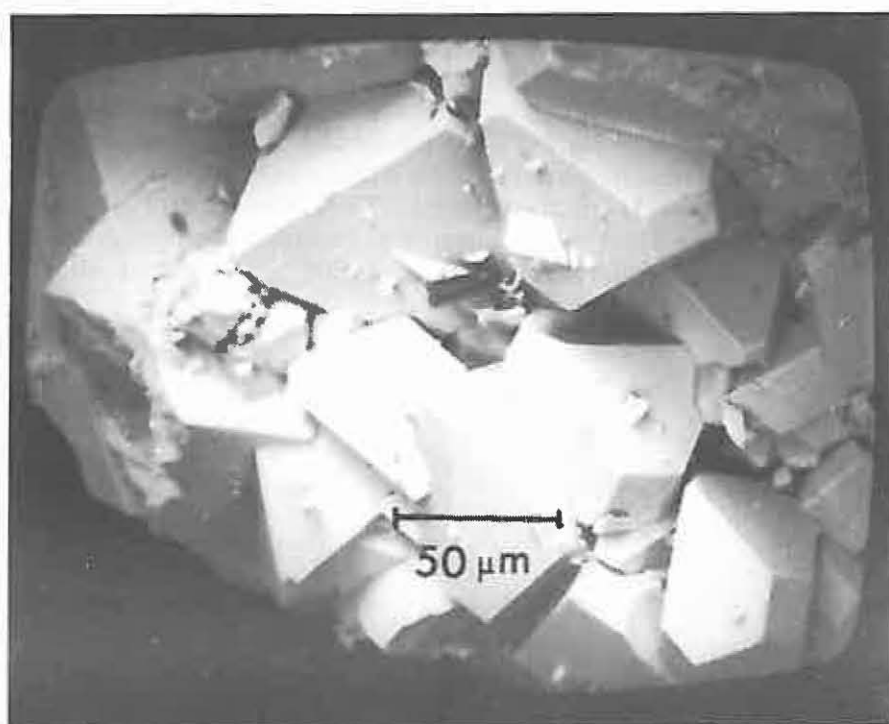


Figure 20B. More detailed view of the crystalline growths.

Although no X-ray diffraction analysis was performed on material from the pewter samples, the S.E.M. and optical microscopy gave results that are very similar to that obtained from aerobically corroded pewter from the wreck of the *Rapid* (1811). This material has been extensively studied by chemical and X-ray techniques (this author unpublished). The lustrous dark-grey material is probably one of a series of intermetallic tin-antimony compounds which have the composition SnSb , Sn_3Sb_2 or Sn_4Sb_2 . When the

leaded pewter corrodes, the tin-antimony intermetallic compounds are more stable than the surrounding tin and lead matrix, and can form an inter-connected matrix of tin-antimony compounds while the rest of the metal is converted into a mineralised form. This leaves the object in its original shape but the surface will be covered with outgrowths of minerals such as cassiterite (tin oxide, SnO_2) and anglesite (lead sulphate, PbSO_4).

The crystals found on the inside and leading edges of the core of some mineralized bamboo were shown to be composed of calcium and carbonate ions. A sample of the material was examined by X-ray Diffraction and gave a pattern identical to that of inorganic calcite which is the more stable of the two major mineral forms of calcium carbonate. The crystal habit of the calcite is shown in the S.E.M. micrograph in Fig.20C where the largest crystals seen are approximately 0.8 mm long. The presence of calcite crystals is not unexpected from such marine sites since calcium carbonate is supersaturated in most tropical waters. The size of the crystals is more unusual since they are commonly found on wreck sites in the 20 - 100 μm range rather than in the 800 - 3,000 μm observed on this sample.

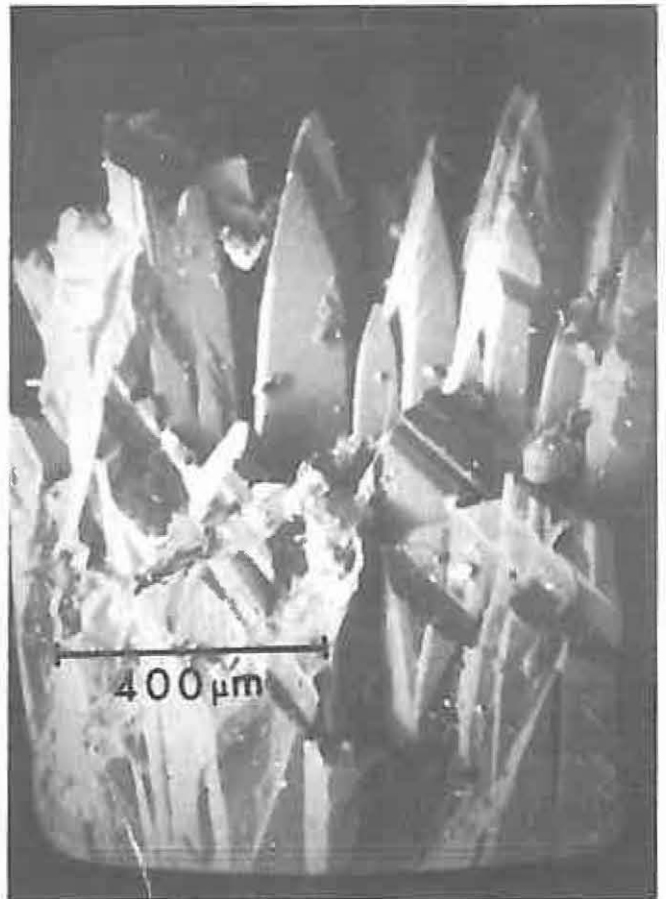


Figure 20C. S.E.M. micrograph showing the crystal habit of calcite.

Acknowledgement: I am grateful to the C.S.I.R.O. Division of Mineralogy for the use of their S.E.M. and X.R.D. facilities.

APPENDIX 2.

THE BUKIT JAKAS SITE, PULAU BINTAN, RIAU ARCHIPELAGO, INDONESIA

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École Française d'Extrême-Orient.

In December 1981, the Indonesian National Centre for Archaeological Research, carried out a six-day campaign on the Bukit Jakas site, at Pulau Bintan in the Riau Archipelago, off the north-east coast of Sumatra. The site consists of the remains of about 20 m of the lower hull of a ship. The excavation revealed about 17 composite bulkheads, consisting of edge-dowelled planks, fitted against the curve of the hull to form the bulkhead itself. In one section, at the southern end of the site at bulkhead 16, a small two-notch mast step was located (Fig.21). Two futtocks start from the step (but they are not scarphed to the step). On the opposite side, obscured in Fig.21 is a floor (in one piece) lying across the keel and rising high on each side. There is no trace of a scarph joint before the sixth strake. At the opposite end of the site where the hull is clearly V-shaped and the keel angles up, one finds only the bulkhead itself, plus one single frame.

Limber holes, one on each side of the keel are also to be found. The strakes are edge-joined with dowels, and there is no evidence of rabbeting. Planks are nailed to the frames with square iron nails. The planks were up to 370 mm wide and 100 mm thick, and there is no evidence apparent of a second layer of planking, but this is not certain.

The timber C14 date gives 1445±80AD and a single ceramic shard has been dated to the late Ming Period.

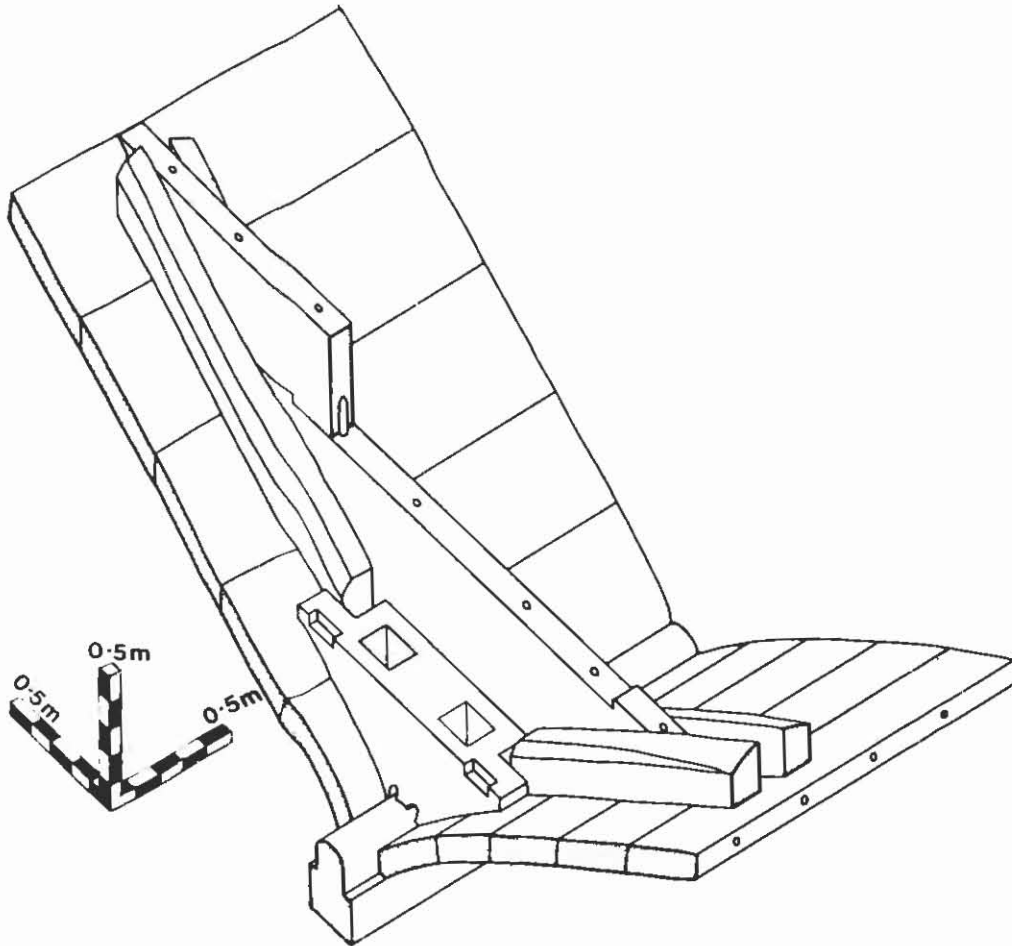


Figure 21. Reconstruction of bulkhead No.16 and mast step, axonometrical view.

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