

# **TWO ANCIENT SHIPWRECKS IN THE GULF OF THAILAND: A REPORT ON ARCHEOLOGICAL INVESTIGATIONS**

by

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In 1975, the author presented a project proposal to the Danish Government and Mr. Ole Crumlin-Pedersen<sup>1</sup>, Director of the Viking Ship Museum in Roskilde, Denmark, for a thorough and scientific study of the underwater wreckage of ancient cargo ships lying in the Gulf of Thailand. As a result, beginning in early 1975 the Fine Arts Department of the Ministry of Education, in co-operation with the Royal Thai Navy and Danish experts, conducted exploratory excavations. The first director of the expedition was Mr. Crumlin-Pedersen. In 1977 work was continued under the supervision of the author. To date a total of eighteen ships has been investigated.

The investigations were divided into two phases during 1977: (a) discovery and exploration of sunken junks by plotting and following possible ancient trade routes taken by cargo vessels; and (b) concentrated excavations at the Sattahip site<sup>2</sup>. Sources for the extensive preliminary

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1. Mr. Ole Crumlin-Pedersen is the underwater archeologist who directed the excavation of five Viking ships found in Roskildefjord, Denmark, 1957-1962; author of "Viking ships", Congress of Underwater Activities, 1962 (London, 1968); "The Skuldelev ships", *Acta Archaeologica*, vol. XXXIX, 1958; *Fem Vikingskibe* (Roskilde, 1969).
2. The Sattahip shipwreck was explored by a joint Thai-Danish group in 1975. The ship lies at a depth of 42-44 meters on the seabed of Sattahip Bay, Chon Buri Province. The ship is about 12-14 meters in width and 32-34 meters in length. To date, almost 4,000 pieces of ceramic ware have been salvaged from the cargo compartments. More than 75 per cent of the ceramics is Sukhothai and Sawankhalok products; the rest is Annamese ware and a number of underglazed dishes with an unclear identity. The vessel is made of teak, and is about 400 years old. The utensils found indicate that the crew of the ship was mainly Siamese.

research and study included historical records of the relations between Siam and foreign countries during the seventeenth and eighteenth centuries A.D., records of ancient Chinese maritime trade routes, stone inscriptions, and chronological records of the twelfth to eighteenth centuries A.D.

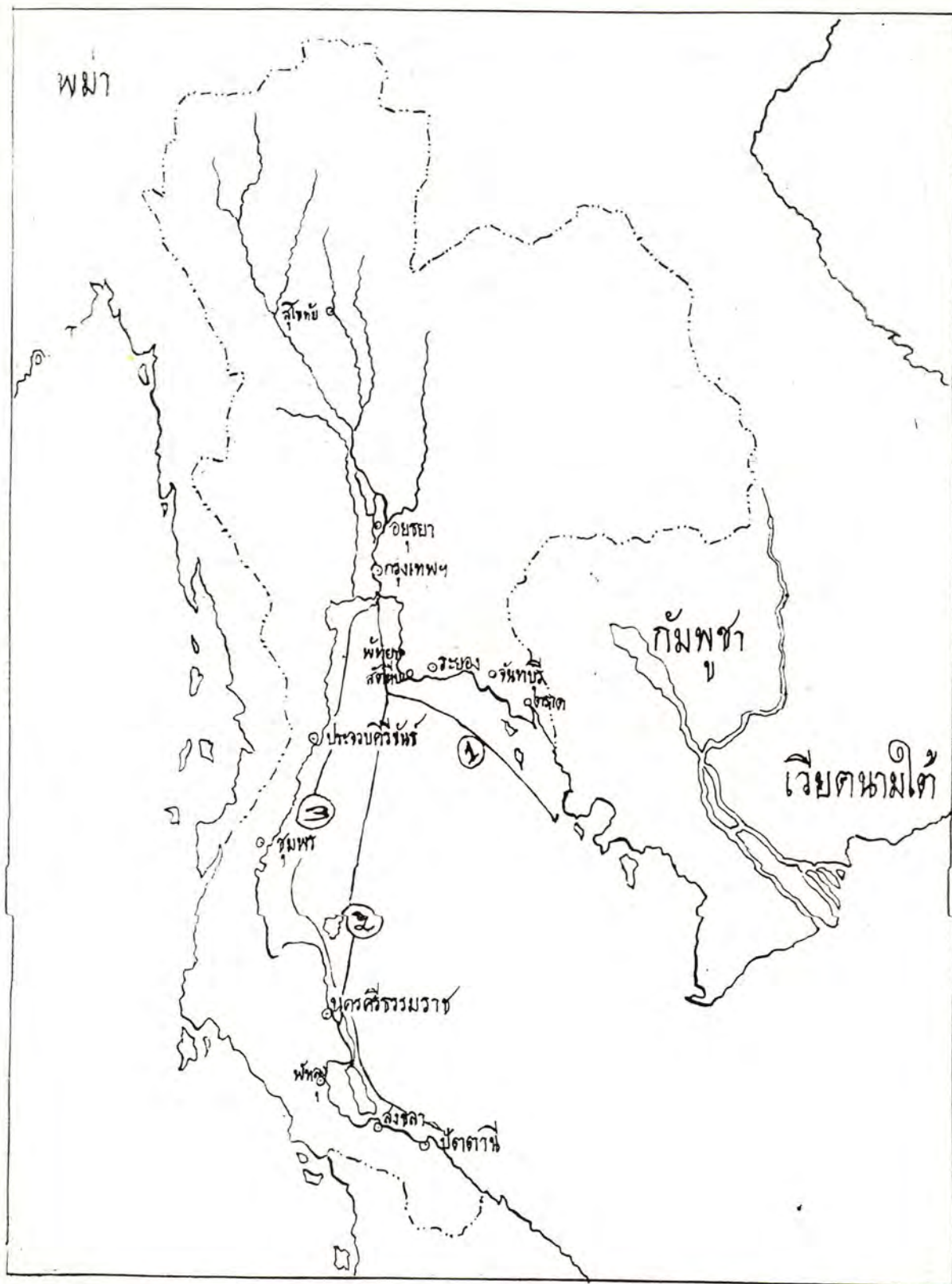
The investigations indicate that three ancient Siamese maritime trade routes, dating from Sukhothai and early Ayutthaya times, may have existed. The first trade route (see map) progresses from the Chao Phraya River delta along the eastern coast of the Gulf of Thailand, to the Thai province of Trad on the Cambodian border. The second route goes directly south, bypassing Sattahip, down to Nakhon Si Thammarat, Songkhla, Phatthalung and Pattani. The third route heads westward from the Chao Phraya along the coast to Prachuap Khiri Khan, Chumphon and Pattani.

Explorations have revealed seven wrecks along the first route, ten along the second, and one along the third. One very fascinating observation was the differences between ship's cargoes along each route. For example, the eastern coast wrecks contained very little Sukhothai or Sawankhalok ceramic ware. Wrecks on second route, however, bore large quantities of ceramic ware, some of which is of very high quality. Some wrecks along this route also contained Chinese and Annamese ceramics as well. The third route yielded a smaller ship size than the other two routes, and the quantities and quality of cargo were notably inferior.

Of the eighteen wrecks discovered so far, four are of note, and three of these have been studied in depth: at Sattahip, Prasae<sup>3</sup>, Pattaya and Koh Kradad. The Prasae wreck contained as much cargo as that at Sattahip, although there has not been enough time to explore it fully. The wrecks at Koh Kradad and Pattaya will be covered in this report,

3. The Prasae ship lies on the seabed in Rayong Province. Great amounts of ceramic ware have been lost through pirate diggings. The wreck is a very interesting one, lying at a depth of 44 meters. Most of the cargo is Annamese and Sawankhalok products.





Map of possible sea routes taken by Siamese traders from the fourteenth to sixteenth centuries A.D.

while the discoveries at Sattahip and Prasac will be the subject of a longer, more detailed paper at a later date. Handicapped by a lack of adequately trained personnel, work nevertheless proceeded very well, yielding large quantities of artifacts. An on-site laboratory was constructed to provide not only immediate and detailed observations, but to preserve the specimens from sudden and extensive deterioration from contact with the air, and from accidents which could occur in transit to distant laboratories. The artifacts were soaked in continuously circulating fresh water for four weeks, after which the coral and debris were carefully removed. The objects thus properly preserved, detailed observations were noted and all objects were fully cataloged, photographed and described on site.

Descriptions of the two wrecks below, those at Koh Kradad and Pattaya, begin with a short history of the discovery of the site and a description of the site itself, followed by details of the excavation and of the finds studied. A short discussion of the results of the study and analysis concludes each section.

The author wishes to note the timely and very professional contributions of several people who greatly facilitated an otherwise very difficult project. Mr. Nikom Musigakana<sup>4</sup>, archeologist with the Fine Arts Department, and Lieutenant Nakorn Aranyanak<sup>5</sup>, a Royal Thai Navy frogman, both went to Denmark for extensive training in underwater archeology. Lieutenant Nakorn worked with Mr. Crumlin-Pedersen for three months to obtain valuable first-hand experience in underwater excavations and techniques. Mr. Pong Sono of the Division of Wood Analysis, Royal Forestry Department of the Ministry of Agriculture and Co-operatives, did excellent work on the wood and leaves. Dr. Chyagrit Siri-Upathum of the Institute of Atoms for Peace

4. Mr. Nikom was working as the manager of this project during 1974-1976.

5. Lt. Nakorn Aranyanak has been responsible for the exploratory excavation of the Sattahip ship since 1974, and has been leading the actual excavation of the same wreck from December 1976 to May 1977. His report on the excavation of the Sattahip ship will be published at a later date.



did the  $C_{14}$  dating. Professor Kaset Pitakpaivan of the Geological Survey Division, Department of Mineral Resources of the Ministry of Industry, also provided valuable analysis. These three advisors went to Denmark in the Summer of 1977 for further studies. Mrs. Chiraporn Aranyanak, conservator at the Bangkok National Museum, who also trained in Denmark in conservation and underwater archeology, was responsible for immediate preservation and conservation of the ceramics and artifacts salvaged.

A special debt of gratitude is owed to the Danish Ministry of Education, which contributed Danish experts to work with the official team, and which granted a series of scholarships to Thai archeologists and divers to go to Denmark for studies and training.

### **The Koh Kradad shipwreck**

#### *Discovery*

Koh ("Island") Kradad is a small island located off the eastern coast of the Gulf of Thailand, in Trad Province. The immediate area is peaceful and calm, with beautiful coral outcroppings in the shallow waters. Local fishermen have known for many years that there are several shipwrecks scattered offshore, and have experience in diving and collecting cargo from them. Our official survey group succeeded in locating a shipwreck in co-operation with one fisherman, who reluctantly led us to the proper location of the wreck to be described.

The exploratory excavation took place in February 1977. The working period was limited, and we were unfortunately handicapped by a lack of trained personnel. The information obtained from the wreck is, therefore, moderate; further investigation will be carried out in the near future.

#### *The site and excavation*

The wreck is imbedded in a coral reef under two meters of water south of Kradad Island, and only a few hundred meters from the coast. Being at a distance from the deep rift of about 40 meters, it is no wonder

that the site has been subjected to pirate digging for several years. While the ship was not covered by sand, coral has gradually taken possession of the surrounding area.

A great number of hard, grey stones are found in and around the wreck, covering an area of approximately 10 by 20 meters. Planks, lumps of wood, pottery and sherds are scattered around the site within an area of about 20 by 40 meters.

Naval divers, under the direction of Lieutenant Nakorn, started the excavation by removing the coral and stones from the northern area of the site, digging a trench and collecting planks, wood fragments, stones and other artifacts for further study. Before leaving the site, the stones that had been removed were replaced in order to protect and preserve the wreck from damage.

### *Finds*

In general, the finds can be classified into the following categories: wooden objects, stones, and pottery.

#### *(a) Wooden objects*

*Planks and wooden pegs.* The planks and most of the wooden remains pictured here are side-planks and wooden pegs. Several pieces found scattered around the site have been sent for  $C_{14}$  dating.

A double-planking method was used at the joints. Planks were joined lengthwise with hardwood pegs (*Terminalis* sp., indigenous only to southeast Asia and Africa)<sup>6</sup>. Pegs varied in size, though each had one end sharpened in a four-bladed form. Some of the specimens pulled from between two planks were transferred to Mr. Pong for further study. The samples depicted in figure 1 have a diameter (d) of 3.2 centimeters (cm) and 3.1 cm, respectively, and a length or height (ht) of 12 cm and 6 cm. Actual length of the pegs used is unknown, as thus far no complete

6. I.H. Burkill, *A Dictionary of the Economic Products of the Malay Peninsula* 1: 1212, 2: 1319 (Kuala Lumpur, 1966); Pong Sono, บทบาทของไม้ที่รักษาทางไม้ในโครงการศึกษาเรือโบราณของกรมศิลปากร (Bangkok; Division of Wood Analysis, Ministry of Agriculture; 1977).



sample has been found. This type of peg is known to have been used by traditional Chinese boat-builders<sup>7</sup>.

(b) *Stones*

Large numbers of rectangular granite stones of various sizes littered the entire site. The specimen depicted here is 3.8 cm, 7.5 cm and 12.6 cm in thickness, width and length respectively (fig. 2).

(c) *Pottery*

Several pieces of the pottery were raised for study. The site has been disturbed by pirate digging for more than ten years, and undoubtedly other complete and valuable finds have been stolen from the wrecks. The pottery from the Koh Kradad site will need much research and further discussion.

*Sugar palm pots.* Small, baked clay pots (fig. 3) had been filled with palm sugar for transport and sale. They are made of clay mixed with coarse sand, and have reddish-yellow coloration. (UNEX-K-47/77<sup>8</sup>, d 12 cm, ht 5 cm; UNEX-K-41/77, d 11 cm, ht 5.5 cm.)

*Basin.* This specimen (fig. 4) is of unglazed red clay with no decorative design. (UNEX-K-71/77, d 30.5 cm.)

*Vases.* The vase with a long slender neck and flared mouth (fig. 5) has an underglaze decorative design in iron-black color, with three circular bands on the shoulder and two on the lower body. The design, framed in a circle, comprises a set of "blush-stroke"<sup>9</sup>. The unglazed footrim is slightly carved, and beige in color. The design bears a close resemblance to Sukhothai products, but the piece is unquestionably from Sawankhalok kilns. (UNEX-K-20/77, d 5.2 cm, ht 6 cm.)

7. Chaen Patchusanon, *History of the Thai Navy* (Bangkok, 1967).

8. Artifact numbers of the field catalog of the underwater excavation, 1977 (Bangkok National Museum).

9. For samples of "blush-stroke", see William Willetts, *Ceramic Art of Southeast Asia* (Singapore, 1971). An example appears on the shoulder of a Sawankhalok vase, p. 139, fig 178.

The glazed design of the pear-shaped vase or bottle with the flared mouth (fig. 6) has been deteriorated by the sea, and is very dirty. It also is from the Sawankhalok kilns. (UNEX-K-20/77, d 5.2 cm, ht 6 cm.)

*Boxes.* The shape and decorative designs of the four boxes collected from the site (fig. 7) are typical of Sawankhalok covered boxes.

The specimen illustrated at upper left is Sawankhalok ware, decorated in an iron-black underglaze. The body is painted with rectangular panels, alternating with a cross-hatched<sup>10</sup> design, with the base and footrim unglazed and beige in color. (UNEX-K-38/77 d 8.7 cm, ht 5.5 cm.)

The specimen on bottom right, also Sawankhalok ware, is painted in brown monochrome underglaze. The body is covered with a set of circular bands above the unglazed footrim, and a group of vertical lines surrounds the mouthrim. (UNEX-K-37/77, d 18 cm, ht 6 cm.)

*Lids of covered boxes.* The lids in figures 8 and 9, unfortunately, do not fit the illustrated boxes nor do they fit others found at the site. The handle rising from the centre of each lid appears in one of two forms.

(i) Lids with a *lotus-bud handle* (fig. 8) have an iron-black underglaze decoration, with six circular bands above a set of six decorative panels. These panels form a continuous pattern between the lid and the body of the box, and are divided into two sets: three with a floral design, and three in a cross-hatched pattern. The characteristics of the specimens are identical to those produced from the Sawankhalok kilns. (UNEX-K-16/77, d 7.5 cm, ht 2.5 cm; UNEX-K-24/77, d 9 cm, ht 4 cm.)

(ii) Lids with a *fruit-shaped handle* (fig. 9) have the form of a four-sepal mangosteen stalk, and are decorated with three or five unglazed, monochrome, circular bands. These lids also share six rectangular

10. *Ibid.*, pp. 144-145.



panels with the body of the box: three of a cross-hatched design, and three floral. A series of vertical lines separates the panels. (UNEX-K-3/77, d 7 cm, ht 2.5 cm; UNEX-K-2/77, d 7.5 cm, ht 3 cm.)

*Lid of a jar.* Found among the coral and stones was an earthenware lid, probably the lid of a jar (fig. 10). It has a coarse, unglazed body with a lotus-bud handle. The paste is a reddish-yellow color mixed with coarse sand. This type of lid is commonly found among Sukhothai and Sawankhalok products. (UNEX-K-50/77, d 13 cm, ht 3 cm.)

*Jars.* Two large, brown-monochrome, Sawankhalok storage jars with four ring-handles were safely raised from the wreck, one of which appears in figure 11. Both of them have five circular bands decorating the neck. A chocolate-brown glaze covers the upper body to the waist. The wide, flat, unglazed base is beige in color. (UNEX K-7/77, d 15 cm, ht 55 cm; UNEX-K-74/77, d 18 cm, ht 38 cm.)

*Bowl.* A part of a large, red clay bowl was found, the rim of which is everted and the body without decorative design. (UNEX-K-71/77, d 30.5 cm.)

*Blue-and-white ceramics.* Part of a Ming bowl was found (fig. 12), decorated in the center with a blue-painted bird on flowering plants, encircled by two rings. The blue design on the outer cavetto comprises panels of growing plants and lotus flowers. The design is in underglaze with a duller blue color. (UNEX-K-26/77.)

The piece in figure 13 belongs to a blue-and-white Ming bowl bearing a limpid design. The glaze is whiter than that in figure 12, and the blue is bluer and purer. The base and foot design is in underglaze, with the center of the bowl bearing plants and a bird framed in a double-ring design. The inside mouthrim is turned slightly outward, decorated in wavy lines between circular bands, one above and two below. The outer cavetto is painted in underglaze blue in the form of lotus panels. The footrim shows traces of adhered sand and wheel lines beneath the glaze. (UNEX-K-81/77, d 14.5 cm, ht 8 cm.)

The fragment of a bowl in figure 14 (Ming ware) has a shallow form with an everted lip. The inside mouthrim is painted with a floral spray beneath a clear glaze. The design in the center of the bowl shows two circular bands framing a bird among plants and grasses. The design appearing on the outer cavetto (fig. 15) is a free rendering of a marsh with two geese swimming among lotus clumps. The footrim is rather tall, and clearly shows wheel lines. The glaze on the base has deteriorated, permitting the fine white paste to be observed. (UNEX-K-35/77, d 17 cm, ht 7.5 cm.)

Two Ming-ware sherds were noted: the base of a bowl (UNEX-K-35/77, 10×4.5 cm), and the mouthrim of a bowl with a floral scroll design (UNEX-K-29/77, 7.1×11.5 cm.)

The Ming specimen in figure 16 is covered with a dull blue-green glaze with a wide crackle. The decoration on the outer cavetto is a flower design framed in double rings. A decorative band ornaments the inside mouthrim (fig. 17), while distinct scrolls adorn the inner cavetto and a floral pattern adds distinction to the center. On the base are traces of adhered sand and wheel lines. (UNEX-K-30/77, ht 6.4 cm.)

Sherds of Ming ware with Chinese characters (fig. 18) include two blue-and-white fragments. One is very small, and the characters unfortunately have become illegible. The other specimen, however, offers interesting information: four of the characters can be identified and interpreted. (UNEX-K-79/77, d 4.5×7.5 cm; UNEX-K-34/77, d 8×7 cm.)

#### *Discussion and analysis*

Although exploration was short-termed and the excavation not exhaustive, the collected finds are quite unique, reveal some interesting data and stimulate many unanswered questions.



Why is the wreck located in shallow water not far from a rift? How did it arrive there? Did a storm take the ship off-course, or was the captain unfamiliar with the particular area? Possibly he was lured there by pirates, or became lost in fog, or perhaps he was looking for fresh supplies on the island. One can think of many explanations, but clearly something catastrophic happened to the ship. It would appear that the ship broke apart on the rocks and sank, spreading cargo and wood debris over a large area.

Perhaps the most unusual find at the Koh Kradad site is the granite stones. Their presence also begs many questions: were they the main cargo? If so, what was the ship's destination? From where did the stones come, and what was to be their final use?

At present there is no evidence available to answer those questions. There are some areas in Thailand, however, where granite is to be found such as Nakhon Sawan, Tak, and the mountainous areas of Chanthaburi (60 kilometers from the site). This type of stone has been used in Thailand to construct stone walls and pedestals, and for garden decoration. The stones could have come from Chanthaburi and been loaded on the ship for an unknown destination and purpose. Future investigations will hopefully shed more light on this intriguing find.

Metal objects have yet to be discovered at the Koh Kradad site, although lead is a common find in other sunken vessels located in the Gulf of Thailand. Around the peg holes small traces of oxidized metal were found, but as yet there is not enough evidence to justify the belief that iron nails were used.

The sugar pots are more crude and primitive than those of the same type found in other sunken ships explored to date, their shapes resembling a miniature European wash basin. They were used for transporting palm sugar, an important commercial product for over 500 years. Pots of this type are in use for the same purpose in some parts of present-day Thailand.

Distinctions between the Koh Kradad sugar pots and those found in other wrecks are easily observed. The former were shaped by hand from a very crude baked clay and unglazed. The paste was mixed with coarse sand, and all pots are of a reddish-yellow color. Pots from the Sattahip wreck are, for example, dark grey in color, and the paste made with fine sand.

At present it would be presumptuous to make any statements about their age based only on form and design. This type of earthenware does not bear patterns, decorations, incising or stamping from which to determine age and type by either relative or paralleled dating techniques. Thermoluminescence is perhaps the only reliable technique for calculating the time when the pots were last heated.

All present evidence supports the conclusion that the wreck under study is an ancient cargo vessel. That is firmly supported by the ceramic wares, especially the blue-and-white pieces with Chinese characters. The decorative designs on the small, long-necked vase establish the identity of Sukhothai-period products contained in the wreck. The distinctive "blush-stroke" pattern on the vase is typically found on the inner cavetto of fishbowls produced during the Sukhothai period<sup>11</sup>. The fruit-shaped, glazed boxes with dark-brown, handpainted, decorative patterns are another indicator of the ship's age<sup>12</sup>. Many varieties of such covered boxes were made at the Sawankhalok kilns<sup>13</sup> from the fourteenth to the early fifteenth centuries A.D.

Apart from the two vases, no other traces of typical Sukhothai or Sawankhalok celadon and decorated ware have been discovered—neither dishes with underglazed floral patterns, nor decorative fish designs. The typical double-looped jarlets commonly found in ancient graves in Calagatan<sup>14</sup> have not been discovered here. One might surmise that the

11. Charles Nelson Spinks, *The Ceramic Wares of Siam* (Bangkok, The Siam Society, 1965), p. 23.

12. *Ibid.*, pp. 66, 160-161, plate 27.

13. *Ibid.*, p. 69.

14. Leandro and Cecilia Locsin, *Oriental Ceramics Discovered in the Philippines* (Tokyo, 1967); Robert B. Fox, "The Calagatan excavations", reprint from *PS*,



celadon ware was lost to pirate diggers and souvenir hunters, though some of the less valuable broken sherds should be still on site. However, to date no celadon fragments have been discovered.

Possibly the most interesting observations concern the blue-and-white sherds, which were examined by several specialists, including one from the Bangkok National Museum and reputable antique dealers, who provided much useful information. These sherds are identical to those of decorated Chinese ware of the Wan Li period (1573-1619) centuries A.D. Generally the designs are birds, geese and flowering plants, all typical of Ming-ware decoration<sup>15</sup>. The characters themselves are painted on the outer cavetto of the bowl.

Of the four legible characters, the first two are: 公日 signifying the year and date. The second is open to interpretation: 在 meaning "to be" or "to stay". The last word: 堂 carries a dictionary meaning<sup>16</sup> of "hall", "room" or "section". This word is classified in the "hall-mark" group of Ming dynasty (1368-1644) in inscriptions, marks and characters<sup>17</sup>.

Most of the Chinese marks or characters which occur on the cavetto or center of the bowl are of a poetic nature<sup>18</sup>. One possible interpretation is that they indicate the time and place the poetry was composed. While that may not be a correct assumption, the characters bear evidence of the late Ming period and thus provide strong indicators establishing their identity as Ming ware.

VII no. 3, 1959; Robert B. Fox, "The prehistory of the Philippines", *Hemisphere*, 1968, pp. 10-16; M. Joseph Adrian, *Chinese and Annamese Ceramics Found in the Philippines and Indonesia* (London, 1973), p. 10 (cf. grave of mother and child: excavation at Santa Ana, 1968).

15. R.L. Hobson, *The Wares of the Ming Dynasty* (Tokyo, 1975), p. 120.

16. W.F. Meyers, *The Chinese Reader's Manual* (Shanghai, 1974).

17. Burton and Hobson, *Handbook of Marks on Pottery and Porcelain* (London, 1912); R.L. Hobson, *op. cit.*

18) S.W. Bushell, *Description of Chinese Pottery and Porcelain: Being a translation of the T'ao Shuo* (Oxford, 1910); M. Joseph Adrian, *Ming Porcelains* (London, 1971).

The Koh Kradad shipwreck was evidently a sea adventurer during the early period of Ayutthaya, and was wrecked no later than the mid-seventeenth century A.D.

### **The Pattaya shipwreck**

#### *Discovery*

For several years treasure-hunters and souvenir-seekers have been combing most of the sunken shipwrecks off the coast of Pattaya, Thailand's best-known seaside resort located in the southeastern province of Chon Buri. These shipwrecks are continuously passed by numerous boats taking tourists to and from the islands off the Pattaya coast.

The official diving team found a local diver who knew of some underwater pottery finds, and who divulged much information about sunken vessels not only in Pattaya and the surrounding area, but also wrecks lying along the eastern coast of the Gulf of Thailand. This man fortunately was interested in the antiquity of his country, and was not simply bent on making quick profits from antique-trading and treasure-hunting. He confirmed that off the coast of Pattaya there were at least three cargo vessels which carried pottery, and he took the official diving team to the ship to be described.

#### *The site and excavation*

The ancient shipwreck reported here lies at a position between Pattaya hill and Koh Larn at a depth of 28 to 30 metters. The investigation of this wreck took place during February and March 1977, and discovered 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 mud and sand. Careless use of such methods compounded the damage from deterioration to both the wooden structure of the ship and its cargo.



A fairly strong current flows from the north carrying seaweed, coral and stone fragments that circulate around the vessel and degrade visibility. The wreck was covered by a mound of sand and mud, the top of which inclined  $25^{\circ}$  N indicating that the wreck lay on its side. Portions of the wreck protruded from the mound at an angle of  $45^{\circ}$ . The wreckage and broken pottery were scattered over an area measuring  $33.32 \times 17.40$  meters. Judging from the results of an exploratory excavation by Lieutenant Nakorn, the Pattaya wreck seems to have been a cargo ship. Seven cargo compartments have been found to date. The divers clearly discerned nine wooden planks projecting at regular intervals, which were probably parts of the cargo compartments.

At the northern end of the excavation area, a rectangular shape measuring  $30 \times 100$  cm was found. Covered with coral, it appeared to be rusted iron, and from its pedestal-like shape was assumed to be a steel plate used as ballast. Traces presumably of explosives used by treasure-hunters were noted along the sides of the object. A test trench was dug along one side of the plate, and a number of storage jars was found beneath the plate itself. Planks, iron, lead, potteries and sherds were salvaged from the area for further study.

#### *Finds*

The finds obtained from the Pattaya site can be divided into three categories: wooden objects, metal items and potteries.

##### *(a) Wooden objects*

*Planks, wooden pole, bamboo fragments.* The plank salvaged (fig. 19), measuring  $60 \times 80$  cm, was found under the iron lump mentioned above, and appeared to be part of a wooden wall in one of the cargo compartments. Lumps of iron, lead and strips of bamboo were stuck to the plank. Rattan strips bound a wooden pole to the plank, and the specimen was entirely covered with what appeared to be iron rust. (UNEX-P-18/77, UNEX-P-19/77, UNEX-P-20/77.)

*Leaves.* Palm leaves, resembling those growing in fresh-water swamps, were found adhering to the specimen in figure 19. Samples of wooden objects and leaves were sent to Mr. Pong at the Division of Wood Analysis, and to Dr. Chyagrit at the Institute of Atoms for Peace, for analysis and  $C_{14}$  dating.

(b) *Metallic items*

*Lead.* It has been known for several years that tons of lead were salvaged from the wreck and sold by treasure-hunters. The pieces found so far are of a pyramidal shape (fig. 20), commonly found in sunken vessels in the Gulf of Thailand. They average  $6.5 \times 5.5$  cm in size, and all bear traces of sand adhering to their surfaces.

Aside from the iron lumps fused to the planks, a small lump of iron measuring about  $25.5 \times 12.5$  cm was found near the trench in a crater cause by pirate diggers' explosives. This lump, rust-covered and with pieces of wood adhering to the surface, was sent to Professor Kaset at the Geological Survey Division for analysis. (UNEX-K-18/77.)

(c) *Pottery*

*Earthenware rice or curry pots*<sup>19</sup>. Of unglazed, thin grey paste, the pot in figure 21 bears a decorative design on its shoulder of wavy strokes alternating with stamped, straight lines. The body of the pot is decorated with a group of short, incised lines. (UNEX-P-1/77, d 29 cm, ht 15.5 cm.)

The pot in figure 22 is of unglazed, soft-burned clay. The vessel is impressed with a corded pattern, alternating with geometric lines on its shoulder and incised stroke lines on the body. (UNEX-P-2/77, d 46 cm, ht 11 cm.)

Three large sherds of rice pots were found, decorated with corded patterns and incised lines as in figure 22.

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19. Ho Ching Hin and Bobby Ng, "Sha Tsui, High Island", *Journal of the Hong Kong Archaeological Society*, vol. V, 1974. The Hong Kong Museum and the Hong Kong Archaeological Society discovered an ancient ship in the bed of the High Island Reservoir, near Sha Tsui Village, in 1974. Description of the finds together with photographs has given strong hints of a resemblance between the Sha Tsui junk and a few ancient vessels found in the Gulf of Thailand. Beside the celadon glazed-ware of Sawankhalok, the unglazed earthenware sherds found at the site with stamped patterns were described as follows: "... such designs have not been seen locally, but the method of manufacture, stamping and paste resemble in many ways pottery from prehistoric sites in Hong Kong..." (*ibid.*, p. 31). The wares in question are actually a type of earthenware manufactured in Thailand since ancient times.



*Storage jars.* Three large, stoneware, Sawankhalok storage jars were collected from the Pattaya wreck. Many such jars are reported to have been lost to pirate digging.

The large Sawankhalok jar in figure 23 (d 42 cm, ht 5.2 cm), with four loops, has an everted mouthrim. The shoulder is separated from the neck by a moulded rib, and the loops are attached to the shoulder. Three circular bands decorate the shoulder and neck. The upper body is done in a chocolate-brown glaze down to the waist, with the base unglazed permitting the fine beige paste to be observed.

The large, four-looped Sawankhalok jar in figure 24 (d 21 cm, ht 30 cm) has the same shape and form as the preceding specimen, although it is a bit smaller. Decorative circular bands ornament the shoulder alone; the whole jar, with the exception of the waist and wide base, is covered with a brown-monochrome glaze. There is a grooved inner rim to accommodate a lid.

The upper part of one small Sawankhalok jar (fig. 25; d 18 cm, ht 35 cm) perhaps the most interesting find, was discovered with its lid in place, buried in dark brown soil similar to a laterite-clay mixture. Judging from the shape of the jar it must have been about 35 cm high. Traces of brown-monochrome glaze remain on the sides. The lid has a lotus-bud handle upside down on the mouthrim of the jar. Traces of rice were found inside but, as the bottom had split apart allowing the rice to wash away, not enough remained for analysis.

*Part of a kendi.* Resembling a teapot spout, the *kendi* fragment is of unglazed, dark grey paste, and about 10 cm long.

*Jar lids.* Seven unglazed stoneware lids were collected (fig. 26), each with a lotus-bud handle rising sharply from the center. Their sizes range from 15 cm wide and 4.5 cm high, to 8 cm wide and 2.5 cm high. They are undoubtedly lids for brown-monochrome Sawankhalok storage jars.

*Box lid.* The lid is dome-shaped with a pyramid top forming a handle, and is an example of Sawankhalok ware of unglazed, dark grey paste<sup>20</sup> (d 7 cm, ht 4 cm).

20. For an example, see Willetts, *op. cit.*, p. 159, fig. 244.

*Covered box.* Octagonal and decorated in a blue underglaze, the box in figure 27 (d 8 cm, ht 4 cm) has alternating designs of leaf-spray and wave patterns. The inside of the box is wiped with a translucent glaze, with the curved footrim and base unglazed and oatmeal in color. The painted decorations are in the Annamese style, while the leaf-spray and wave patterns confirm the Annamese origin of the box<sup>21</sup>.

*Sherd.* One bowl-bottom (d 18 cm) was discovered, its glaze much deteriorated and dirty.

#### *Discussion and analysis*

According to information obtained from local fishermen and fortune-hunters, the Pattaya ship originally carried tons of lead, mostly pyramid-shaped ingots, each piece measuring 6 cm in diameter and about 2.5 cm high. All specimens seem to contain sand, probably from the moulding process.

The presence of the lead raises many questions. Where was its origin, and where was it bound? Why the particular pyramidal shape? Why did almost all of the shipwrecks found so far in the Gulf of Thailand carry lead—as ballast, or export cargo?

Historical records show that lead has been mined in Kanchanaburi Province since ancient times in the remote areas of Si Sawat and Sangkhla Buri District, about 130 kilometers west-northwest of Bangkok<sup>22</sup>. Two groups of crucibles were used to melt the lead, and samples were taken to the laboratories at the Bundesanstalt für Bodenforschung, in

21. Cheng Lammers, *Annamese Ceramics in the Museum Pusat Jakarta* (Jakarta, The Ceramic Society of Indonesia, 1974); see vegetal forms and geometric designs, pp. 108-109, figs. IV-V. For another example, see Adrian, *Chinese and Annamese . . .*, *op. cit.*, p. 171, fig. 105.

22. The area between the Kwae Yai and Kwae Noi rivers has long been exploited for its minerals. Numerous sites with abundant Pb-slag remains are evidence of such activities. C<sub>14</sub> dating analysis has shown that ancient mining took place during the "late medieval" period between 1310 and 1480 A.D., in Si Sawat, and 1480-1640 A.D. in Sangkhla Buri.



Hanover, Germany<sup>23</sup>. Carbon<sub>14</sub> dating revealed that one group dates between 667 and 337 years ago, the other from 497 to 337 years<sup>24</sup>.

Professor Kaset, while conducting independent investigations, found over 10,000 pieces of slag buried in the area<sup>25</sup>. From the lead mines at Songthaw and Si Sawat he recovered three sherds. One is a fragment of a base of celadon ware, from the Sawankhalok kilns; the other two are blue-and-white Ming ware.

Inhabitants of Kanchanaburi forests currently mould lead ingots by making small holes in sand with conical ends of sticks or paddles, pouring the melted lead into the holes. The sand grains adhering to the surface of the ingots recovered from the Pattaya wreck could indicate this technique is several hundred years old.

If the lead works were located near waterways, the most convenient method of transporting the finished ingots to nearby towns would have been by boat or raft. Another possibility is that the pyramids of lead were packed in bamboo baskets and taken by cart through the dense forest to their destinations. The small pyramids also lend themselves to transport by litter where necessary.

Lead was found in other shapes at the Pattaya site: cylindrical, bowl-shaped, and hat-shaped (fig. 28). They differ in size, but on average they do not exceed 12.5 cm in diameter and 8 cm in height.

Thailand has a long history of trade in lead, perhaps earlier than the fourteenth century A.D.<sup>26</sup> Records on the relations between Thailand and foreign countries from the late sixteenth to early eighteenth centuries clearly indicate that Thailand's main exports included elephant

23. M.A. Geyh, *Kommentar Zu den Ergebnissen der Padiokohlenstoff Analysen aus Thailand* (Hanover, NLFB, 1971).

24. Department of Mineral Resources, *Mineral Prospection of German Geological Mission in Thailand* (Bangkok, 1971).

25. Kaset Pitakpaivan, "Report on iron specimens from sunken junks in the Gulf of Siam" (Bangkok, Department of Mineral Resources, 1977).

26. F. Hirth and Rockhill, 'Chan Ju-Kna': *His Work on the Chinese and Arab Trade in the Twelfth and Thirteenth Centuries, Entitled 'Chu Fan Chi'* (St. Petersburg, 1912).

tusks, rice, hides, wood and lead<sup>27</sup>. Historically, lead trading was active in Malacca, Indonesia and the Philippines. Records confirm that Western ships transported lead and other cargo from Siam to many countries.

During the sixteenth century A.D. lead was used abroad for many purposes, including roofing material and in alloys, Japan was demanding lead from Thailand during her civil war for use in bullets<sup>28</sup>, as ballast in ships, and for measuring sea depth. However, the amount of lead found at the Pattaya site is too great to be simply ballast, leading one to conclude that it was the main cargo of the vessel.

Regarding the iron samples from the vessel, Professor Kaset in co-operation with Dr. Othorn Sukhato has come up with the following analysis<sup>29</sup>.

The AGL magnetic property can be divided into three categories:—

1. First is light magnetic part. This is magnetite.
2. Second is that part with good magnetic susceptibility. This is metallic iron.
3. Third is non-magnetic or with very weak magnetic susceptibility. This is slag material, lead and organic material.

The AGL was cut for internal viewing, and from the cut pieces two thin sections were made for microscopic study.

The specimen was washed and soaked in plain warm water for half an hour, and the surface cleaned with a toothbrush. After excess water on the surface was removed by cloth, the specimen was left at room temperature for two weeks.

After two weeks, various newly formed oxides of iron showed up very well, for example:

27. Pairote Kesmaenkit, บันทึกเรื่อง สัมพันธ์ไมตรีระหว่างประเทศไทยกับนานาประเทศ ["Translated from the records of the relations between Siam and foreign countries in the seventeenth century"], (Bangkok, 1970).
28. หอสมุดแห่งชาติ ประชุมพงศาวดาร ภาคที่ ๒๐ เรื่องทางพระราชไมตรีระหว่างไทยกับญี่ปุ่น (Bangkok, 1964).
29. Kaset, *op. cit.*



Large and rusty brown oxide of iron on the surface where there is metallic iron. In a few places are bright yellow limonite and red haematite.

A section of the AGL shows, megascopically, numerous pores and vugs of various sizes in the massive matrix with inclusions of small and large fragments up to a centimeter long; green slag; rounded grainy and sandy materials. Flow structures can be seen both in the matrix and in the embedded fragments.

Thin section under polarizing microscope revealed magnetite, haematite, limonite, quartz, feldspar, calcite, biotite, muscovite and plenty of zircon.

The green slaggy material revealed itself to be a glass material under polarizing microscope.

#### Conclusions:

1. The specimen AGL is an incomplete smelting of iron ores, which consists of magnetite and haematite.
2. Apparently the ores were crushed before smelting, and smelting was carried out to a stage in which metallic iron was partially obtained.

A piece of bamboo is apparently embedded in the iron. The wood might be dumped with the iron and slag, and was later firmly attached to iron by the aid of iron oxide formation and marine organism, with carbonate shell growing on iron and wood.

Careful study of the bamboo and wood specimens by Mr. Pong show that the bamboo is *Gigantochloa sp.*<sup>30</sup>, which is only found in southeast Asia. The long spaces between the joints make it too weak for use as weight-bearing uprights, such as those used for the foundation poles of traditional Thai houses, but is very good for walls and baskets.

The bamboo from the cargo compartment seems to be fragments of a wall, as its ends show traces of iron oxide which is found on the planks. Some of the bamboo bears strips of rattan similar to that which

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30. Pong, *op. cit.*

fastened the pole to the plank, mentioned in discussion of figure 19, and other fragments belonged to the baskets where lead or foodstuffs were stored. Dr. Chyagrit states that from the result of  $C_{14}$  dating, the bamboo was cut from its roots 350 years ago<sup>31</sup>. This seems to be the chief evidence for dating the vessels.

As for the strips of leaves adhering to the surface of the iron lumps, Mr. Pong has identified them as *Nipa fruticans* (*Palmae* family) which is commonly found in southeast Asia and Australia, and grows in tidal mud, rivermouths, and mangrove areas<sup>32</sup>. In Thailand and the Malay Peninsula, *Nipa fruticans* grows mainly on the coastal areas. The leaves are used for thatching houses and packing purposes. It is justifiable to presume that the cargo compartment, where the leaves were found, contained iron lumps and lead covered by the leaves, forming a bed for rice, meat or other foodstuffs. This method of packing is used in present-day Thailand.

By contrast, neither the official diving team nor local fishermen and robbers have found any Sukhothai-period products at the site.

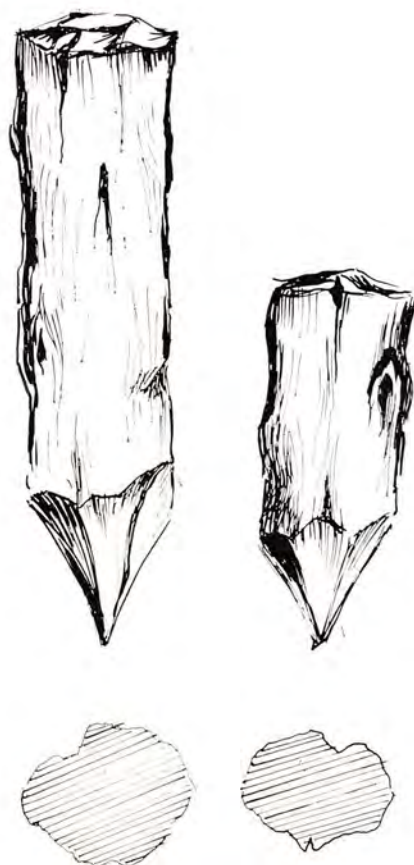
There seems no doubt that we are dealing with a cargo vessel, but the unanswered question is what exactly was the main cargo? The presence of large quantities of lead hint at a known principal export item of Thailand. The composition of the pottery types permits little doubt that pottery was not meant for export. The various sizes of storage jars indicate that the ship was provisioned for a long voyage.

Evidently the Pattaya cargo-carrier was active during the mid-seventeenth century A.D., but the cause of its sinking still remains a mystery.

31. Chyagrit Siri-Upathum, รายงานการกำหนดค่าอายุโดยวิธีคาร์บอน<sup>14</sup> ของโบราณวัตถุใต้ทะเล (Bangkok, Institute of Atoms for Peace, 1977).

32. Burkill, *op. cit.*



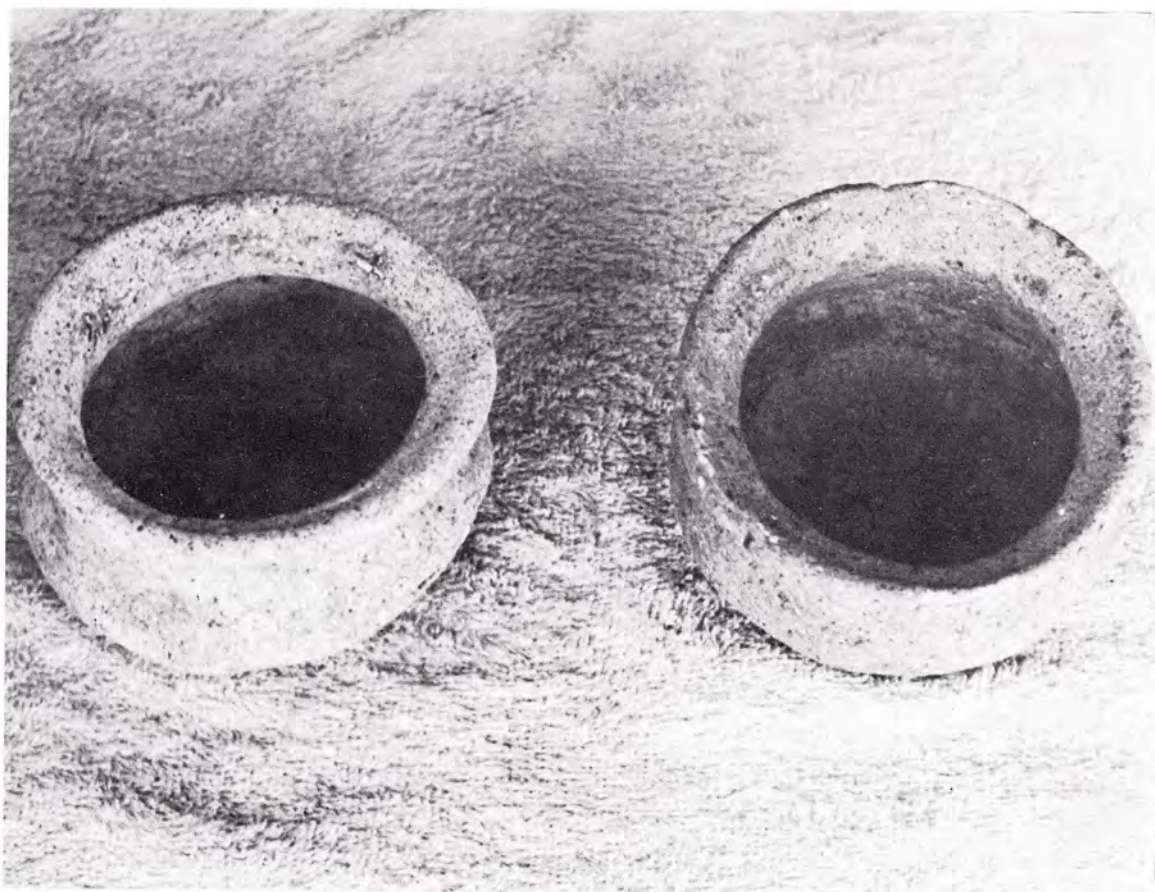


*Figure 1. Wooden pegs (not drawn to scale).*



*Figure 2.* Granite stone.





*Figure 3. Sugar-palm pots.*

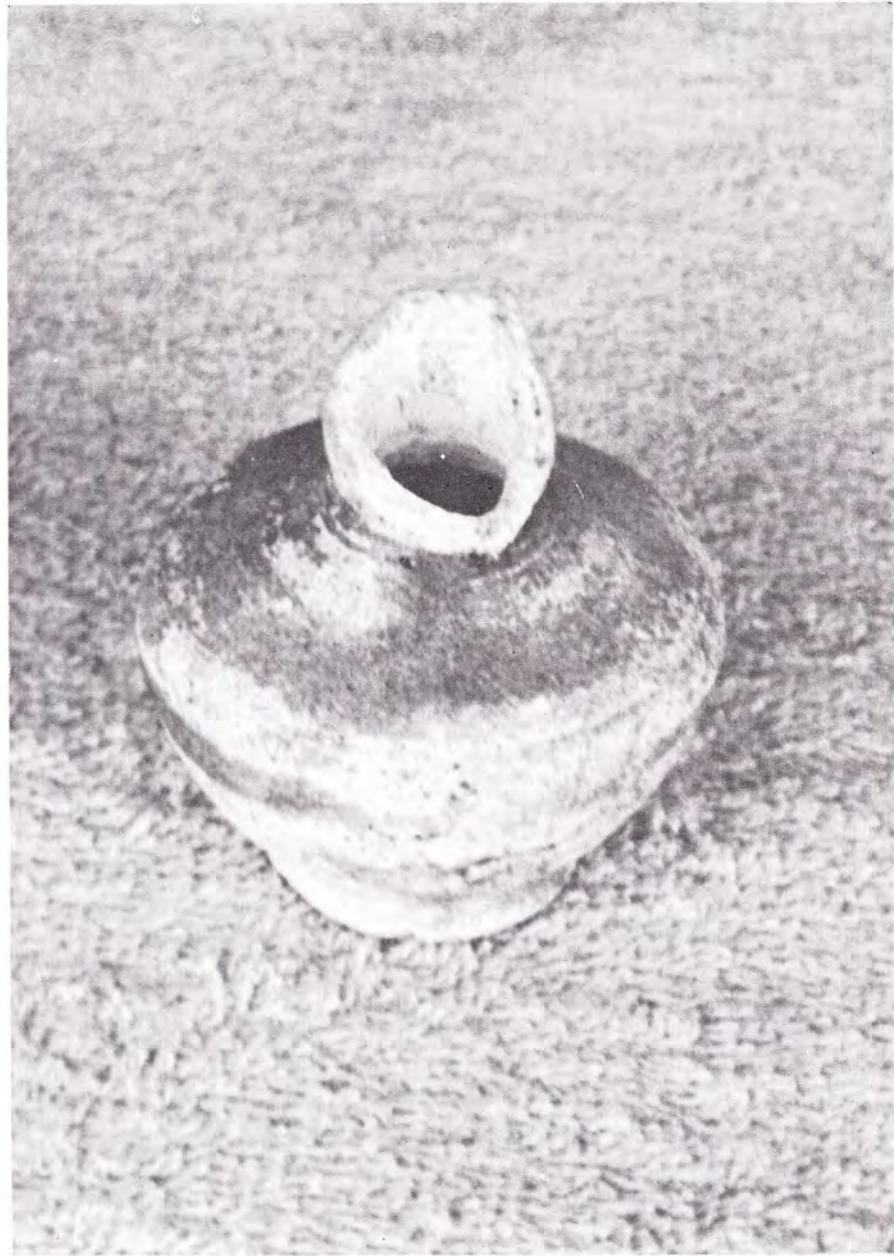


*Figure 4.* Earthenware basin.



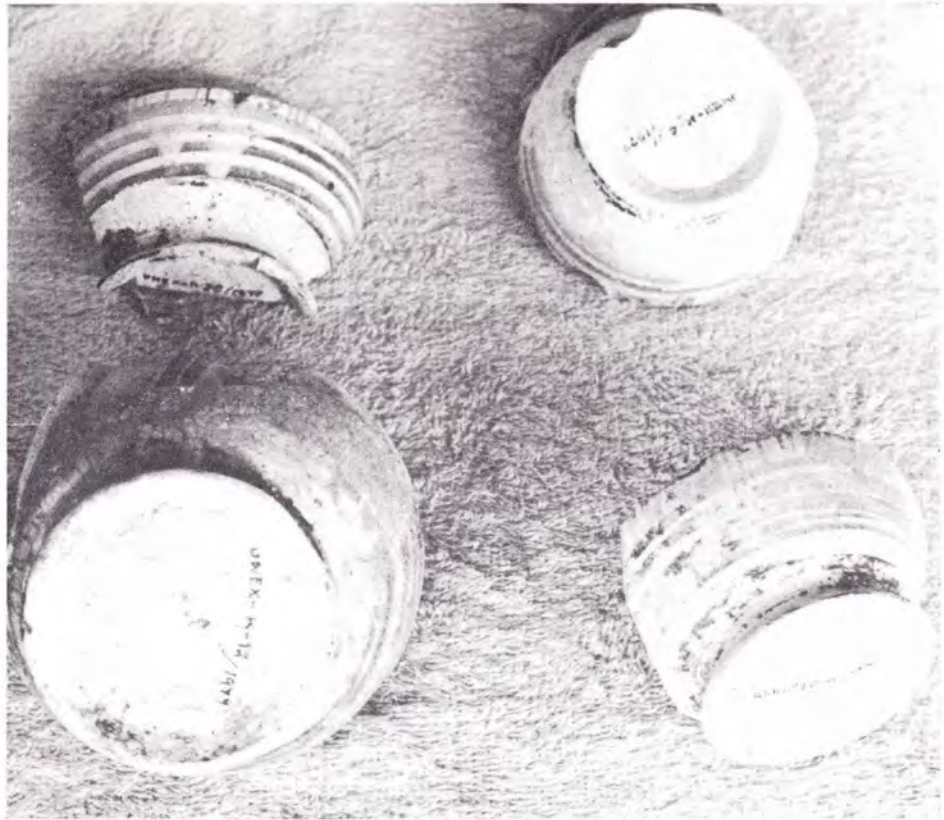


*Figure 5.* Vase with 'blush-stroke' pattern.

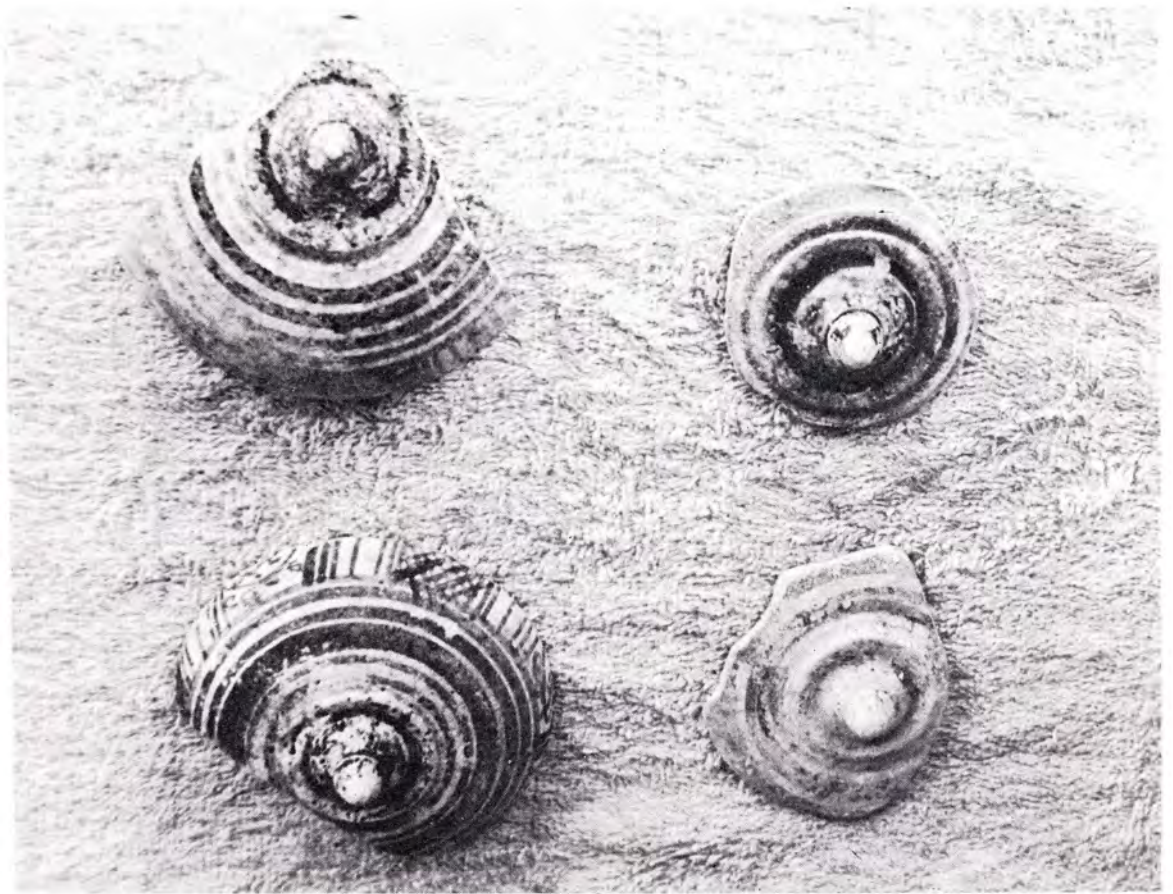


*Figure 6.* Pear-shaped vase.



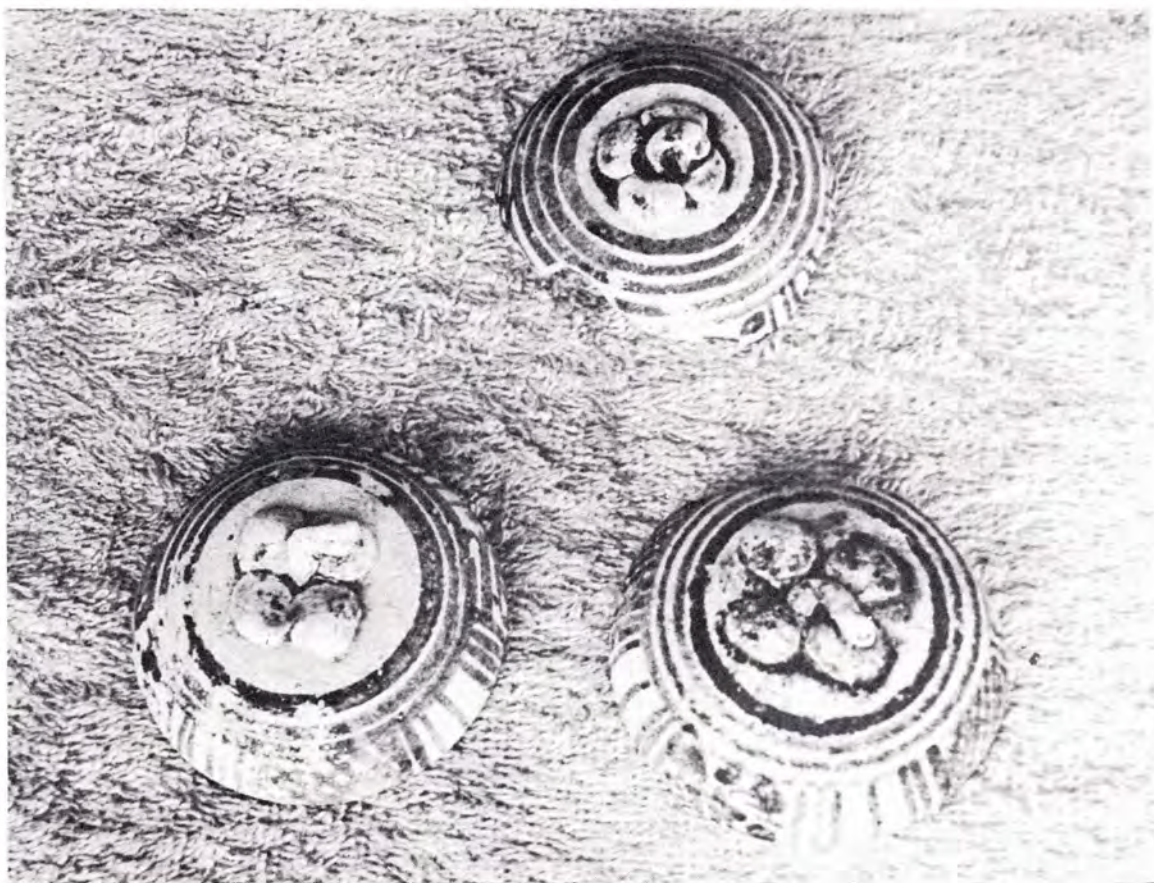


*Figure 7.* Four 'boxes' of Sawankhalok ware decorated with typical designs.



*Figure 8.* Lids of covered boxes with a lotus-bud handle.



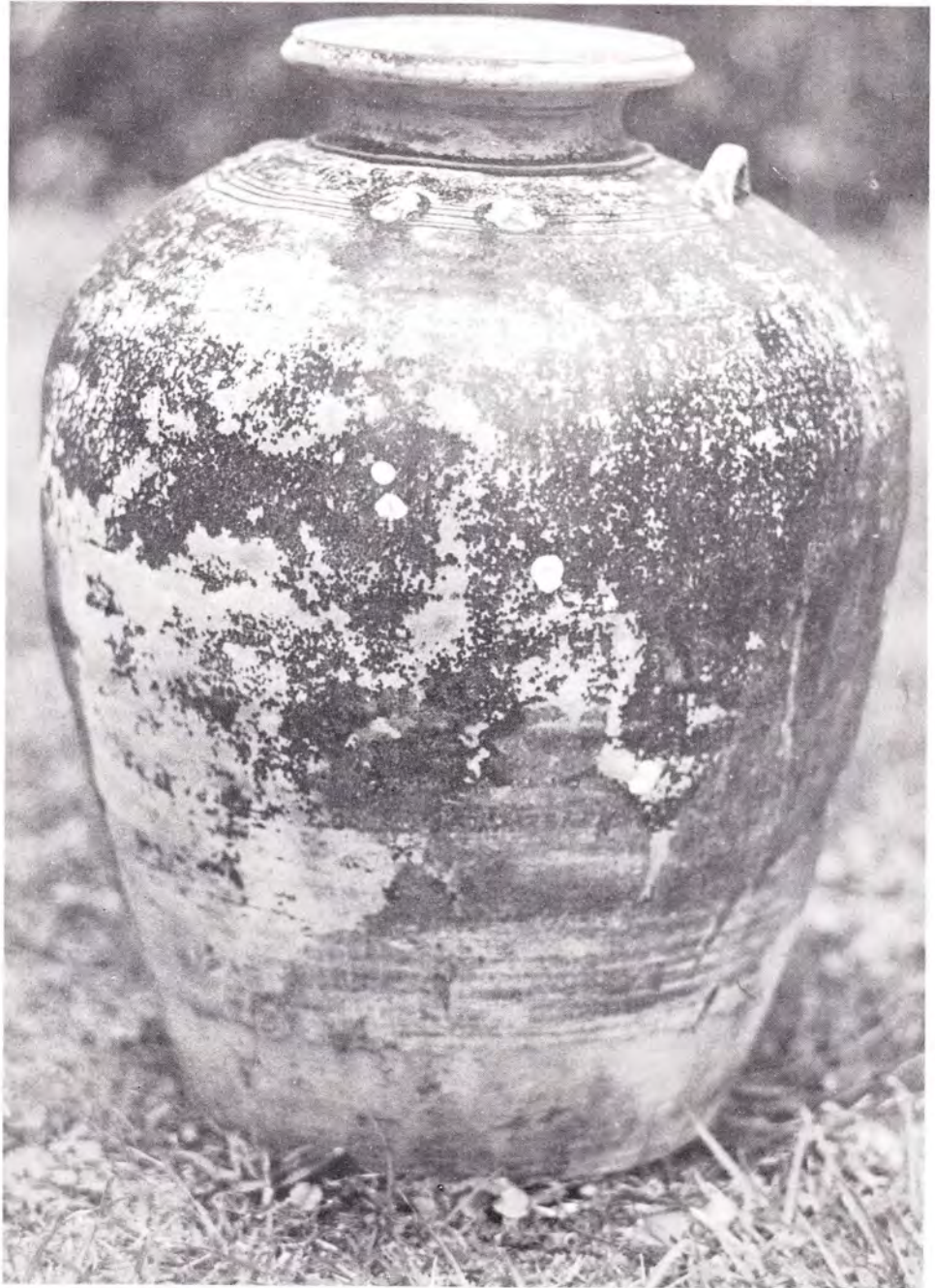


*Figure 9.* Lids of covered boxes with a four-sepalled 'mangosteen' handle.

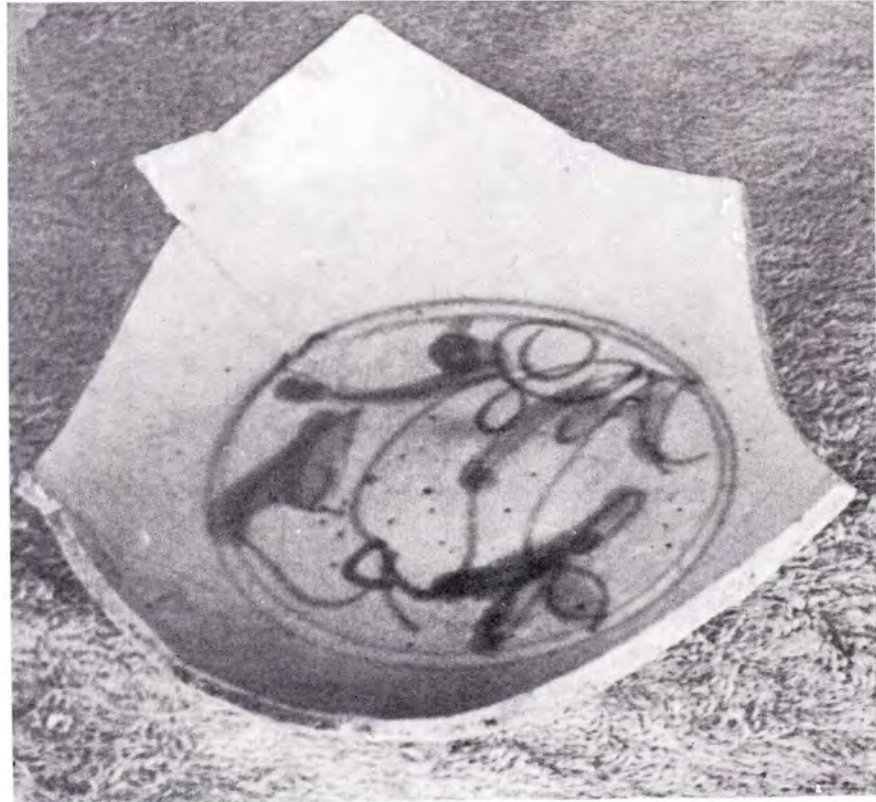


*Figure 10.* Earthenware lid of a jar.





*Figure 11.* Sawankhalok jar with four ring-handles.



*Figure 12.* Part of a blue-and-white Ming bowl.





*Figure 13.* Part of a blue-and-white Ming bowl.



*Figure 14.* Part of a blue-and-white Ming bowl.





*Figure 15.* The design on the outer cavetto of a blue-and-white Ming bowl, with geese swimming beside lotus clumps.



*Figure 16.* Part of a blue-and-white Ming bowl with a wide crackle.





*Figure 17.* Decorative design on the inner base of a Ming-ware bowl.

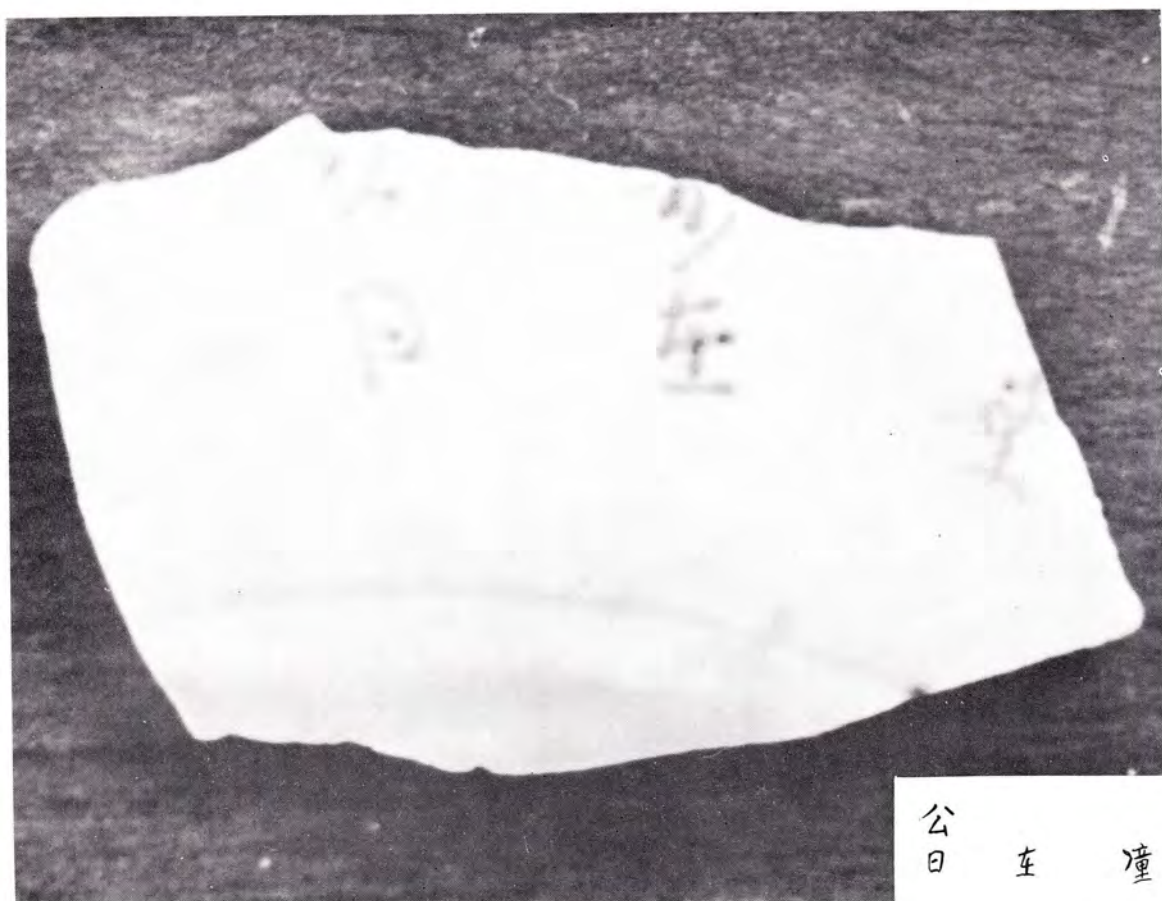


Figure 18. Sherd with Chinese characters, late Ming period.



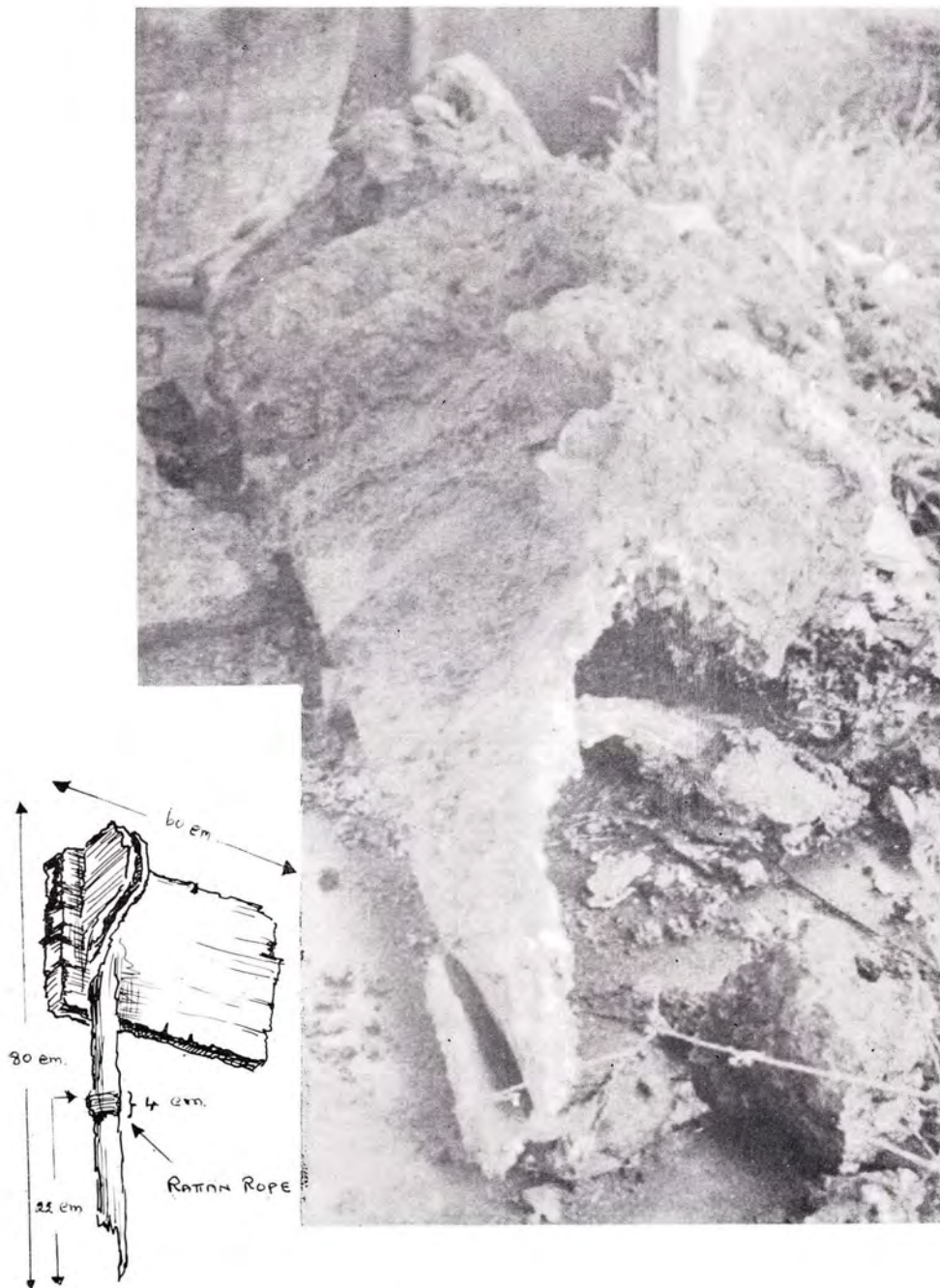
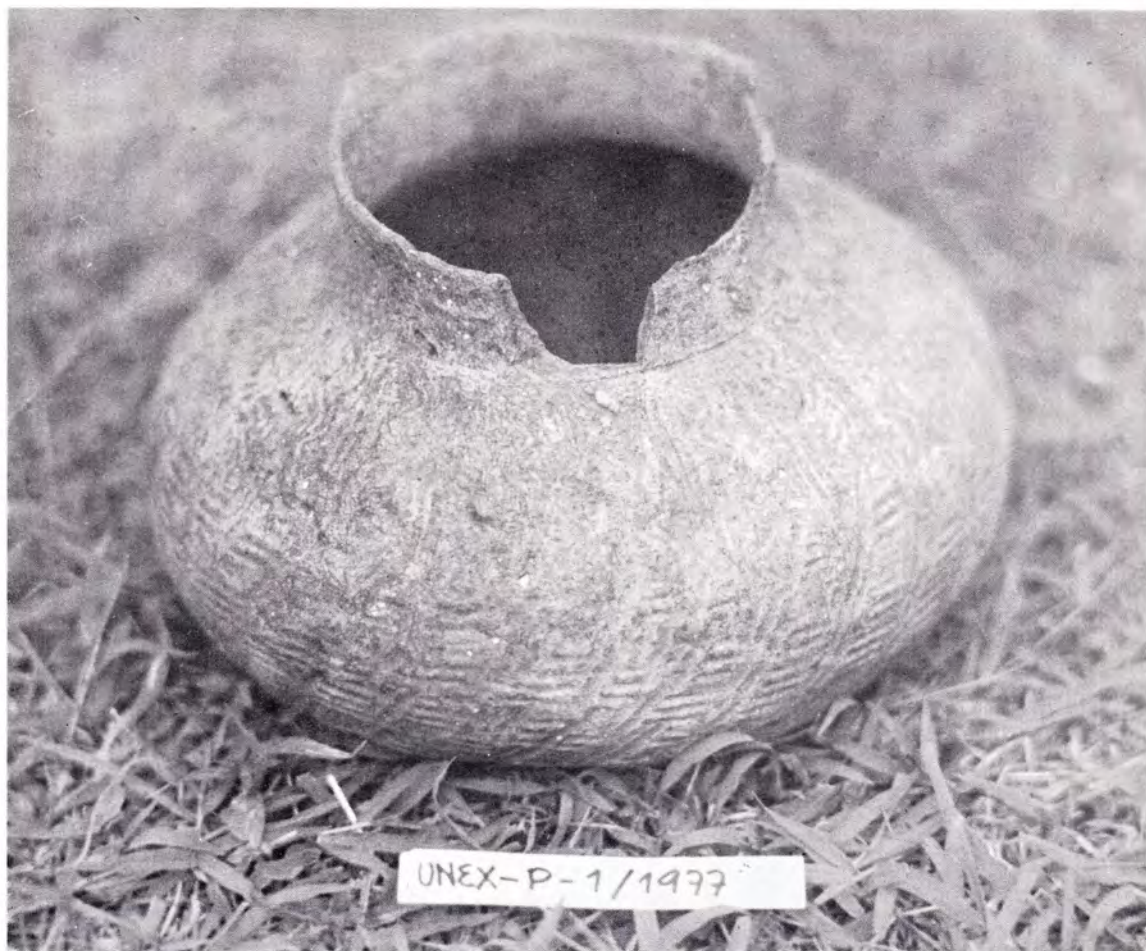


Figure 19. Wooden plank under an iron lump, with lead and a fragment of bamboo stuck to it.



*Figure 20.* Pyramid-shaped lead lumps.



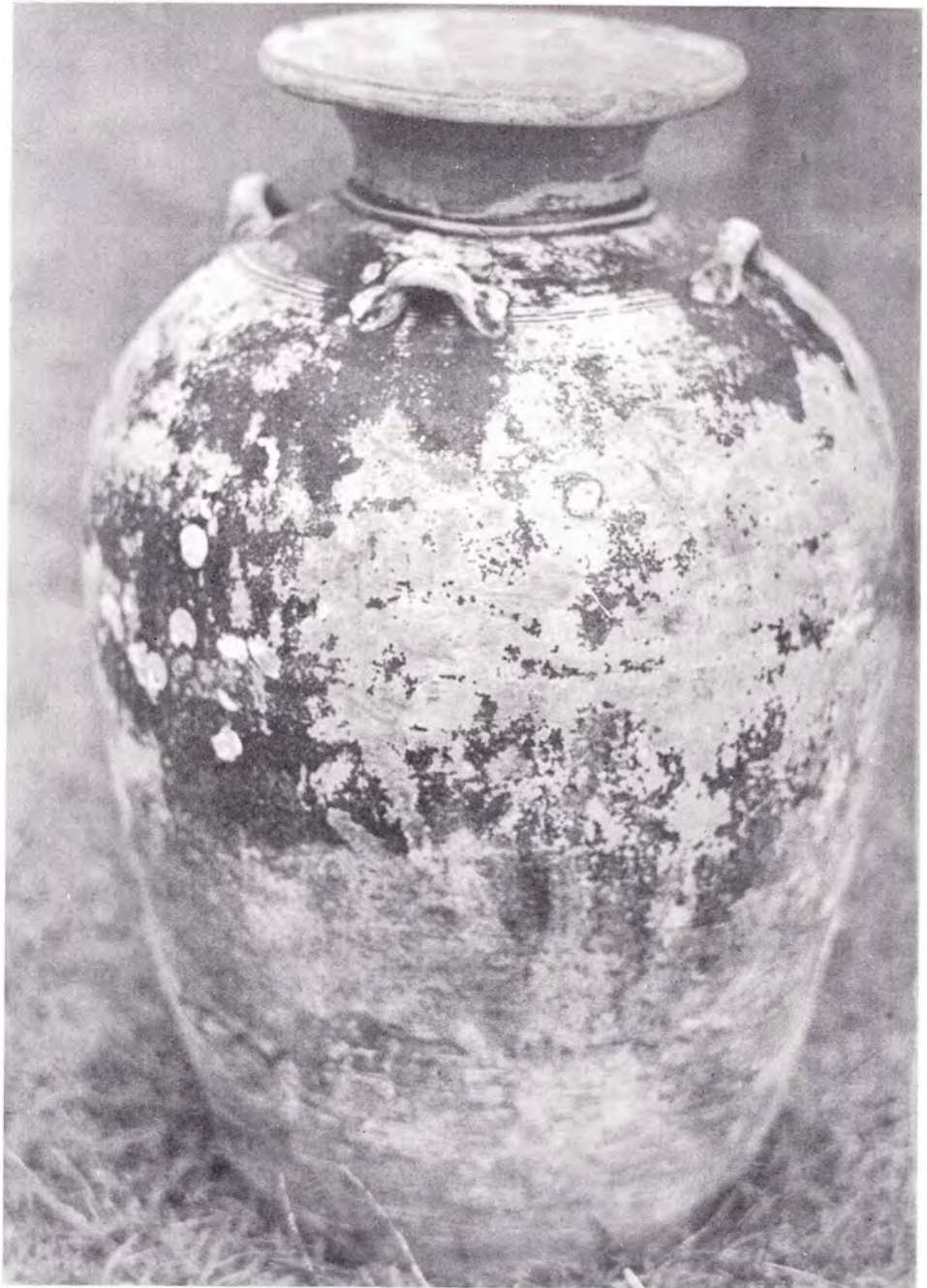


*Figure 21.* Earthenware rice pot with a pattern of stamped and incised lines.



*Figure 22.* Rice or curry pot, of unglazed clay with corded pattern.





*Figure 23.* Sawankhalok storage jar (d 42 cm, ht 52 cm).

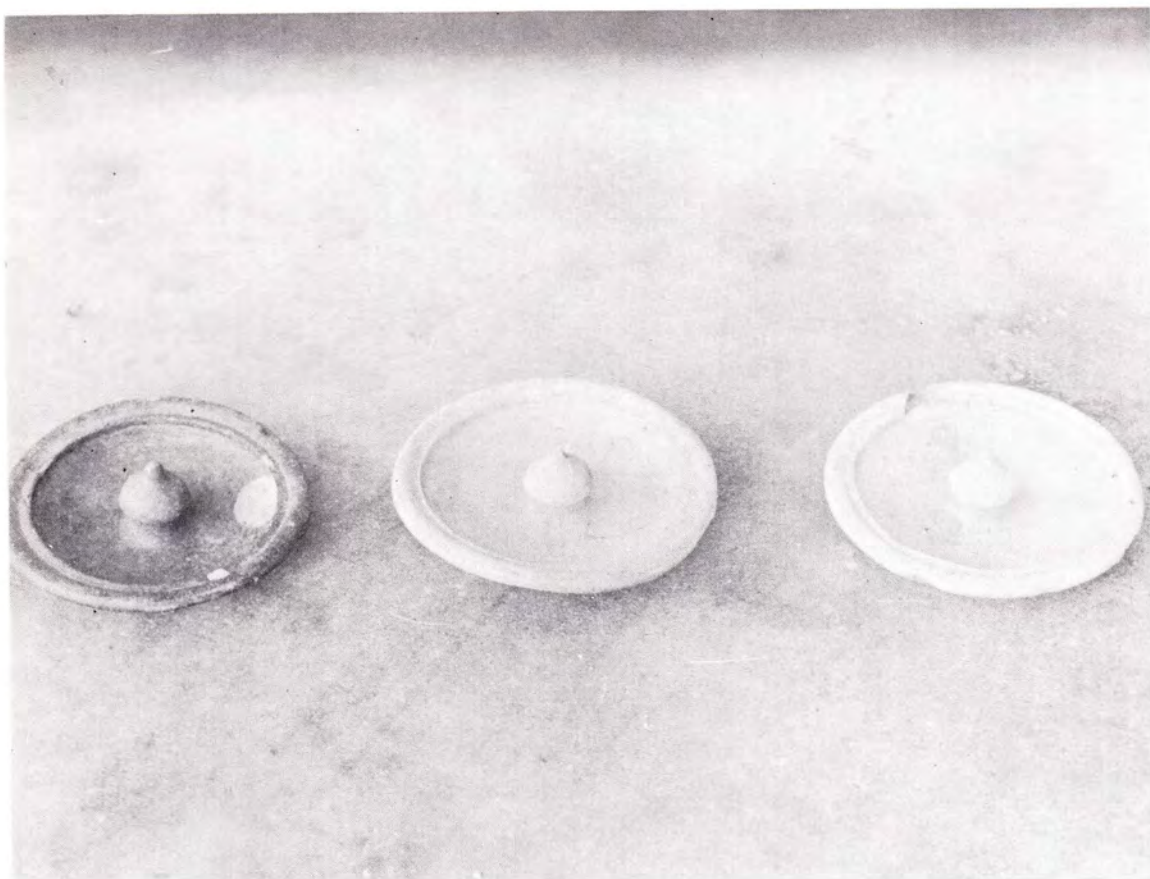


*Figure 24.* Sawankhalok jar with four looped handles (d 21 cm, ht 30).





*Figure 25.* Jar with traces of rice inside (d 18 cm).



*Figure 26.* Stoneware jar lids with lotus-bud handles.





*Figure 27.* Octagonal covered box, Annamese ware, with leaf-spray and wave patterns.

*Figure 28.* Formed lead found in the Sattahip ship.



(a) Cylindrical shape.



(b) Hat shape.



(c) Ball shape.