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Metal Finds and Metal-working

at the

Parliament House Complex,

Singapore

by

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Introduction

Archaeological research on pre-colonial Singapore first began in 1984 with excavations on Fort Canning Hill, the residence and ceremonial centre of the ruling elite of Temasek, a fourteenth century Malay trading centre. As the settlement was built on what is part of the administrative and ceremonial centre of modern Singapore, the opportunity to extend the scope of research beyond the Hill is somewhat limited. The Parliament House Complex Excavations of 1994/1995, was the first time an excavation was conducted at a site away from Fort Canning Hill. Conducted by the Singapore History Museum and Dr. John Miksic of the National University of Singapore, the site excavated is along the Singapore River and within the boundaries of the pre-colonial settlement as described by various historical sources.

Finds from the Parliament House Excavations include: Chinese trade ceramics; Southeast Asian earthenware pottery; metal finds of iron, bronze and copper; and slag, the latter being evidence of metal-working. As the island of Singapore does not have any sources of metals that can be exploited, the metal-workers of Temasek were entirely dependent on imports.

Although data on Southeast Asian metallurgy is scant, a number of generalisations can, however, be made regarding technology, production, and the trade in metals. Both archaeological and ethnographic data suggest that few innovations in smelting and manufacturing techniques occurred during the pre-industrial period. Approximately the same techniques for extracting and fabricating metals were used, with local innovations occurring from time to time. On the other hand, the general level of metallurgical knowledge should have been quite high. Southeast Asians may not have practiced some of the more specialised techniques used by the Indians and Chinese, but the full repertories of basic processes was widely used and understood.[1] The intensity of maritime and riverine commerce also encouraged specialisation of production.[2]

Metals and metal objects were valuable commodities in the pre-industrial world; they were intrinsically scarce and very labour demanding to produce (with tin being the exception, the region being a major exporter of the metals from as early as the first millennium AD).[3] This scarcity meant that metals were traded over long-distances, and in the case of iron, cheap imports from large scale producers outside of Southeast Asia dominated local markets.[4] Pre-industrial manufacturing also did not achieve the levels of production associated with larger centres such as China, the essential unit of production in Southeast Asia was the household, with a few dependent relatives or apprentices working for the craftsman.[5] Independent producers can be characterised as risk minimisers who will, if possible, combine economic strategies to remain somewhat generalised, scheduling between two economic activities.[6]

Singapore: history and archaeology

Trade was the primary source of wealth and prestige in the pre-colonial Malay World.[7] The estuarine location of Malay settlements along the strategic Straits of Melaka made

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[1] B. Bronson, "Patterns in the Early Southeast Asian Metals Trade", in I. Glover, Pornchai Suchitta and John Villiers (eds) *Early Metallurgy, Trade and Urban Centres in Thailand and Southeast Asia: 13 Archaeological Essays*, Bangkok: White Lotus, 1992, p. 97

[2] A. Reid, *Southeast Asia in the Age of Commerce 1450-1680, Vol. 1: The Lands Below the Winds*, New Haven: Yale University Press, 1988, p. 100.

[3] Bronson, *op.cit.*, p. 65.

[4] Reid, *op.cit.*, pp. 106-119.

[5] *Ibid.*, p. 101.

[6] C.L. Costin, "Craft Specialization: Issues in Defining, Documenting, and Explaining the Organization of Production" in Schiffer, M.B. (ed), *Archaeological Method and Theory*, Vol. 3, Tucson: University of Arizona Press, 1991, p. 17.

[7] O.W. Wolters, *History, Culture and Region in Southeast Asian Perspectives*, Singapore: Institute of Southeast Asian Studies, 1980, pp. 37-38. The Malay World should be distinguished from the Malay Archipelago. It is a collective term for the coastal polities of eastern Sumatra and the Malay Peninsula, sharing a common culture. During the seventh to twelfth century, the geographical area corresponded with areas within the Srivijayan sphere of influence, and from the fifteenth century, associated with areas under the

them ideal collection and redistribution points for marine and forest produce from the hinterland, and of imported luxury items such as Chinese porcelains and silks, Indian cloth and bronzes; and subsistence provisions.[8] The Straits is also a natural shelter from the monsoons. Malay ports provided harbour facilities and and protection against pirates.

While external trade was the source of wealth and prestige, it is the trade in subsistence provisions which dominates overwhelmingly in bulk and significant value terms.[9] A seventeenth century European account noted that "these people are constrained to keep up constant intercourse with one another, the one supplying what the other needs."[10]

As manpower, and not territory, was the most important resource of a Malay ruler, it was often difficult to distinguish the city from the kingdom. Malay polities were no more than a political unit in which a focally situated settlement exercised direct control over a restricted peripheral territory and exacted whatever tribute it could from an indefinite region beyond.[11] By bringing both coast of the Straits under its vassalage, the Sumatran kingdom of Srivijaya became the dominant political and economic power in the Malay World between the seventh to twelfth centuries. All external trade became centred on an entrepot in southeastern Sumatra. Vassals were, however, declaring their independence from the Maharaja as early as 1079.[12] The expansion of Chinese mercantile activities during the Southern Sung (1127-1279) set in train tendencies disastrous for the system of

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influence of the Melaka Sultanate. The Malay Archipelago on the hand is the collective term for insular Southeast Asia, and is culturally diverse.

[8] J.N. Miksic, "Traditional Sumatran Trade" *Bulletin l'Ecole Francaise d'Extreme Orient*, 74 (1), 1985, p. 446.

[9] A. Reid, "Trade Goods and Trade Routes in Southeast Asia: c. 1300-1700", *SPAFA Consultative Workshop on Maritime Shipping and Trade Networks in Southeast Asia, Final Report*, Bangkok: SPAFA and Fine Arts, 1985, p. 249.

[10] Francis Pyrard quoted in A. Reid, *Southeast Asia in the Age of Commerce, 1450-1680: Vol. 1, The Lands Below the Winds*, New Haven: Yale University Press, 1988, p. 6.

[11] P. Wheatley, *Nagara and Commandery: Origins of the Southeast Asian Urban Traditions*, Dept. of Geography Research Paper nos. 207-208, Chicago: The Dept. of Geography, University of Chicago, 1983, p. 233.

[12] G. Coedes, *The Indianized States of Southeast Asia*, Honolulu: East West Center, 1968, p 179.

communication centred on Srivijaya. The situation deteriorated further during the Mongol period (1279-1368).[13]

The earliest reference to Singapore appears in the Chinese text the *Daoyi Zhilue*, compiled in 1349 by Wang Dayuan (Map 2). Although Wang omits any references to political allegiance he does make it abundantly clear that, apart from Temasek, the economic life of the Malay Peninsula was confined to the northern tracts.[14] Historical sources seem to support the supposition that after a century or more of modest but increasing prosperity as a vassal of Java, and then the Tai, Singapura was founded by Paramesswara, an ambitious and perhaps ruthless descendant of the rulers of Srivijaya. However, his act of occupying this site was too provocative to the Tai, who expelled him at the end of the fourteenth century, after which a settlement with some foreign trade including the export of jungle wood maintained itself rather quietly until it was destroyed by the Portuguese in 1613.[15]

Temasek, like other Malay trading centres did not have a substantial agricultural hinterland, and so dominant was the trade-based town that it was difficult to distinguish between the city and the kingdom.[16] Wang Dayuan provides the only contemporary account of the settlement. According to him "the land was poor and grain scarce".[17] John Crawfurd who visited Singapore in 1821 described the ancient settlement as a "kind of triangle" (Map 3).[18]

[13] O.W. Wolters, *The Fall of Srivijaya in Malay History*, Ithaca: Cornell University Press, 1970, p. 42.
[14] *Ibid.*, p. 85.
[15] J.N. Miksic, *Archaeological Research*, p. 44.
[16] A. Reid, "The Structure of Cities in Southeast Asia, 15th to 17th Centuries", *JSEAS*, 11 (2), 1980, p. 240.
[17] P. Wheatley, *The Golden Khersonese: Studies in the Historical Geography of the Malay Peninsula to AD 1500*, Kuala Lumpur: University of Malaya Press, 1961, p. 83.
[18] J. Crawfurd, *Journal of an Embassy from the Governor General of India to the Court of Siam and Cochin China*, Reprint, Singapore: Oxford University Press, 1967, p. 44.

> "It was bounded to the east by the sea, to the north by a wall, and to the west by a salt creek or inlet of the sea. The inclosed space is a plain, ending in a hill of considerable extent, and a hundred fifty feet in height."

The hill described by Crawfurd is Fort Canning Hill, the creek, the Singapore River, and the wall to the north, the *parit Singapura*, a defensive moat. Crawfurd also observed brick foundations, possibly the remains of a temple complex; and fruit trees which bore very small fruits, due to the age of the trees and which he believed were part of an orchard planted in the fourteenth century.[19] Wheatley, incorporating the above description with Chinese accounts of Temasek, offers the following reconstruction:

> "The hill was the nucleus of the settlement, where the temples and other important buildings were located; on the plain below were the dwellings of the citizens."[20]

Malays would have been the dominant group at the settlement until its destruction by the Portuguese in 1613. *Orang laut*, sea nomads, in their houseboats along the coast and estuary of the Singapore River, formed a significant sector of the population. Collectors of marine and forest produce, they were loyal to the ruler, and an effective naval force, cutting off trade from other ports and directing it to Singapore.[21] The *orang laut* were an important part of the system of governance and prosperity, and in the nineteenth century, some groups still retained a function in the Johor court.[22] There would also have been a quarter settled by foreign merchants. According to Wang Dayuan, natives and Chinese dwelled side-by-side at Lung-ya-men, a site on the island of Singapore west of Temasek.[23] Lung-ya-men,

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[19] *Ibid.*, p. 46.
[20] Wheatley, *Golden Khersonese*, p. 305.
[21] D. Sopher, *The Sea Nomads*, Singapore: National Museum, 1977, p. 315.
[22] L.Y. Andaya, *The Kingdom of Johor 1641-1728*, Kuala Lumpur: Oxford University Press, 1975, p. 45.
[23] Wheatley, *The Golden Khersonese*, p. 82.

however, was not a trading centre but home to pirates preying on vessels sailing through the Straits of Singapore.[24] A significant number of the population would have shifted to Melaka after the Tai attack, and by the seventeenth century, the dominant group on the island would be the *orang laut.*

According to Wang, the indigenous products traded at the settlement included, very fine hornbill casques, lakawood of moderate quality and cotton. The Chinese traded "green cottons, lengths of iron, cotton prints of local manufacture, *chin chin* (half tael coins), porcelain ware, iron pots and suchlike".[25]

Until the first excavations on Fort Canning in 1984, the only remains from the fourteenth century were a fragment of the Singapore Stone, an inscription that once stood at the mouth of the Singapore River, and gold ornaments found by workmen near the summit of Fort Canning Hill.

Only one fragment of the Singapore Stone has survived; the inscription was blown up by the British in 1824 to make way for the quarters of a colonial military official. Unfortunately the inscription was not transcribed before it was destroyed, and the surviving fragment is too worn to provide any significant information other than the language and script used. There are, however, conflicting opinions as to the language, script, and age of the inscription. One opinion is that it is in old Malay similar to that used in Sumatra during the twelfth century, consistent with Temasek being part of the Srivijayan sphere of

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[24] Questions have been raised regarding the accuracy of the *Daoyi Zhilue*, and Wang might have confused his description of Lung-ya-men with perhaps, Temasek, as the former was no more than a haven for pirates preying on ships sailing the Straits of Singapore.
[25] Wheatley, *op. cit.* p. 83.

influence. Another opinion places the script as fourteenth century eastern Javanese, the island being a vassal of the eastern Javanese kingdom of Majapahit during this period.[26]

The gold ornaments, comprising an armlet, two finger rings, and three earrings, were identified as being made in a style associated with Majapahit.[27] It is also possible that the ornaments are of local manufacture, the armlet with a *kala* head in *repousse* on a plaque, and having a flexible chain is unique. As little is known of Malay gold during this period, the only conclusion that can be arrived at is the context in which the ornaments were found. The owner, probably a member of the aristocracy, was trying to conceal the ornaments, perhaps during the Tai attack at the end of the fourteenth century.

When excavations were first conducted at Fort Canning, the location chosen was approximately 80 meters south of the find spot of the gold ornaments. It was concluded from the finds that the site was probably reserved for or devoted to a special purpose. A date of late thirteenth to early fifteenth century was assigned based on stylistic comparison of Chinese ceramics from the site.[28] A 1988 excavation uncovered a hearth, glass globules, shards of glass, and hundreds of glass beads, indicating that this was part of a glass-working site. It is possible that scrap glass was imported, remelted and cast into new forms at the site.[29]

Compositional analyses of glass and pottery have also helped to establish possible trade connections between Singapore and other areas of the Archipelago. Fine-bodied white earthenware of relatively high aesthetic and technical standards which probably functioned

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[26] J.N. Miksic, *Archaeological Research on the "Forbidden Hill" of Singapore: Excavation at Fort Canning, 1984*, Singapore: National Museum, 1985, p. 13.
[27] R.O. Winstedt, "Gold Ornaments dug up in Fort Canning", *JMBRAS*, 6 (4), 1928, p. 4.
[28] J.N. Miksic, *Archaeological Research*, p. 89-90.
[29] J.N. Miksic, "Beyond the Grave: Excavations North of the Keramat Iskandar Shah, 1988", *Heritage*, no. 10, 1989, p. 55.

as ceremonial wares, were imported into Singapore from southern Thailand.[30] Analysis of of glass beads from Fort Canning, Palembang, and the Pulau Tujuh group of islands in the South China Sea, yield the inference that the Singapore and Palembang belonged to separate networks of bead trade, probably separated in time as well as space. The Pulau Tujuh, on the other hand appears to have taken part in both networks. It is highly unlikely that the inhabitants of the Pulau Tujuh were in direct contact with merchants from outside the region, and probably obtained their beads from local intermediaries. During the fourteenth century, Singapore probably provided the point at which glass beads and glass vessels, and ceramics were received from China and sent to Pulau Tujuh in exchange for sea products gathered locally. For the earlier period, when Srivijaya held the monopoly of trade between China and western Indonesia, Palembang would be an obvious candidate for such a role.[31]

The establishment of a descendant of the Maharajas at Temasek tied the fortunes of the island to the aims of the heirs of Srivijaya, to restore their position as the overlord of the Straits. This led to the founding of Melaka in the fifteenth century after the Tai attack, and the adoption of Islam by the Buddhist ruling elite, a move which is believed to have made Melaka a focus of Muslim merchants. The shift of the royal centre to Johor and later to the Riau-Lingga Archipelago, south of Singapore, were attempts to reassert their position as the dominant power in the Malay World. Singapura remained during this period a fief of the Sultans of Melaka and their heirs. In the fifteenth century travellers could still change ships at Singapura, and there was a *shahbandar*, harbour master, at the settlement in the seventeenth century.[32] At the turn of the nineteenth century, a member of the Johor

[30] J.N. Miksic and Yap, C.T., "Fine-Bodies White Earthenware of Southeast Asia: Some X-ray Fluorescence Tests", *Asian Perspectives*, 28 (1), 1990, p. 56.
[31] J.N. Miksic, "Archaeology and Early Chinese Glass Trade in Southeast Asia", *JSEAS*, 25 (1), 1994, p. 46.
[32] J.V. Mills, *Ying-yai Sheng-lan: The Overall Survey of the Ocean's Shores, 1433*, Cambridge: Cambridge University Press, p. 325, and C.A. Gibson-Hill, "Singapore: A Note on the History of the Old Strait", *JMBRAS*, 27 (1), 1954, p. 177.

aristocracy moved to Singapore with a group of followers. The East India Company established a factory at Singapore in 1819; soon after, in 1824, the island was ceded to the British.

Parliament House Complex Excavations

The Parliament House Complex falls within the boundaries of the settlement as described by Crawfurd during his visit to Singapore in 1821, an area, according to Wheatley that was part "were the dwellings of the citizens", and where workshops and markets were situated. When Raffles and the military forces of the East India Company landed at the mouth of the Singapore River 1819, the area was part of the compound in which the *Temenggong* of Johor-Riau and his followers were settled. In 1824, a Land Allotment Committee decided that "the whole space included within the Old Lines of Singapore and the Singapore River should be reserved exclusively for public services."[33] The area was first the site of the Singapore Cantonment, housing the military forces of the East India Company, and when the Cantonment was moved to another location it was host to a series of public and commercial buildings. Two-storeyed buildings fronted both High Street and North Bridge Road from the latter part of the nineteenth century. These structures were demolished in the 1980,s to make way for a car-park, and a structure 10 meters northwest of the excavation site. In 1994, the structure and car-park were demolished to make way for the for the annex to the Parliament House Complex (PHC). The original Parliament House is situated about 200 meters southeast of North Bridge Road. The area proposed for development is about 200 meters by 150 meters, bounded by High Street to the north, North Bridge Road to the west, and the Singapore River to the south (Map 3). A break in construction schedule allowed for excavations to be carried out at the site.

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[33] C.B. Buckley, *An Anecdotal History of Old Times in Singapore, 1819-1867*, Kuala Lumpur: University of Malaya Press, p. 79.

As a structure was planned for the site, the excavation strategy was to retrieve as much information as was possible given the limited time and resources. An area at the northern corner of the plot, at the junction of High Street and North Bridge Road was selected. This decision was made based on a test pit excavated prior to the larger excavation season. Chinese ceramics from the Sung-Yuan period were found in a layer of loose black soil, an intact stratification which formed the pre-colonial strata, approximately 0.7 m. from the present surface. A geological survey of Singapore shows that the pre-colonial settlement was built on alluvial soil, consistent with the loose black soil which forms the pre-colonial strata.[34]

The pre-colonial strata range between 0.7 to 0.9 m. below the present surface. Above this layer was predominantly yellow clay and brown clay, with debris of bricks and floor tiles (fig. 2 and 3). The latter represented the shallow foundations of nineteenth and early twentieth century structures which once stood at the site. Disturbances in the pre-colonial strata can be detected by the presence of clay and debris similar to that of the upper layer. There is no indication of human activity below a depth of 1.3 meters. Relative dating based on stratigraphy was not possible as no change in soil colour was visible. Finds were, therefore, recorded at intervals of 10 cm., in the hope of forming a relative chronology. This also did not prove fruitful. The site was inhabited continuously from the late thirteenth to at least the Portuguese attack of 1613; and soil conditions allowed for more recent deposits to settle at a lower depth.

Associated finds

Pottery shards, Chinese trade ceramics and Southeast Asian earthenware, form the bulk of the finds. Fragments of over-fired pottery were also found. Faunal remains include animal and fish bones, and shells. The only evidence of a structure is a post-hole in Square

[34] J. Scrivenor, "The Geology of Singapore Island; with a Geological Sketch Map", *JMBRAS*, 2 (1), 1924.

VII, 30 cm. below the surface of the pre-colonial stratum. Despite the presence of slag, there are no other traces of metal-working - hearths, furnaces, crucibles, tuyeres - in the area excavated.

Metal finds from the Parliament House Complex

The remaining sections of this paper presents a detailed discussion of the metal finds from the Parliament House Complex. This is the first site from the pre-colonial period that has yielded a wide range of metal finds. Metal finds from previous excavations at Fort Canning include a bronze rim, a number of corroded iron finds, and a very small number of gold flakes. Slag from the site also represent the first evidence of metal-working at the settlement, the existence of which has always been assumed based on ethnographic records of other sites in the Malay World and dating back to the seventeenth century.

Much of the reseacrh on Southeast Asian metallurgy has been concentrated on dating the advent of metal-working in the region, with emphasis mainly being placed on prehistoric sites in Thailand. For the pre-modern period, the bulk of the research has been on religious artefacts of precious metals and ornaments, basically art historical in nature. A feature of the Parliament House Complex site is that it was part of an area in which the common citizens of the settlement, and the traders would have dwelled. The artefacts are, therefore, more representative of items of daily usage rather than luxury and prestige artefacts. Another interesting aspect of the site is the fact that the island of Singapore does not have any natural deposits of metals that can be mined. The metal-workers of the settlement relied entirely on imports for their raw material, and with regard to specialisation of production, the sector could have developed differently from other models in Southeast Asia.

The metal finds have been classified into two general categories: by-products and raw material; and artefacts. These categories were further divided into the following sub-categories.

A. By-products and raw material.

1. Slag and hammer scales.
2. Copper prills.

B. Artefacts.

1. Iron artefacts.
2. Copper and bronze artefacts.
3. Fishhooks.
4. Wires.
5. Gold.
6. Coins.

Although fishhooks, wires, and coins can be classified as iron, bronze, or copper artefacts, a separate category was created as these finds represent either a specific economic activity, or an artefact that was manufactured by the local metal working sector, or both. Unfortunately, compositional analysis could not be carried out on samples of slag, which would have been valuable in determining the metals extracted.

A. By-products and raw material

1. Slag

A total of 1565 pieces of slag, weighing 799 gm. were recovered from the site (Tables 1 & 2). The greatest concentration was in Square X, 802 pieces weighing 392.5 gm. There were 365 pieces of slag weighing 181.75 gm. in Square VIII. Classification of slag was done based on physical appearance not production processes. Attributes considered include colour, frequency and size of gas holes, shape, and texture. Several factors cause these differences – the metal being extracted, temperature of the furnace during smelting, crucible smelting, and the smithing of iron.

Slag are produced mainly by the reduction of metal oxides in ores to a relatively pure form of the metal. The ore is smelted in furnaces, and refractories – sand, husk, etc. – are added to lower the melting point of the metal (the use of refractories is necessary because pre-industrial smelters could not attain high furnace temperatures). The metal separates from the impurities, which combine with refractory material to produce slag. The percentage of metal extracted from the ore is dependent on furnace temperatures, some metal oxide still remain in the ore and can be detected using basic compositional analysis. The raw metal is then melted in crucibles to produce ingots, or as part of the alloying process. Crucible smelting also produces slag.

Iron is, however, the exception. The high furnace temperatures required to melt the iron could not be attained by indigenous Southeast Asia producers (the exception being the Tais who acquired blast furnace technology in the seventeenth century, and were capable of producing cast iron). Refractories reduce the temperature at which the iron oxide turns into a viscous material that settles at the bottom of the furnace. The bloom, as this is called, contains a high percentage of impurities, and the slag contains a relatively high percentage of iron. After cooling the bloom is then heated and forged to further remove impurities, a process that also produces slag – smithing slag. In Southeast Asia the wrought iron is sometimes traded in bar form.

As the smith is unable to attain the high temperatures required to cast iron in the same manner that copper and bronzes are, iron artefacts are forged into shape by first heating the wrought iron, and hammering it into the desired shape, a process which also produces slag. It is, however, very difficult to differentiate smelting and smithing slag in an archaeological context. This requires more background information on the context and the quantities and nature of other associated materials and debris.[35] The magnetic nature of some slag, or its iron content, does not necessarily indicate iron smelting. Iron is a naturally occuring metal in many parts of the world, and often found with other metals. The lower melting point of metals such as copper means that the iron oxide in the ore remains within the slag.

a. Type 1, fig. 4.

Total no: 248 pieces; total weight: 267.75 gm.

Avg. size: 25 mm. x 25 mm. x 15 mm.; Avg. size of large slag: 45 mm. x 43 mm. x 27 mm., Avg. size of small slag: 13 mm. x 11 mm. x 7 mm.

Slag categorised as type 1 are dark grey in colour and the surface characterised by ridges and protrusions. These protrusions vary in size and appear as droplets attached to the body of the slag. The surface of the protrusions are relatively smooth and appear as if they were polished. Gas holes of varying sizes are visible on the surface of the slag without the aid of any magnification, smaller gas holes, measuring less than 1 mm., are more dominant than larger ones. In many samples, there are reddish brown discolouration on parts of the slag body, from the high iron content of pre-industrial slag.[36]

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[35] P.T. Craddock, *Early Metal Mining and Production*, Washigton D.C.: Smithsonian Institution Press, 1995, p. 18.

[36] H. Bachmann, *Identification of Slags from Archaeological Sites*, Occasional Publication no. 6, London: Institute of Archaeology., 1982, p. 3.

In one sample, a protrusion which had broken off from the main body, larger gas holes, between 1.5 mm. to 3 mm, can be seen at the point at which the piece was broken off from the larger slag.

b. Type 2, fig. 5.

Total no: 519 pieces; total weight: 161.75 gm.

Avg. size: 25 mm. x 20 mm. x 10 mm.; Avg. size of large slag: 45 mm. x 20 mm. x 10 mm., Avg. size of small slag: 15 mm. x 13 mm. x 7 mm.

Type 2 slag are flat, the surface covered with sand which has adhered itself to the slag from the corrosion. The cross-section is dark brown in colour and does not show any gas holes, in this respect it resembles the cross-section of an iron artefact, not the glassy dark grey of slag. It is possible that these are hammer scales or hammer slag produced during forging.

c. Type 3, fig. 6.

Total no: 88 pieces, total weight: 42.25 gm..

Avg. size: 25 mm. x 20 mm. x 9 mm.; Avg. size of large slag: 45 mm. x 35 mm. x 15 mm., Avg. size of small slag: 10 mm. x 10 mm. x 5 mm.

Slag in this category have a similar surface texture and cross-section to type 2 slag, the exception in this case is the rounded shape of the slag body.

d. Type 4, fig. 7.

Total no: 278 pieces, total weight: 67.75 gm.

Avg. size: 27 mm. x 16 mm. x 18 mm.; Avg. size of large slag: 33 mm. x 23 mm. x 17 mm., Avg. size of small slag: 10 mm. x 8 mm. x 3 mm.

Type 4 slag are dark grey and appear as droplets with smooth rounded edges. The slag body is narrow and long. There are very few gas holes on the rounded outer edges of the slag, but flat surfaces, which appear to be the point at which the slag broke off another piece, have minute gas holes with some large gas holes of more than 1 mm. appearing intermittently. Many samples have a reddish brown discolouration indicating an iron content.

e. Type 5, fig. 8.

Total no: 91 pieces, Weight: 55.0 gm..

Avg. size: 21 mm. x 20 mm. x 11 mm.; Avg. size of large slag: 47 mm. x 34 mm. x 20 mm., Avg. size of small slag: 13 mm. x 11 mm. x 7 mm.

Dark grey in colour, type 5 slag has a flat surface. In some samples the flat surface show signs of the slag having broken off from another piece. The surface of the slag is relatively smooth with low ridges no higher than 2 mm. Sand grains are the only visible inclusions on the body of the slag. Some samples have areas of reddish brown discolouration, possibly from the high iron content. All slag pieces in this category are generally hard and do not break when pressure is applied manually.

Gas holes are visible on the surface but do not exceed a diameter of 1.0 mm. The cross-section of a sample which has been broken off reveal gas holes much larger in size, and number when compared to the surface. The larger gas holes appear as crevices, and are concentrated toward the centre of the section.

f. Type 6, fig. 9.

Total no: 267 pieces, total weight: 182.50 gm..

Avg. size: 30 mm. x 25 mm. x 15 mm.; Avg. size of large slag: 50 mm. x 28 mm. x 15 mm., Avg. size of small slag: 10 mm. x 10 mm. x 4 mm.

Type 6 slag is generally flat and dark grey in colour, with rounded edges where not broken off a larger piece. The flat surface is rough and has gas holes as large as 1 mm. in diameter. Gas hole are more numerous in the cross section of the slag and vary in size from 0.5 mm. to 1.5 mm. in diameter (fig. ? b). Inclusions in the form of white, and crystalline particles can be seen in the cross section. The rounded edges of the slag have a smooth texture.

g. Type 7, fig. 10.

Total no: 74 pieces, Weight: 22.0 gm.

Avg. size: 22 mm. x 15 mm. x 10 mm.; Avg. size of large slag: 30 mm. x 25 mm. x 25 mm., Avg. size of small slag: 15 mm. x 10 mm. x 4 mm.

These are dark grey in colour with a glossy surface, and show a flow texture similar to type 1 slag. Some samples have a buff discolouration on the relatively smooth surface. Droplet-like protrusions also appear on a number of samples. Traces of rust appear on some samples and gas holes of varying sizes are visible on the surface of the slag, and vary in size between 1 to 1.5 mm. In general, the slag has a rounded body. Type 7 slag are lighter in weight than other slag types.

2. Copper prills, fig. 11

Copper prills, spherical pieces of pure copper, some as large as 10 mm. in diameter, are produced when copper ore is reduced to metallic copper and slag As the prills are embedded in the slag, the slag is cracked to release the copper. These are then collected and remelted in crucibles to produce refined copper which is then cast into ingots or sheet metal. Remelting of prills also produces slag. The small amount of prills found is probably due to an efficient retrieval process. The relatively high price of copper during the pre-industrial period would have ensured that smelters reduce wastage to a minimum.

Smelting and smithing

The reddish brown discolouration on some samples, and the magnetic nature of many samples, with the exception of type 7 slag, do not necessarily indicate that the slag are by-products of iron smelting or smithing, but neither does it discount the possibility. According to Tylecote, non-ferrous smelting slag are usually high in iron and is the main reason for the iron content of crucible slag; another reason is the iron from raw copper being melted which can often be as high as several per cent. [37]

The absence of large slag at the site is not an indication of specific processes employed at the settlement but rather of the limited excavation area. The presence of copper prills, however, allow for the following conclusions: firstly, copper ore was imported into the settlement and that some of the slag are by-products of copper smelting; and secondly, some of the slag appear to have been broken off larger pieces, possibly to release the prills.

It is also possible that some of the finds classified as slag, types 2, 3, and 7, are not smelting or smithing slag but rather hammer scales and hammer slag. These are ejected at the anvil, either as spherical globules of molten non-magnetic slag or as plates of scale which are usually highly magnetic.[38] The remelting of copper prills in crucibles could also have formed the non-magnetic type 7 slag. Unfortunately, a number of crucial tests could not be carried out on the samples. Metals extracted could have been determined with

[37] ,*Ibid*, pp. 323-324.
[38] R.F. Tylecote, *The Early History of Metallurgy in Europe*, London and New York: Longman, 1987, p. 320.

compositional analysis using X-ray fluorescence, while relative density would have allowed for further differentiation of attributes between slag types.

B. Artefacts

1. Iron artefacts

a. Cast iron fragments, fig. 12.

The concave surface of the artefact suggest that it is a fragment from a vessel, either a bowl or pot. The surface is relatively smooth and reddish brown in colour from oxidation. There are concretions on the surfaces from corrosion. A total of 33 pieces were recovered, 30 pieces in Square VIII, and 3 pieces in Square XII-XIV. All the fragments have a concave surface, and a thickness of 2.5 mm.; the average dimension of the fragments is 22 mm x 17 mm.

Metallographic analysis was carried out on one sample. Although the sample was highly oxidised, some parts still allowed for the microstructure of the metal to be observed. At a magnification of 150x, a dendritic microstructure can be observed, formed by the cooling of cast iron.

These fragments are probably part of cast iron wares imported from China; Wang Dayuan mention iron pots and lengths of iron among the commodities the Chinese used for barter at Temasek during the fourteenth century.[39] Until the sixteenth century, China was the sole exporter of cast iron to the region, when first the Japanese and then the Tais finally broke the Chinese monopoly.[40] Other forms of cast iron wares and tools would have been imported into the settlement. Cast iron woks and *parangs*, a chopping tool, were among the

[39] Wheatley, *The Golden Khersonese*, p. 83.
[40] B. Bronson, *op.cit.*, p. 71.

artefacts found at two shipwrecks from the thirteenth century, one in the seas around the Riau Archipelago and the other in the Java Sea.[41]

It is very possible that other fragments, and also larger fragments, of cast iron are among the finds from the Parliament House Complex. Metallographic examination of samples is, however, impossible because of the highly oxidised state of the finds.

b. Knives.

i. Sq. XIII, Level 4; 80 mm. x 25 mm. x 6 mm.; fig. 13 a.

ii. Sq. XI, Level 1; 65 mm. x 23 mm. x 3 mm.; fig. 13 b.

iii. Sq. XI, Level 1; 50mm. x 30 mm. x 3mm.; fig. 13 c.

iv. Sq. XI, Level 1; 39 mm. x 34 mm. x 3 mm; fig. 13 d.

Despite the high degree of corrosion, the outline of the artefact (a) is still visible and resembles that of the pointed edge of a knife blade. Both edges are curved, the cutting edge having a wider arc. Artefact (b) has a similar outline but both edges are straight.

Artefact (c) was found together with (b) and the hilt described below, and has the same thickness. The broader width of the artefact suggests that it formed part of the body of the knife.

The fourth sample (d) has a protrusion on one edge of the flat piece and resembles a hilt. As (b), (c) and (d) were found at the same location, it is possible that these were fragments of the same blade.

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[41] J. Miksic, personal communication.

c. Fragment: Sq. VI, Level 2; fig. 14 a.

The artefact resembles the pointed end of a small knife and was broken off a larger object. The curve at the broken end suggest that this was probably part of an iron tool rather than a knife.

d. Fragment: Sq. VI, Level 2, fig. 14 b.

No function can be assigned to this artefact, probbaly a fragment from an iron tool.

e. Corroded iron artefacts

The majority of iron artefacts, 156 pieces, have been classified in this broad category. Two distinct groups have been classified based on appearance and dimensions. The remainder of the finds are too corroded for any attributes to be assigned.

i. Flat iron piece; Sq. XI Level 1; 86 mm. x 69 mm. 9 mm.; fig. 15.

Concretions have formed on the surface of the artefact, a cross-section also reveals a high degree of corrosion throughout the body of the sample. A total of 11 pieces of iron of varying sizes but with similar thickness to the above were found at the site. This classification is based mainly on the relatively large flat surface, measuring between 55 mm to 85 mm., and a thickness of between 8 mm to 12 mm.

The large surface, and the thickness of the artefact suggest that it was either part of a large implement such as a hoe, or, in view of the context in which it was found, one of the billets from which iron implements are forged. Nineteenth century European observations noted that bar-iron of both local and European make were the generally accepted form of iron in trade.[42] "These pieces are about 8 to 9 inches long, 1.5 inch thick, and 0.5 of an inch thick."[43]

ii. Flat iron pieces.

A second category of flat iron pieces comprise finds to which no specific attributes can be assigned. Many of these pieces have a thickness of 3 mm. and less. One particular type has no concretions on its surface and the metal has oxidised in a manner that gives the piece a layered appearance, and a flaky surface. A total of 81 pieces of this type of iron were found. It is entirely possible given the nature of finds at the site that some of these are hammer scales or hammer slag ejected during forging. Hammer scales and slag are usually highly magnetic, and the thickness is related to the time at the heating temperature and the precise atmosphere in which it is being heated.

iii. Iron rods: fig. 17.

A total of 23 pieces of iron rods of varying lengths and diameter were recovered from the site. The variation in dimensions is probably an indication of functions. It is also possible that some of these pieces of iron were discarded because of damage during forging.

f. Iron implements and iron working

Iron artefacts from the Parliament House Complex can be classified into two categories: cast iron imports from China; and forged iron wares, probably produced locally and perhaps also imported via the regional trade network. Some of the artefacts could also be tools from the workshop of a metal-worker, discarded because of damage.

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[42] J. Christie, " Iron working in Sarawak", in *Metal-working in Borneo: Essays on Iron- and Silver-working in Sarawak*, Occasional papers no. 15, Hull: Centre for Southeast Asian Studies, p. 8.
[43] Moor, *Notices of the Indian Archipealgo and Adjacent Countries*, cited in Christie, *ibid.*, p. 8.

The relatively high cost of iron during the pre-industrial era gave rise to the practice of excluding iron as a component in house- and boat-building. Blacksmiths were in demand primarily to make critical items of agriculture and war - plough tips, harvesting knives, mattocks, fishhooks machetes, swords, spear tips, and the famous kris of the Malay World.[44]

2. Bronzes

A total of 33 bronze artefacts were recovered from the site, including rims and bodies of bronze vessels, a bell, ornamental pieces, and highly corroded copper-based artefacts. The finds were scattered throughout the excavation area. A large proportion of the finds are highly corroded that no attributes can be assigned.

a. Bronze vessels.

i. Rim: Sq. IV, Level 4; 35 mm. x 34 mm. x 1.5 mm.; fig 18.

The rim is 1.5 mm. tapering to 0.5 mm. at the base of the fragment. The thickness of the artefact suggests that this is the fragment of a bronze bowl. In areas where corrosion has not taken over, the surface of the artefact is black in colour; the green corroded area indicates that the artefact was made of copper alloy. Fine horizontal striations indicate that the artefact was first cast and then annealed to the desired shape.

ii. Rim: Sq. XIV, Level 2; 23 mm. x 17 mm. x 0.5 mm; fig. 19 a.

A unique feature of this artefact if the absence a curvature, suggesting that the sides of the vessel were straight, and possibly with a flat bottom.

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[44] Reid, *Southeast Asia in the Age of Commerce, Vol 1*, p. 107.

iii. Body: Sq. 1, Level 5, 20 mm. x 18 mm. x 1 mm.; fig. 19 b.

The curvature of the fragment suggest that it was part of a bronze cup, smaller than the rim described above.

A second type of body fragments found are flat, with a thickness of between 1.0 to 1.5 mm. These were probably part of bronze trays or plates, or even part of betel boxes. The relative hardness of some samples suggest a manufacturing process which involved casting the metal into the desired form.

b. Bell: T2, Level 4; Diameter: 28 mm., Thickness: 1 mm., fig. 20 a.

The bell is broken in two with one half still intact. Bells were part of the paraphernalia of Hindu-Buddhist priests, and on the mainland have been found at sites dating before the first millennium AD.

c. Cylinder: Sq. II, Level 4, length: 31 mm., diameter at flared end: 24 mm., diameter at narrow end: 13 mm., thickness: 1.5 mm. at flared end, 3.0 mm. at narrow end; fig. 21.

The cylinder is black with some green discolouration. A conduit runs through the length of the artefact It is flared at one end, the shape suggesting that it was broken off larger, spherical object. The uneven edge of the narrow end also suggest that the cylinder was part of a larger artefact. The relatively straight conduit and the thickness of the artefact suggest that it was cast.

The shape of the object, and the conduit resembles a kendi spout. Kendi spouts are, however, very much shorter than this artefact, given the broken off narrow end. It is also possible that it was part of a bronze sculpture that has been broken.

d. Floral ornament, fig. 20 b.

i. Sq. I, Level 5; Length: 23 mm., Diameter of petal: 21 mm., Thickness: 3 mm.

The artefact resembles a flower with six petals attached to a stalk with a hole in the centre, and is broken from another piece at the stalk. A second piece was found at Square IV, Level 2. The second piece has the same dimensions but length of 20 mm. The floral ornament probably functioned as decoration.

f. Bronzes in pre-colonial Singapore.

During the fifteenth to seventeenth centuries, bronze items such as betel sets, water-carriers, and dishes were among the most important accumulation of capital by the rich.[45] The relatively high price of copper, and therefore, of bronze wares meant that many of these artefacts would have belonged either to a member of the aristocracy or the foreign merchants residing at the settlement. Bronzes would also have been an integral part of rituals and ceremonies. Bronze images of Hindu-Buddhist deities from this period have been found throughout Southeast Asia. At Majapahit, bronze vessels, plates, and trays, were used as holy water reliquaries and for religious offerings.[46]

Although the technology to manufacture bronzes was available to the artisans of the artisans of the settlement, it cannot be established conclusively whether the bronzes from the site were manufactured locally or imported. This can only be resolved with the discovery of a work site, or fragments of moulds.

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[45] Reid, "The Structure of Cities", p. 243.

[46] J.N. Miksic, et. al., *The Legacy of Majapahit*, catalogue of an exhibition, Singapore: National Heritage Board, 1996.

3. Fishhooks

Fishhooks and iron rods used in the manufacture of fishhooks, here termed fishhook iron, form the largest number of artefacts that could be identified with a specific metal-working activity. A total of 375 fishhooks and fish hook iron were found; of these 11 were the barbed end of iron fishhooks, 11 bronze hooks, and 353 fish hook iron.

a. Iron fishhooks, fig. 22 & 23.

A total of 11 iron fishhooks were recovered from the site. There are two hook sizes; the curve of one type has a diameter of 30 mm, the other 25 mm (fig. 21 a &b, 22). Of the barbed ends found only two are of the latter type. Following are the characteristics of iron fishhooks:

i. The rods have a diameter of between 3 to 3.5 mm.

ii. All iron hooked ends found are barbed.

iii. A copper or bronze wire was used as the leader wire (fig. 21 d). The wire was attached to an eyelet formed by folding over the end during forging. The wire was run through the eyelet and then twisted. The length of the leader wire, however, cannot be determined from the finds. Some of the copper wires found at the site were probably made for this purpose.

A straight iron rod with a barbed end measuring 44 mm. in length was also found (fig. 21 e). It was probably discarded because of a defect which occurred during forging. This and the large number of iron rods classified as fish hook iron confirm that iron fishhooks were made by smiths at the settlement. Iron rods have a diameter of 3 to 3.5 mm, in a variety of lengths, and like the barbed rod, probably discarded because of damage during forging.

The manner in which the hooks were made would have been very similar to the forging of iron nails; with additional processes to form the barb, eyelet, and hooked ends: "the end of a billet would be forged to a rod with its end pointed and cut to the required length."[47] The barb could have been added to the point before or after the rod was cut; the next step would have been to fold over the eyelet for the leader wire, and to bend the hook to the desired shape. It is also possible that a long length was shaped and then cut to size.

b. Bronze and copper hooks, fig. 24.

A total of 11 bronze and copper hooks were found; the majority have a length of 20 mm., the largest 46 mm. The largest hook found has an eyelet and a copper leader wire attached to it (fig. 24 i). Smaller hooks have a flattened end; the fragment above the hook fig 24 (iii) is a flattened end which has broken off. It is possible that, while larger hooks were made with an eyelet, smaller ones, due to manufacturing techniques were made with a flattened end. The hook may have been attached directly to a line and weight, a practice of Malay fishermen of the northeastern Malay Peninsula of the twentieth century. These fishermen also use a grapnel type of hook for squid; a combination of hooks tied together could have functioned in this manner.[48]

The microstructure of a sample similar to fig 24 (iii) suggests that the hook was drawn into shape. This can be clearly seen in the grain structure of the bend of the hook (fig. 25 a). The grains run parallel to the curve, an indication that heat was applied to the copper before it was shaped. This is a process similar to wire drawing; which requires the reduction of a rod by pulling it through a hole smaller than the original. After the first pull the wire may have to be annealed before being passed through the next die. This process makes use of the work hardening properties of metals; pulling the wire through a hole

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[47] Tylecote, , p. 262.
[48] M.L. Parry, "The fishing methods of Kelantan and Trengganu", *JMBRAS*, 27 (2), 1954, pp. ??-??

smaller than the original means that the wire must get stronger to compensate for the loss of overall strength due to the reduction in overall diameter.[49]

At a magnification of 400 the microstructure reveals that the copper was subjected to rapid cooling, consistent with the wire having been annealed before drawing. There is no trace of an alloy, darker areas being oxidation and slag inclusions.

The largest hook (fig. 24 i), is of bronze, and barbed. Striations along its length indicate that it was drawn.

c. Fishing and the metal-working sector

There is a correlation between the material used in the manufacture of fishhooks and the size of the artefact; iron hooks are larger than bronze and copper hooks. Economic and technological considerations would have been primary reasons for this: firstly, iron was a less costly metal than copper; secondly, given technological limitations, smiths probably could not work iron hooks to the size they could with bronze and copper.

The great variation in types of hooks attest to the variety of fish and other marine life that can be exploited as a food source in the seas around the Malay World. In sixteenth century Melaka, fishing was reported as the chief male occupation, well ahead of agriculture.[50] Using a variety of European sources, some as early as 1579, Reid, concluded that the two most efficient fishing methods in use were surrounding shoals of fish with seine nets dragged by a number of boats working cooperatively, and trapping fish in permanent enclosures of bamboo and cane sometimes supplemented by nets. These methods required the cooperation of several fishermen, but in addition almost every coastal

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[49] Tylecote, *op.cit.*, p. 269.
[50] A. Reid, *Southeast Asia in the Age of Commerce, Vol 1*, p. 29.

family did some occasional fishing with a hook and line.[51] The great variation in the type of hooks at Singapore, however, suggests more than an occasional use of the hook and line as a fishing method, and the ethnographic record does lend support to this idea.

A 1952 survey, by M.L. Parry, of Malay fishing methods in the northeast coast of the Peninsula could provide a suitable analogy of fishing in pre-colonial Singapore. According to Parry:

> "Kelantan and Trengganu unlike the other Malay states have apparently been little influenced by the introduction of ideas from other parts of south and east Asia... [This is] responsible for the limited variety of fishing gears in use here."[52]

A variety of methods were employed by the fishermen of these northern states, including the use of the hook and line, and of nets cast from boats. The hook and line were employed in various ways: as a single hook on a line; and the use of multiple hooks set on a single line. More than one line was cast from a boat, and a variety of fish caught. The method was employed both as an auxilliary to nets as well as a primary fishing method. Although the various hook and line methods appear inefficient in comparison to modern day commercial fishing techniques, they did, according to Parry, provide a catch that was substantial enough to be profitable to the fishermen.[53]

It is probable that the fishermen of Singapore employed a similarly wide variety of fishing methods as the twentieth century Malays; Parry noted that the hook and line was employed in water more than ten fathoms deep and also when fishing for bottom living

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[51] *Ibid.*, p. 29.
[52] M.L. Parry, "The Fishing Methods of Kelantan and Trengganu", *JMBRAS*, 27 (2), 1954, p. 77.
[53] *Ibid.*, p. 90-94.

fish.[54] During periods where the sea was rough, the fishermen of Kelantan and Trengganu would also resort to the hook and line in small two-men boats as these boats were generally not affected by the swells. At other times of the year it is noticeable that when the larger gears do badly, there is often a drift towards line fishing.[55] The supply of fish and other types of sea food at the settlement would also have been supplemented by the catch brought to the settlement by the *orang laut.* Baretto de Resende, observed in 1641 that the *orang laut* of the Straits of Singapore sell part of their catch to passing ships.[56] Until the sack of Temasek in 1613, the settlement would have provided a ready market for fresh fish.

There are no records of the hook and line being employed as a fishing method by the *orang laut*. Resende observed that the *orang laut* catch fish by spearing them in the water.[57] Crawfurd also noted that the preferred fishing method of the *orang laut* of Singapore was spearing.[58] Other European sources mention *orang laut* in other parts of the western Archipelago using short-handled nets.[59]

To avoid seasonal vagaries of the catch imposed on the consumption of fresh fish, dried and picked fish was the daily fare among Southeast Asians. It was always on hand and formed an article of internal commerce.[60] Dried fish was also a major item in regional trade.[61]

4. Copper wires, fig. 26 & 27.

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[54] *Ibid.*, p. 91
[55] *Ibid.*, p. 94.
[56] Sopher, *op.cit.*, p. 318.
[57] *Ibid.*, p. 317.
[58] Crawfurd, *op.cit.*, p. 43
[59] Sopher, *op.cit.*, p. 88
[60] Reid, *Southeast Asia in the Age of Commerce, Vol 1*, p. 29.
[61] Reid, *Southeast Asia in the Age of Commerce, Vol 2*, 67.

A total of 233 wires of various shapes and sizes were found at the site, the largest concentration being in Squares I, X, and XII to XIV (table 6). There are some variations in the diameter of the wire but in general they do not exceed 1 mm. No intact wires were found, all were broken at one end if not both.

The twisted wire is the most common type found at the site (fig. 26 b). All were broken at both ends, but the intact parts have similar characteristics. The ends appear to have been tied down at a point before the break, the twisted portion with a length of about 20 mm. A second type has a longer twisted section (fig. 26 a).

Looped wires comprise the second type (fig. 26 c). Two looped wires were linked to give a flexible length (fig 26 d). It is possible that the loops formed the broken ends of the above twisted wires. These looped wires could have formed part of the leader wire for the fishhooks. A u-shaped wire, with a small loop measuring 1 mm. in diameter at one end forms the third type of wire (fig. 26 d). A small quantity of straight wire was also found; it is not known whether these are remains of wires which were later formed into the above shapes, or served a function in this form.

At a magnification of 50, the grains of a section of twisted wire suggest that it was first drawn into a rod and then twisted into the final shape. The grains towards the centre of the section are parallel, and deformed at the edges, evidence of cold-working (fig. 27 a). At a magnification of 400, no traces of alloying can be seen, and this particular sample has less slag inclusions when compared to the copper fishhook (fig. 27b). Like the smaller fishhooks, the wires were made of pure copper and perhaps of a higher degree of purity than the fishhooks.

5. Gold

Three pieces of gold flakes were found at the site; each with a thickness of less than 1 mm.

i. Sq. II, Level 5; 4 mm. x 4 mm.

ii. Sq. X, Level 2; 8 mm. x 8 mm.

iii. T 2, Level 5; 10 mm. x 5 mm.

The flakes are too small for any attributes to be assigned, but were probably detached from larger jewellery pieces.

6. Coins

A total of 145 coins, fragments and intact pieces, were recovered from the site, of these 125 could be identified, the rest were too corroded or too small a fragment. Of the 125 coins assigned dates and provenance, 123 were Chinese bronze coins, 1 Malay coin, and 1 Sri Lankan coin.

a. Melaka/Johor coin, Fig: 28 c.

Date: mid-fifteenth - seventeenth century.

Sq. III, Level 4; diameter: 15 mm.; material: tin alloy.

Dark grey in colour, the obverse has markings on one half that appear as a faint impression of vertical lines. The lines are similar to vertical inscriptions in Arabic script of Islamic coins form the Malay World. There are no markings on the reverse. Examination of the surface with an optical microscope show that the coin was cut into its present shape and then struck with a die to produce the low relief. The distorted shape, and the blank half of the obverse, was probably a result of a defect that occurred when the coin was struck.

This manufacturing technique is consistent with a description of methods used to mint coins at Melaka during the fifteenth and early sixteenth century.

"The coins of Melaka are unique, the method of minting the coin seems to have been to cast blanks and then strike the flans with a pair of dies."[62]

The earliest Islamic coinage were minted at Pasai in the fifteenth century, and unlike the coins of Melaka were moulded. The earliest surviving coin from the Peninsula is from Melaka dating back to the reign of Muzaffar Shah (1446-59).[63] Coins made in this manner continued to be used in Melaka until the Portuguese conquest of 1511, and then at Johor, the heirs of Melaka. These coins were minted in various sizes, ranging from 11.5 mm to 20 mm. in diameter.[64] The use of the coin at Singapore is a reflection of its position as a fief of Melaka, and later of Johor.

b. Sri Lankan coin, fig. 28 a & b.

Provenance of origin: Sri Lanka, Date: 1273-1302

Sq. 2, Level 5.

Minted during the reign of Bhuvanaika Bahu I (1273-1302); a human figure can be seen on the obverse and reverse of the coin. Sri Lankan coins dating between 1197 and 1202 have been found at the northeast Sumatran site of Kota Cina, a trading centre active until the thirteenth century.[65] This site was one of the entrepots which served foreign merchants in search of forest produce from the Sumatran interior.

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[62] C.H. Dakers, "The Malay Coins of Malacca", *JMBRAS*, 17 (1), 1939, p. 2.

[63] R.S. Wicks, *A Survey of Native Southeast Asian Coinage circa. 450-1850: Documentation and Typology*, PhD. Diss., Cornell University, 1983, p. 273.

[64] *Ibid.*, p. 299.

[65] *Money, Markets and Trade in Early Southeast Asia: The Development of Indigenous Monetary Systems to AAD 1400*, Ithaca: Southeast Asia Program, 1992, p. 234.

Trade and cultural contact between the Malay Archipelago and Sri Lanka date back to first millennium AD.[66] The period of close contact between Southeast Asia and Sri Lanka falls between the period starting from the reign of King Vijaya Bahu I (1059-1114) and Parakrama Bahu II (1236-1271). Tin was the principle item exported by Southeast Asians to the island in exchange. According to Perera, luxury goods were sent to Southeast Asia in exchange, although he does not list the products that were traded.[67] Although the Sri Lankan economy was monetised, this was, however, not the universal rule, barter was also an aaceptable form of exchange.[68]

c. Chinese bronze coins

A total of 123 Chinese coins were recovered, of these 98 could be assigned dates and 25 remained unidentified. Of the 98 coins, 90 are from the Northern Sung period, 2 from the Tang period, and 6 from the Southern Sung period. The two Tang dynasty coins have the markings Ka'i Yuan T'ung Pao (621-907). The latest date that can be assigned is to a Southern Sung coin with the markings Chia Ting T'ung Pao (1208).

Chinese coins were, however, circulating for long periods in Southeast Asia and, therefore, do not reflect the founding or terminal dates of a site, and in the case of the Parliament House Complex, many are older than datable Chinese ceramics. The small number of Southern Sung coins at the site was probably the result of a ban on the export of Chinese copper at the end of the twelfth century.[69] From early in the fourteenth century Chinese coins were used as currency at Majapahit. The large number of Chinese bronze coins recovered from Southeast Asian sites suggests widespread acceptance in the region.

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[66] J.G. de Casparis, "New Evidence on Cultural Relations between Java and Ceylon in Ancient Times", *Artibus Asiae* 24, 1961, p. 247-248.
[67] B.J. Perera, "The Foreign Trade and Commerce of Ancient Ceylon: Ancient Ceylon's Trade with the Empires of the Eastern and Western World", *Ceylon Historical Journal*, 1, 1952, p. 309-310.
[68] *Ibid.*, p. 317.
[69] Wheatley, *The Golden Khersonese*, p. 115.

d. Coins and monetisation

Frequently recovered in archaeological sites, the geographical distribution of coins have led to the explanation that coins are the end result of commercial exchange. [70] Although there was a general trend towards monetisation throughout Southeast Asia during the first one and a half millennium of the current era, the process was neither uniform nor continuous. Not all societies in the region came to be money using nor did each society that adopted money become monetised in the same way or to the same degree.[71]

The earliest known use of currency in the Malay World was at Kedah, a practice that was already in existence late in the first millennium AD. Much of the foreign trade, however, was carried on by barter. [72] Wicks is of the opinion that foreign merchants at Srivijaya were required to change their foreign monies into local currency, a practice that would be followed by a number of Southeast Asian kingdoms in later centuries.[73] A seventeenth century European observation mention the presence of money-changers at Aceh.[74]

Fort Canning Artefacts

1. Bronzes

a. Rim; 35 mm. x 22 mm. x 2 mm.; fig 27 a.

Horizontal striations on the rim suggest that it was annealed into shape, a common practice among bronze-workers. The shape of the rim suggest that it is a fragment of a bowl.

[70] R.S. Wicks, *op.cit.*, p. 2.
[71] *Ibid.*, p. 2.
[72] *Ibid.*, p. 225.
[73] *Ibid.*, p. 231.
[74] Reid, *Southeast Asia in the Age of Commerce, Vol 2*, p. 92.

2. Iron artefacts, fig. 27 b & c.

All of the iron finds from Fort Canning are too heavily corroded to allow any identification of its function. In form, however, these finds do not differ fom iron finds from the Parliament House Complex.

Summary and Conclusions

Archaeological data and historical sources allow for a date of late thirteenth to the seventeenth centuries to be assigned to the Parliament House Complex site. Chinese ceramics from the site date between the late thirteenth to fifteenth centuries. Soil conditions, however, do not allow for finer distinctions to be made. Historical accounts allow the terminal date of the settlement to be extended to at least the Portuguese attack of 1613, but it very likely that the population of the settlement would have been reduced further after the attack.

The finds suggest that the area was used for the disposal of household refuse as well as waste material from the metal-working sector, and from the presence of over-fired pottery, of the potters at the settlement. It is highly probable that a craftsmen sector was located close to the excavation site. Production in the metal-working sector would have been at its peak during the fourteenth century. There would have been a reduction in activity after the shift of the royal centre to Melaka, especially of prestige goods of bronze and gold; metal-workers would have continued to produce utilitarian implements of iron, such as the fish hooks, for the everyday need of the population. The level of activity would have been further reduced after 1613, perhaps even a cessation of production. The finds, however, do not allow for the scale of production at the settlement to be determined.

As elsewhere in Southeast Asia, competition from cheap imports would have kept metal-working at Singapore on a relatively small scale. In Sung times iron and ironware were among the commonest commodities shipped from China to the South Seas, and this increased greatly during the Ming period.[75] Local smiths were probably producing items mainly for the consumption of the local population, and these include: utilitarian artefacts such as fish hooks and weapons; and prestige goods and religious artefacts of gold and bronze.

A unique feature of the metal-working sector at the settlement was the diversity of the processes carried out, both smelting of copper ore and the manufacture of copper-based artefacts took place at the settlement. In general, the practice during pre-industrial times was for mining and smelting to be done by the same enterprises, if not the same individuals, but for final fabrication into consumer goods to be separated again organisationally and spatially.[76] One exception noted was near Loei, northeast Thailand, in the mid-nineteenth century. The villagers were involved in mining and smelting, as well as manufacturing. Although questions have been raised over the accuracy of the observations, it was noted that the source of the ore was a mountain in the Loei area.[77] The situation at Singapore was, however, significantly different, there is no source of copper on the island itself. It is also doubtful, as will be seen below that the copper was mined on the Peninsula and shipped to Singapore.

One can only speculate as to the reasons for transporting ore instead of ingots to the settlement. It is likely that the peoples at the source did not possess the technology required to extract copper from ore. This would exclude the mainland as a source; mainland producers had achieved a sophisticated enough level of production by the second millennium AD that the metal would have been exported from these areas in ingot form.

[75] Reid, "Trade Goods and Trade Routes", p. 257.
[76] Bronson, "The Early Metal Trade", p. 69.
[77] B. Bronson and Pisit Charoenwoongsa, *Eyewitness Accounts of the Early Mining and Smelting of Metals in Mainland Southeast Asia*, Bangkok: Thailand Academic Publishing Company, 1986, p. 9.

Borneo seems to be the possible source of raw material for the metal working sector. Compositional analysis of copper artefacts from Candi Bukit Batu Pahat in Kedah suggest the Bau area as a possible origin of the raw material. The copper was probably obtained through trade from the Santubong entrepot.

Ethnographic data from the nineteenth century mention that while the various peoples of the interior were well versed in the smelting and smithing of iron, crucible smelting was a technique foreign to them.[78] Although the Maloh, a group in the interior of the island of Borneo, were excellent brass-workers, they did not produce the alloy. Brass objects imported from coastal ports were reworked into jewellery and other ornaments. During the premodern period, the cost of establishing smelting works near the source probably far outweighed the cost of transporting the ore across the South China Sea for the practice to continue.

Two possible sources of iron used by the blacksmiths at the settlement are China and Borneo. Iron is known to have been smelted at Santubong from the twelfth to fourteenth centuries, and probably earlier.[79] No other smelting or manufacturing sites have been discovered on the island of Borneo, although it is highly probable that sites similar to Santubong did exist along the western coast of the island. The transport of metals from Borneo to the western Archipelago was probably undertaken by the same merchants shipping glass beads, and trade ceramics, to the island. Wrought iron from China was traded, according to Wang Dayuan, as lengths of iron.

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[78] J. W. Christie, "Iron-working in Sarawak" in Christie, J.W. and V.T. King, *Metal-working in Borneo: Essays on Iron- and Silver-working in Sarawak*, Hull: Centre for Southeast Asian Studies, 1988, p. 10.

[79] T. Harrisson and S.J. O'Connor, Excavations of the prehistoric iron industry in West Borneo, 2 vols, Ithaca Cornell University Southeast Asia Program, Data Paper no. 72, 1969, and J. Christie, , "The Santubong Iron Industry" in I. Glover (ed) *Southeast Asian Archaeology*, Oxford: BAR International Series, 1988.

The degree of specialisation within the metal-working sector however can only be determined with the discovery of a work-site. It is possible that the same craftsmen engaged in iron forging were also capable of working with copper and bronze, especially in the production of fishhooks and wires. Diversity, would have helped reduce the risk level of the enterprise, risk avoidance, being a major consideration among specialists of the pre-industrial era. Taking this into consideration the metal-workers could perhaps have acquired the skills to work with different metals.

Although the ethnographic record suggest that metal-workers in Southeast Asia were essentially independent producers, the high price of metals, coupled with the fact that it has to be transported over long-distances and therefore raising the price of the raw material, would seem to suggest the involvement of an affluent class in metal-working. A centrally administered metal-working sector would have the capability sustain the production of a variety of metal wares. This, to some extent could be an explanation for debris from copper- and iron-working being found at the same location.

The discovery of a work site will yield more information on metal-working at pre-colonial Singapore. Compositional analysis of existing material, especially slag, will also yield information on the nature of smelting works at the settlement. As there are limited opportunities for excavations, or surveys, to be conducted on the site of the pre-colonial settlement, the extent and nature of metal-working sector will, unfortunately, never be known.

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Abbreviations:

JMBRAS Journal of the Malayan/Malaysian Branch of the Royal Asiatic Society.
JSEAS Journal of Southeast Asian Studies.

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Table 1
Distribution of slag by type

Type	Amount (no. of pieces)	Weight (gm.)	% of total weight	% of total amount
1	248	267.75	33.5	15.8
2	519	161.75	20.2	33.1
3	88	42.25	5.3	5.6
4	278	67.75	8.5	17.7
5	91	55.00	6.9	6.0
6	267	182.50	22.8	17.0
7	74	22.00	2.8	4.7
Totals:	**1565**	**799**	**100**	**99.9**

Table 4
Distribution of iron fishhooks

Sq. No.	No. of pieces
I	4
II	1
III	2
IV	1
V	2
XII	1
Total	**11**

Table 2
Distribution of slag by location

Sq. No.	Amount (pieces)	Weight (gm.)	% of amount
I	44	35.0	2.8
II	-	-	-
III	125	47.0	7.9
IV	16	21.5	1.0
V	26	13.0	1.6
VI	64	30.75	4.0
VII	-	-	-
VIII	365	181.75	23.3
IX	-	-	-
X	802	392.5	51.2
XII-XIV	120	74.0	7.6
T1	-	-	-
T2	3	3.5	0.1
Total:	**1565**	**799**	**99.5**

Table 3
Distribution of bronze finds.

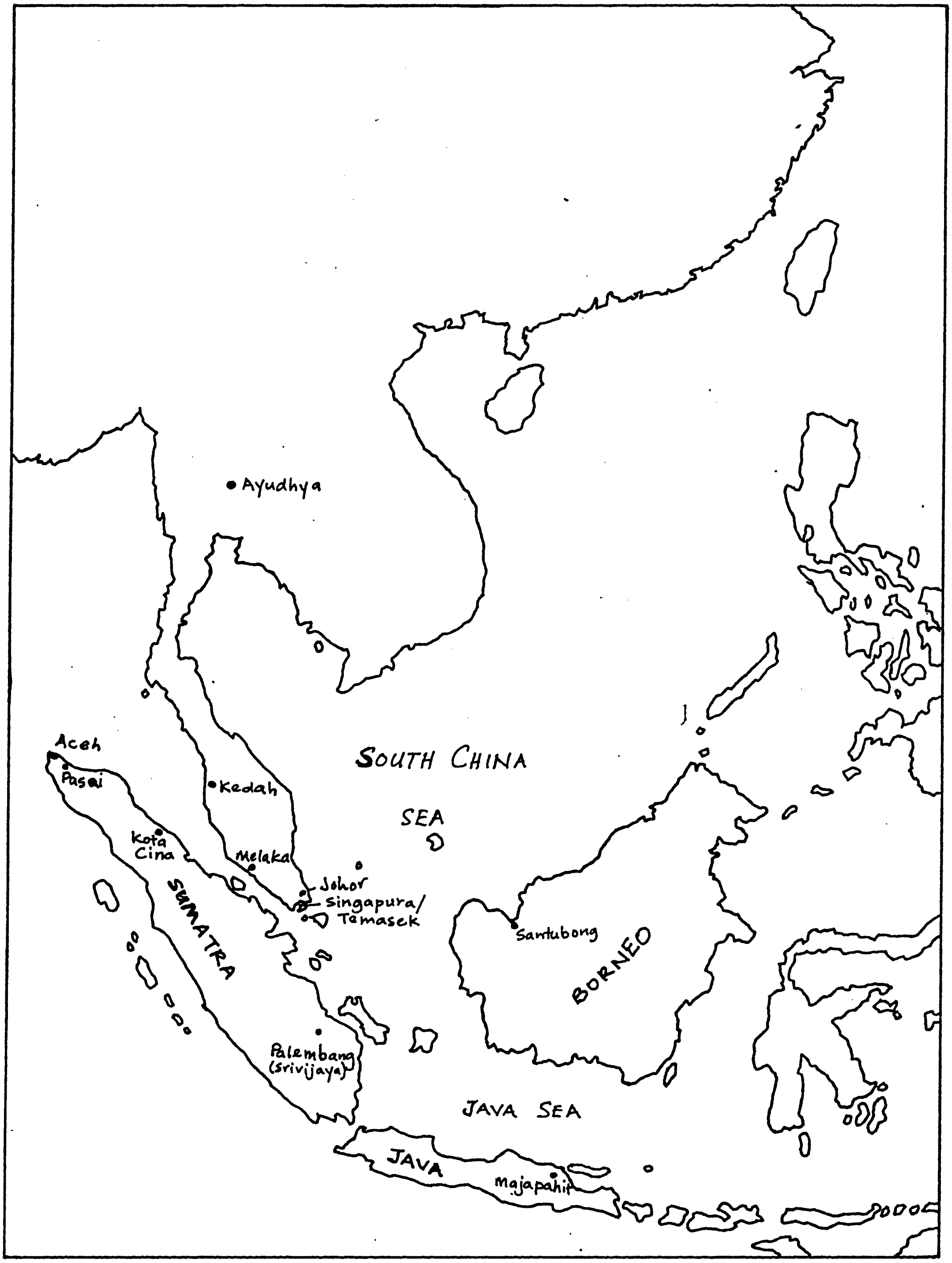
Square no.	Level	Artefact type
I	4	body
I	5	rim
I	5	floral ornament
I	5	body
I	5	body
I	5	body
II	4	cylinder
IV	1	rim
IV	1	body
IV	2	body
IV	2	floral ornament
XII	1	body
XII	2	body
XII	5	body
XIII	2	rim
XIII	3	body
XIV	2	body
XIV	5	body
T2	4	bell

Table 5
Distribution of fish hook iron

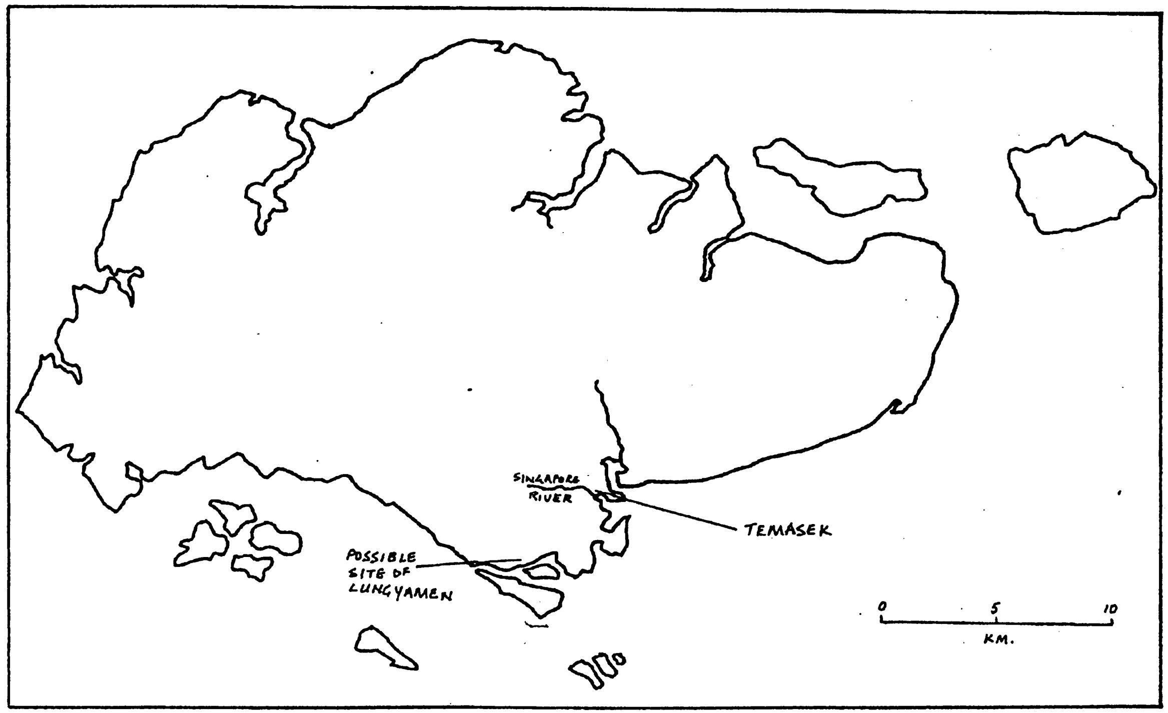
Square No.	Amount (no. of pieces)	Weight (gm.)
I	92	15.75
II	11	2.5
III	42	7.0
IV	36	5.5
V	15	2.75
VI	47	9.5
VII	-	-
VIII	26	5.75
IX	-	-
X	23	5.25
XI	-	-
XII-XIV	71	14.5
T 1	-	-
T 2	1	0.25
Totals:	**364**	**68.75**

Table 6
Distribution of bronze and copper fishhooks

Sq. No.	No. of pieces
I	3
III	1
IV	2
VI	2
X	1
XI	2
Total:	**11**

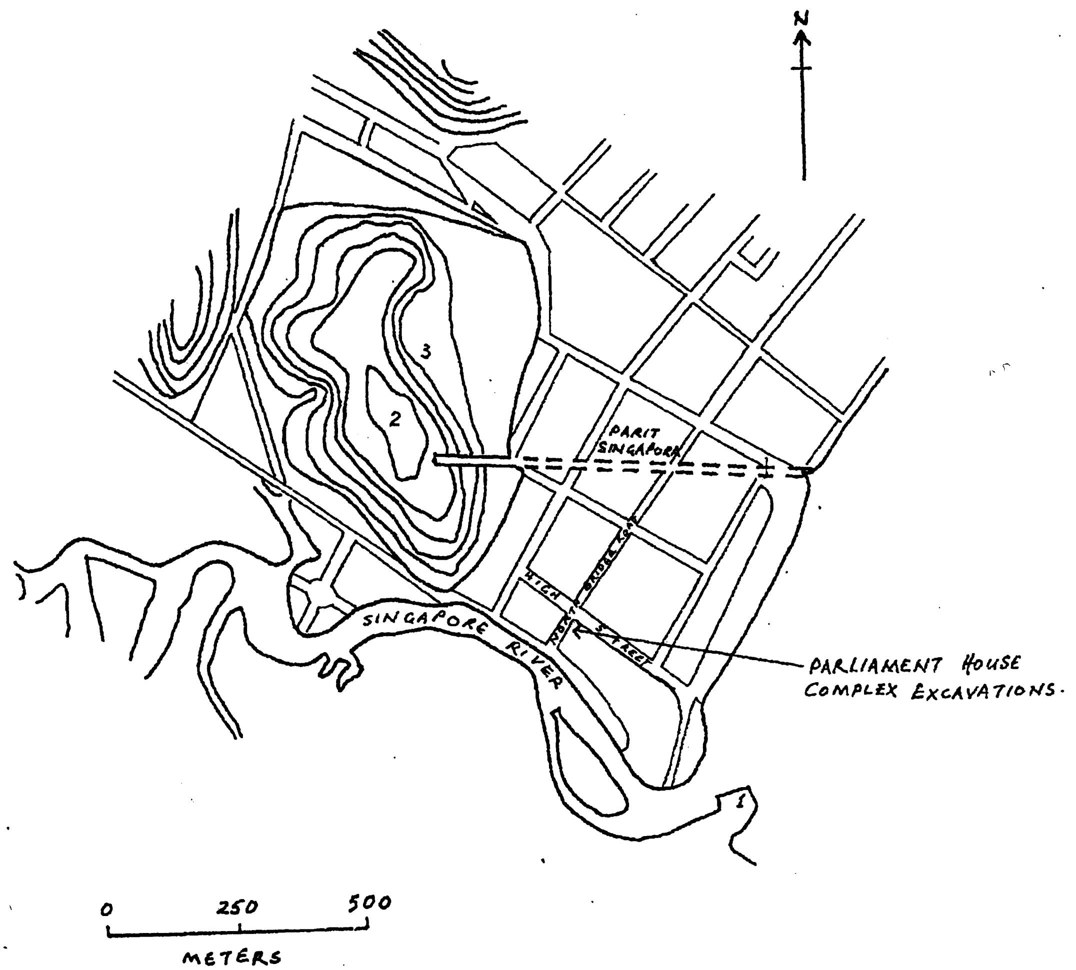


MAP 1. SOUTHEAST ASIA



Map 2. Singapore in the 14th Century

PARLIAMENT HOUSE COMPLEX, FORT CANNING HILL, THE SINGAPORE RIVER, PARIT SINGAPURA; BASED ON J. MIKSIC; ARCHAEOLOGICAL RESEARCH ON THE FORBIDDEN HILL.



1. SITE OF SINGAPORE STONE.
2. FORT CANNING HILL.
3. LOCATION OF FORT CANNING HILL EXCAVATIONS.

Map. 3

FIG. 1:
PARLIAMENT HOUSE COMPLEX EXCAVATIONS 11/94 - 1/95

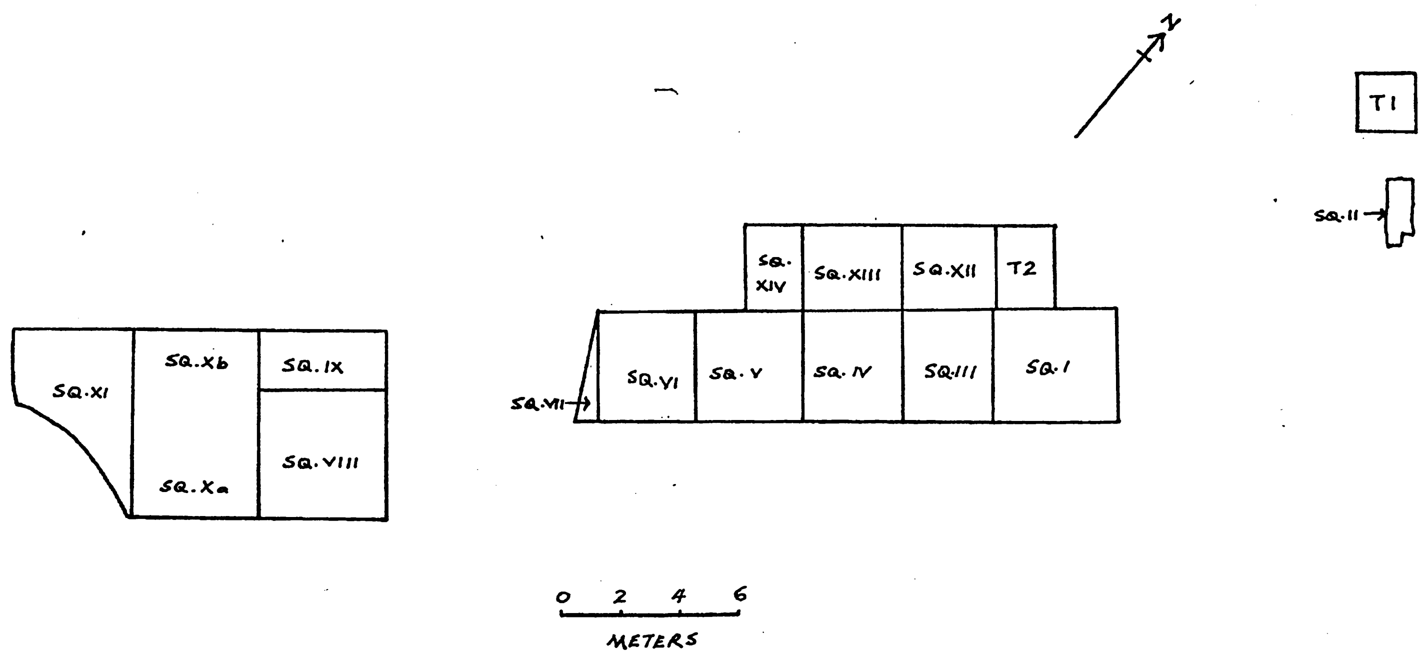


FIG. 2:

PROFILE: SQ. IV, NORTH FACE.

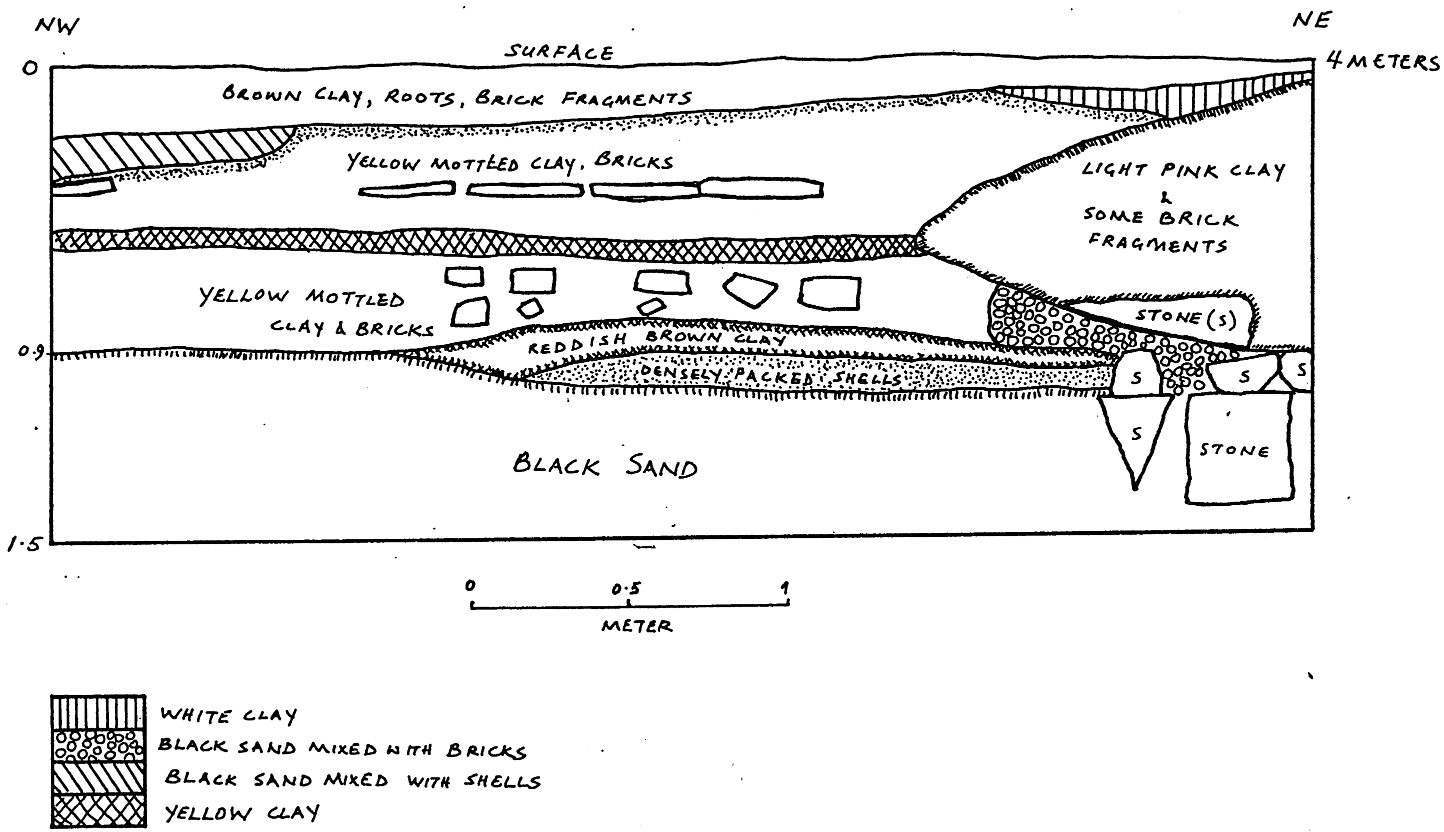
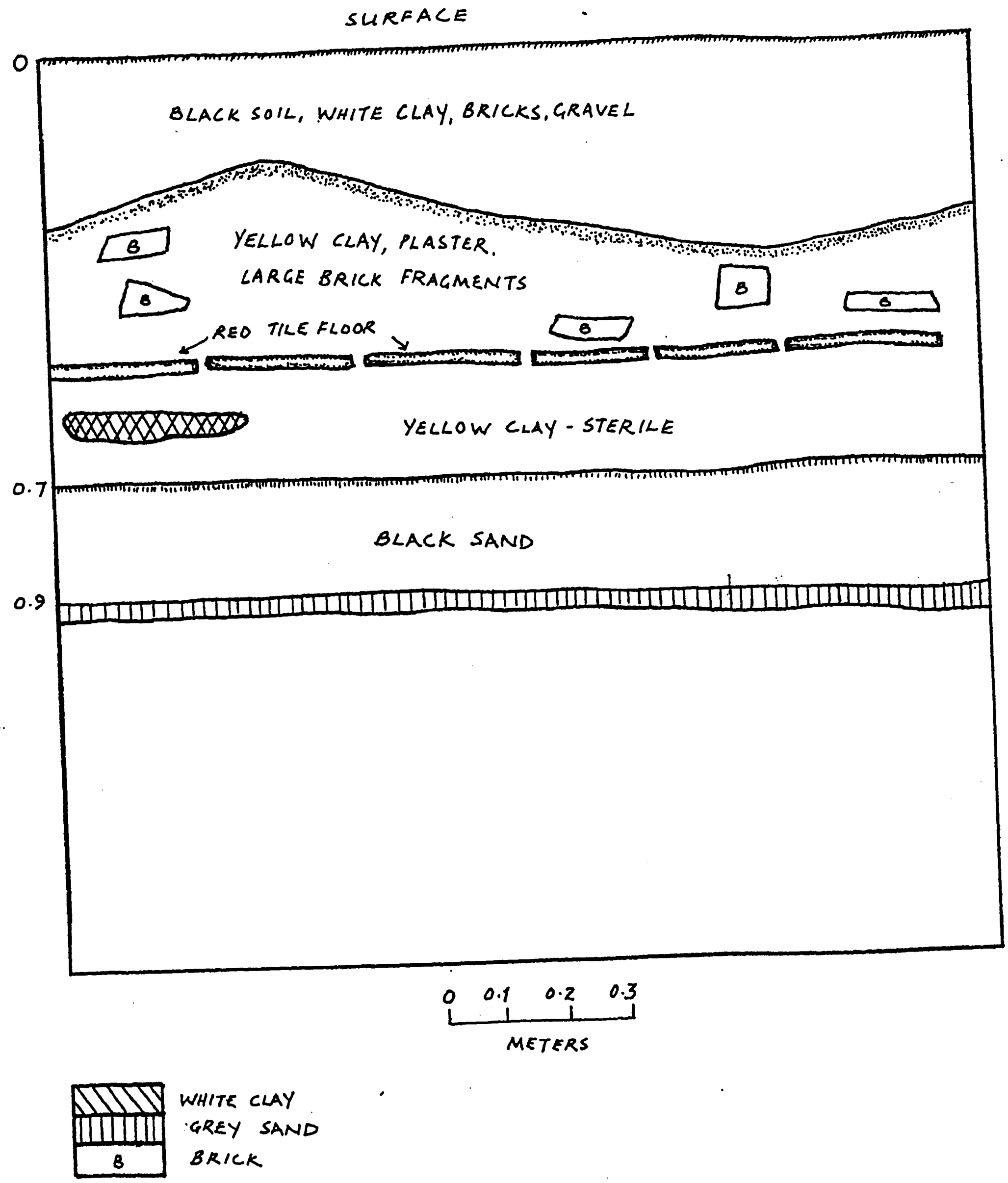


FIG. 3:
PROFILE : T.1 SOUTH WALL



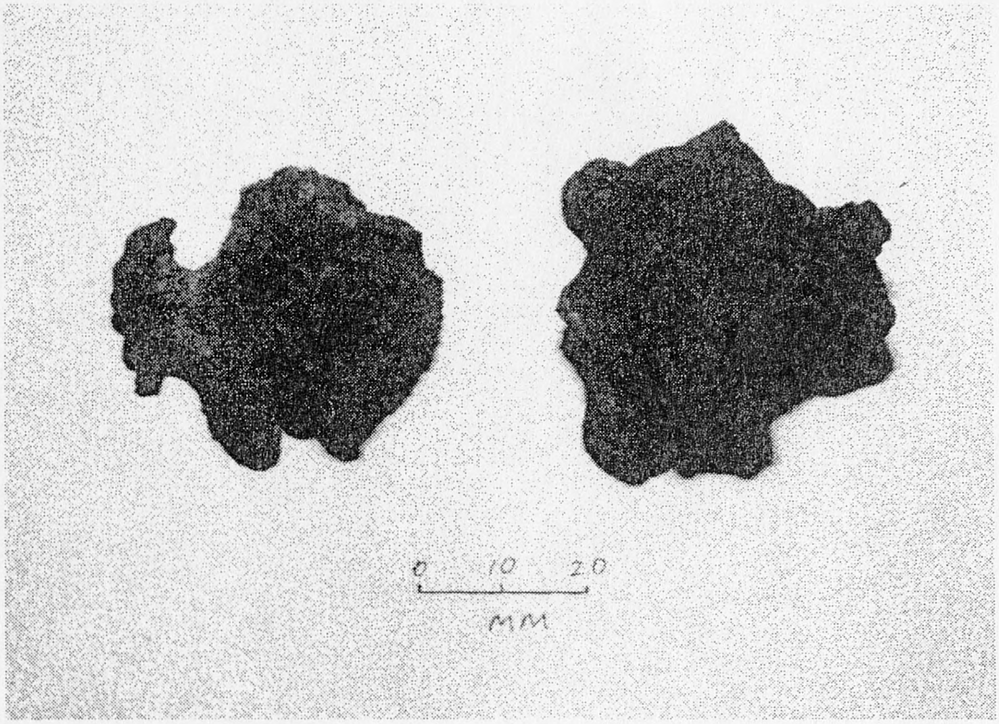


Fig. 4. Slag Type 1.

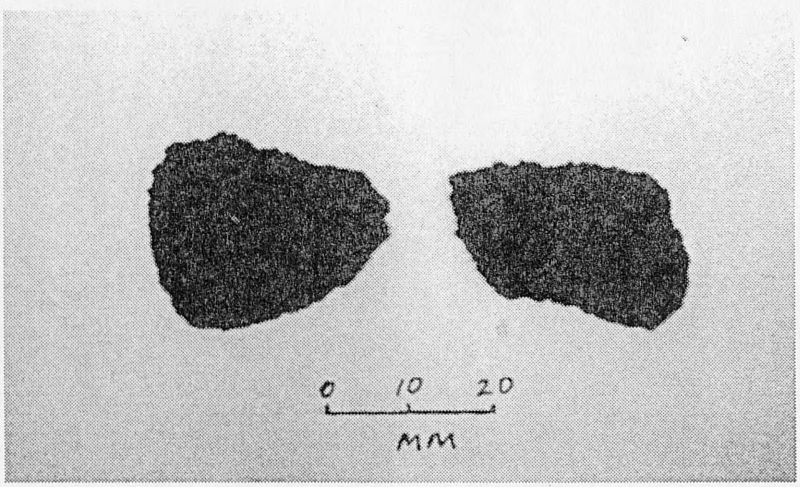


Fig. 5. Slag Type 2.

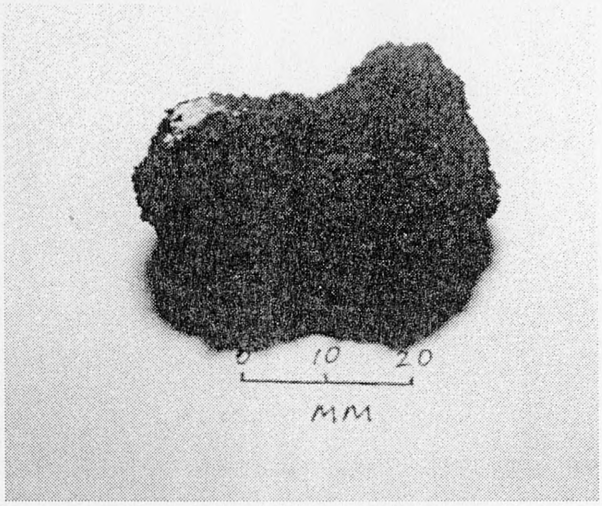


Fig. 6. Slag Type 3.

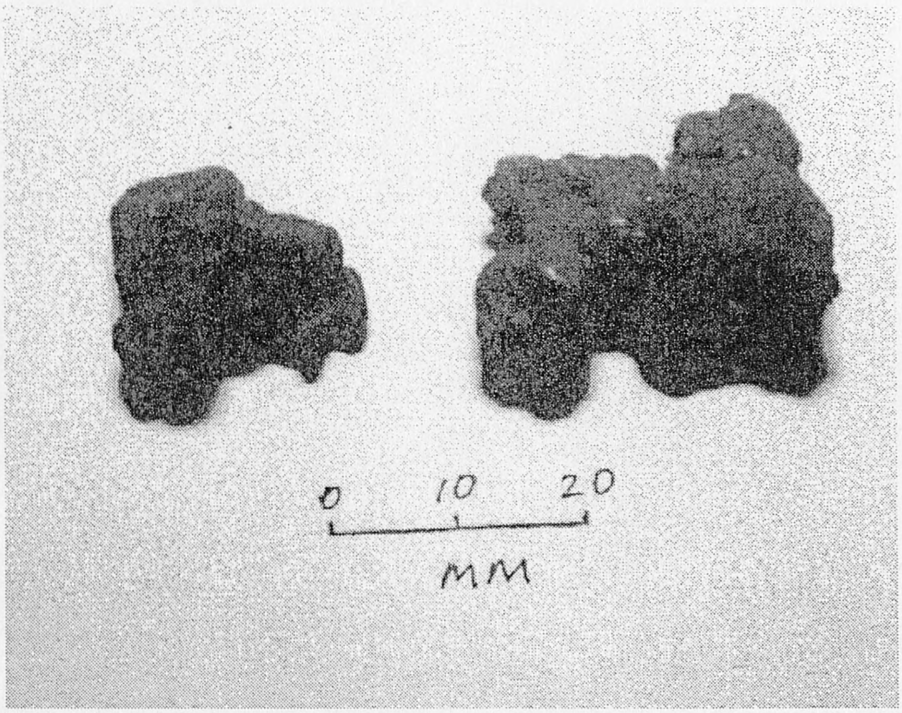


Fig. 7. Slag Type 4

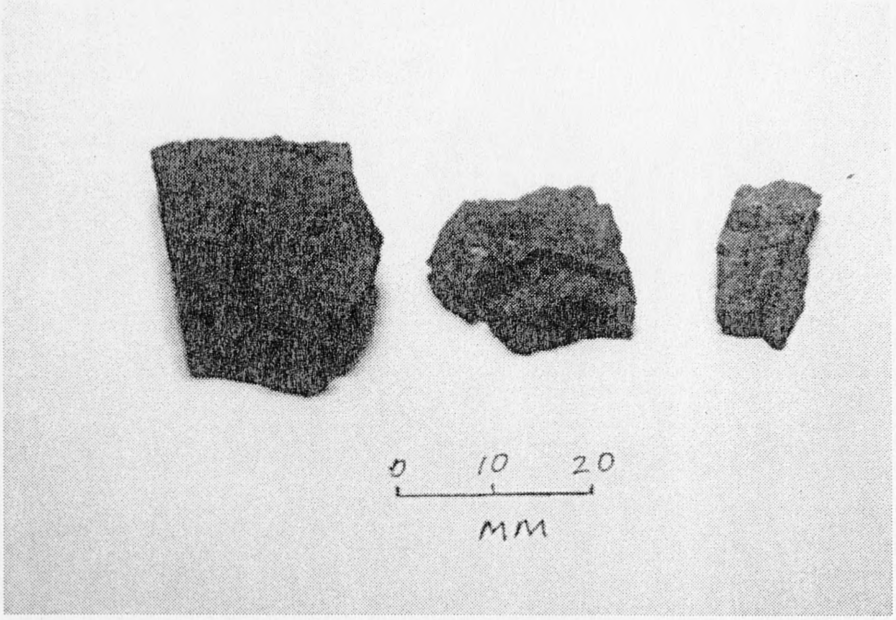


Fig. 8. Slag Type 5.

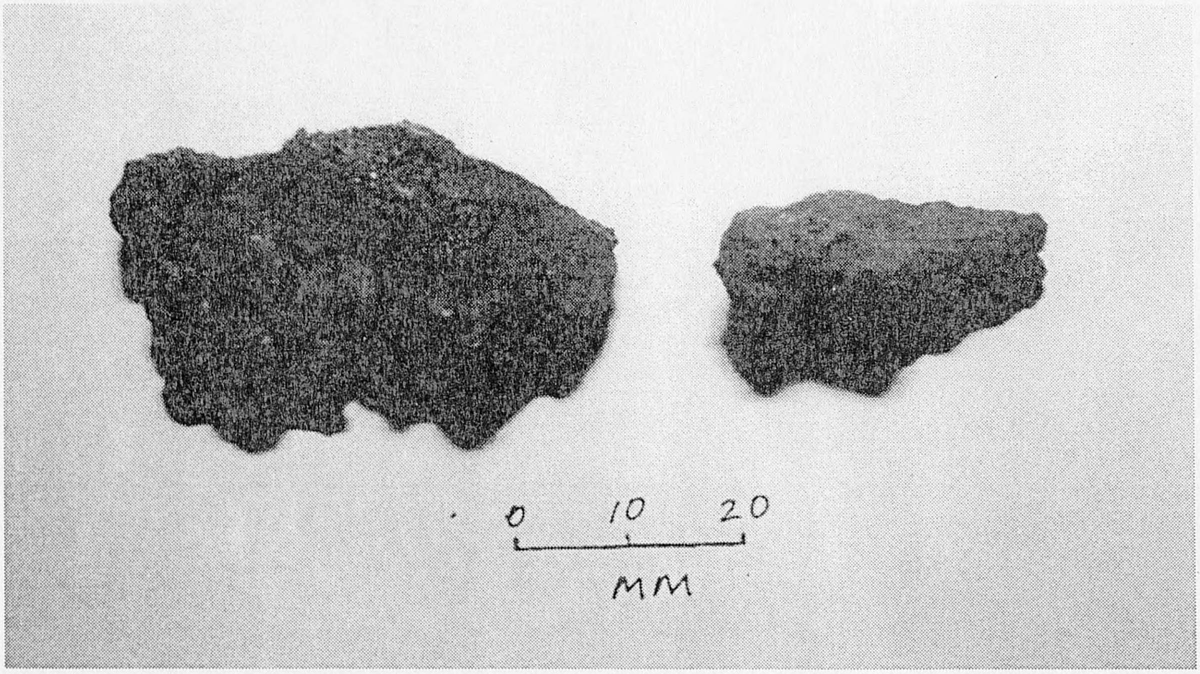


Fig. 9. Slag Type 6

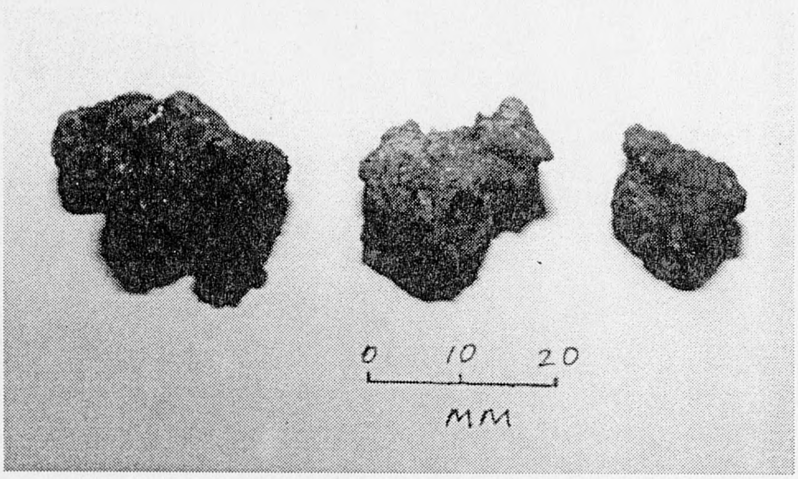


Fig. 10. Slag Type 7.

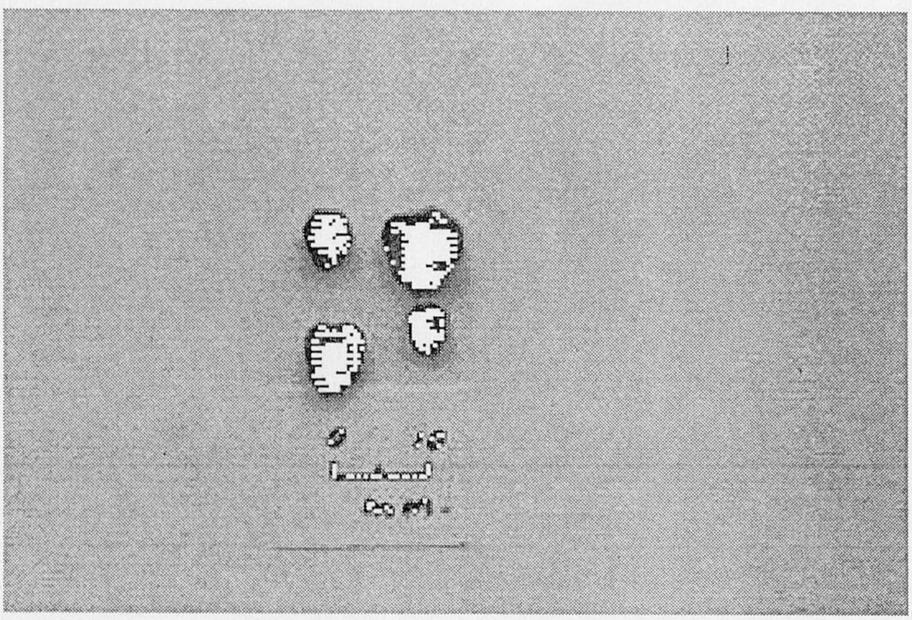
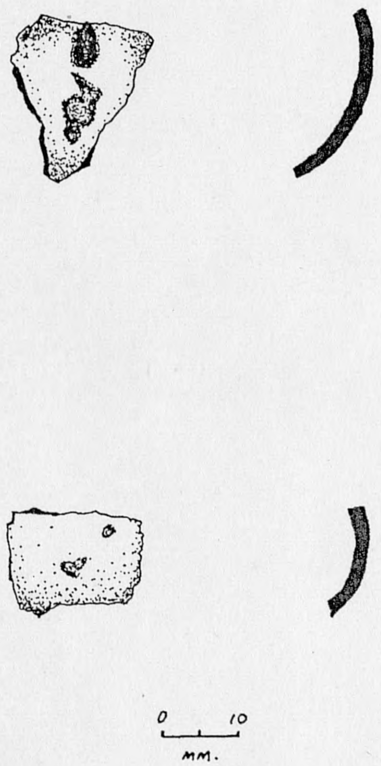


Fig. 11. Copper Prills.

FIG. 12: CAST IRON FRAGMENTS



SQ. VIII, LEVEL 1

SQ. VIII; LEVEL 1.

FIG. 13 : KNIVES

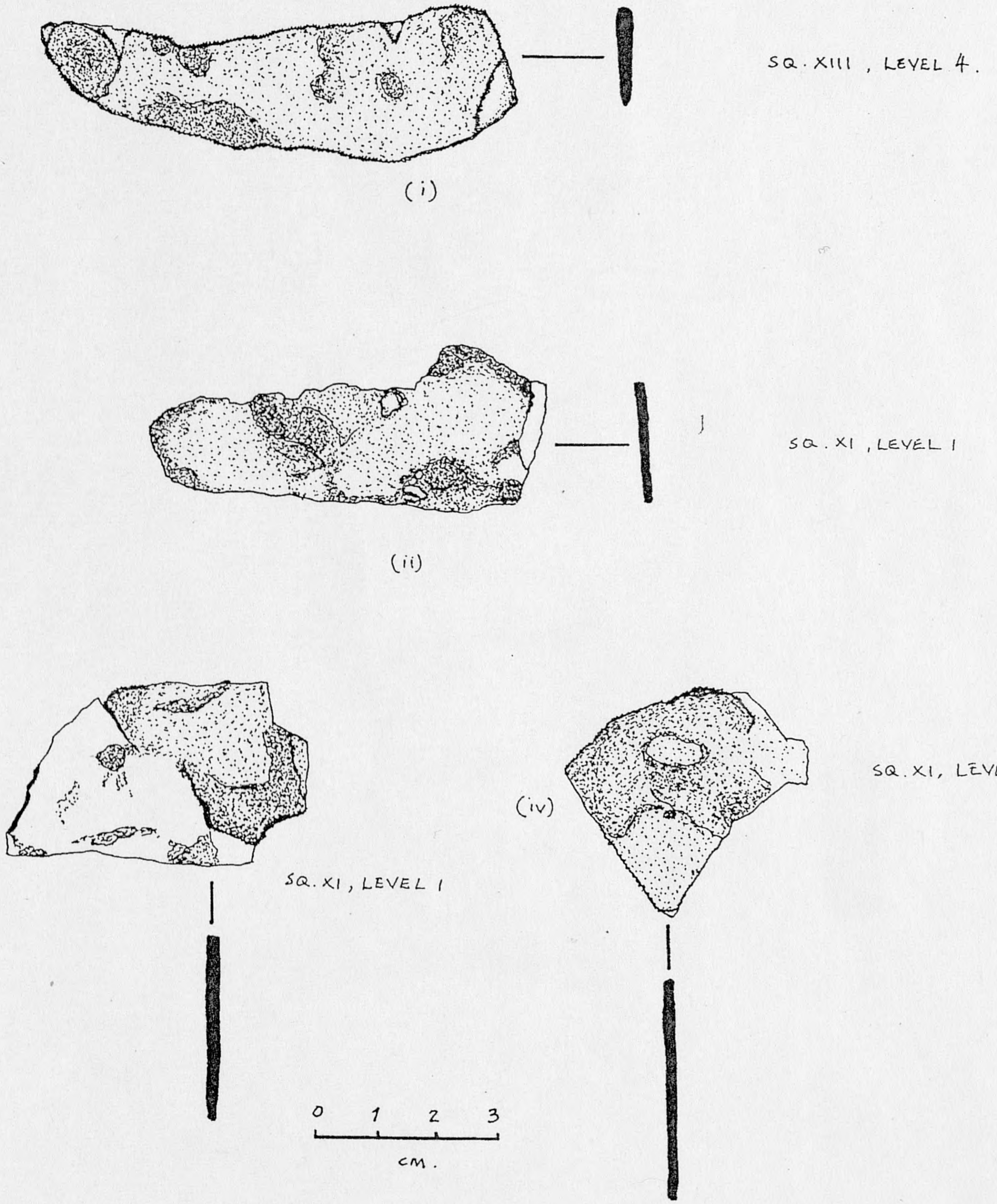


FIG. 14.

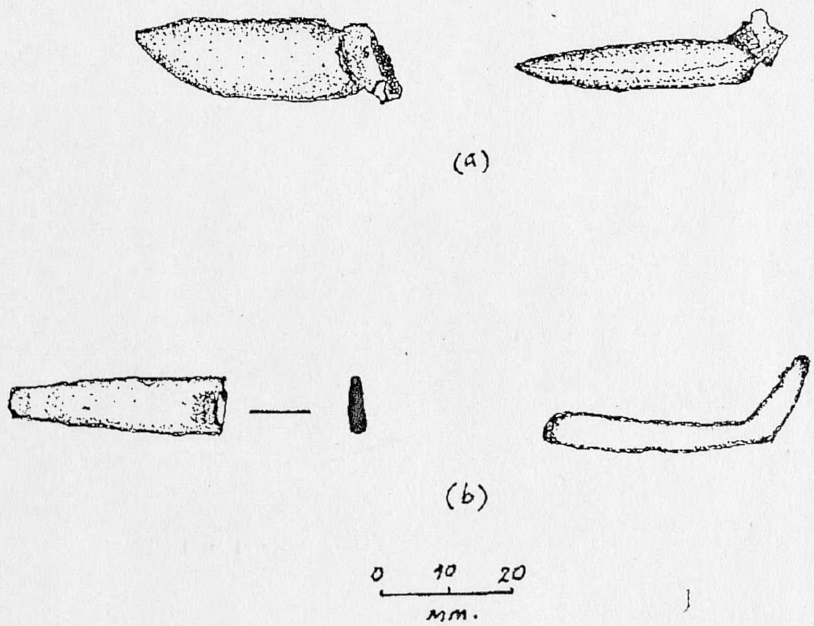
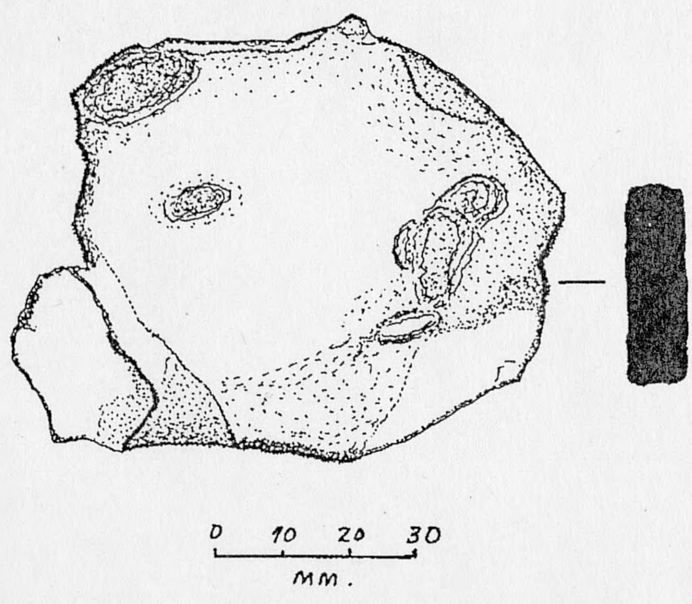


FIG. 15 : FLAT IRON PIECE



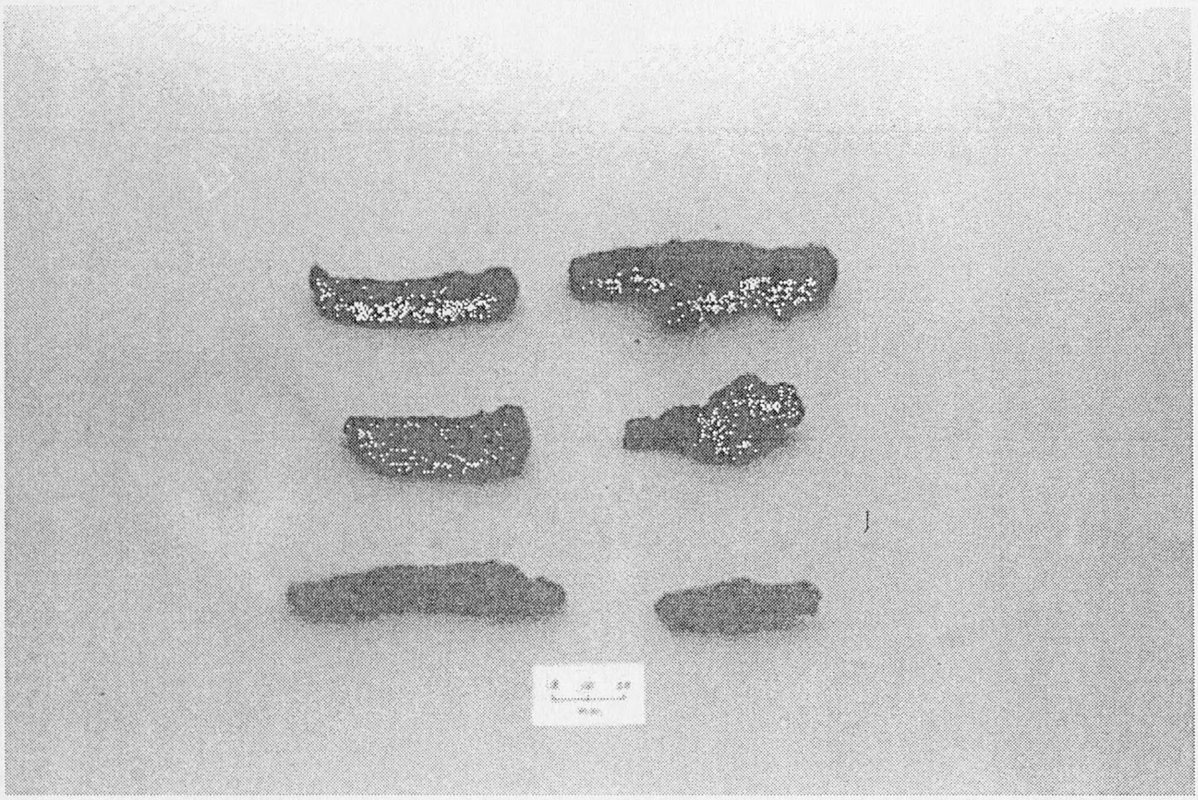


Fig. 17. Iron rods.

FIG. 18:

FRAGMENT OF BRONZE VESSEL RIM.

SQ. 1 : LEVEL 4.

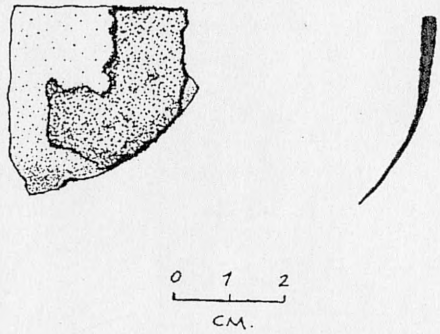
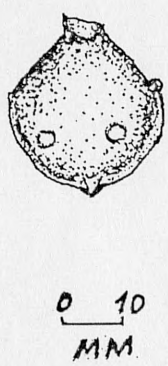
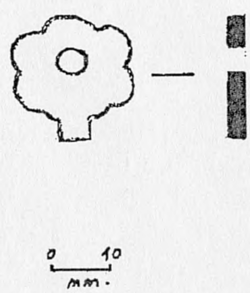


Fig. 20.



a. Bell.



b. Floral-shaped ornament

FIG. 19:

BRONZE FRAGMENTS.

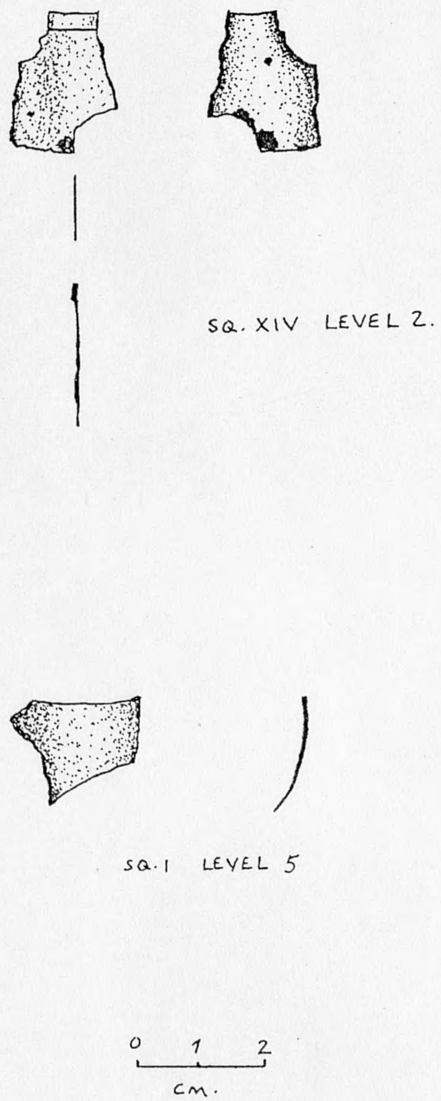
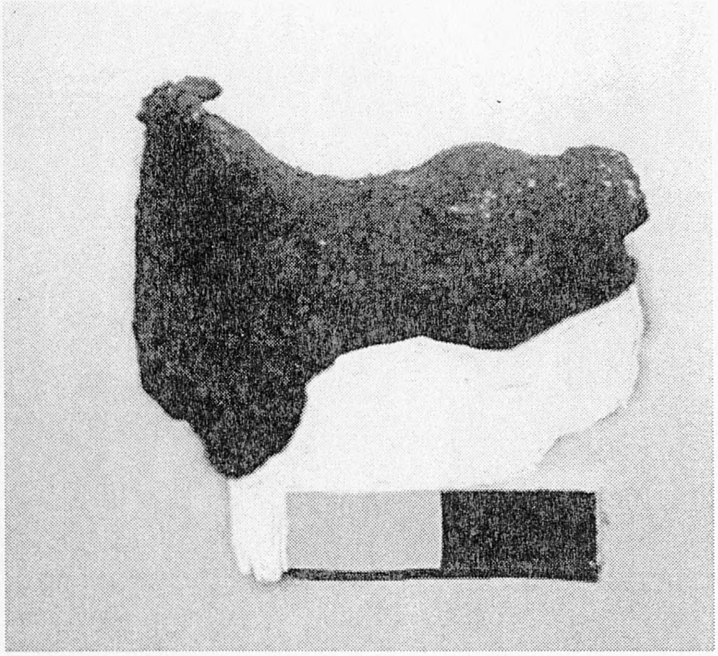


Fig. 21. a & b. Bronze cylinder



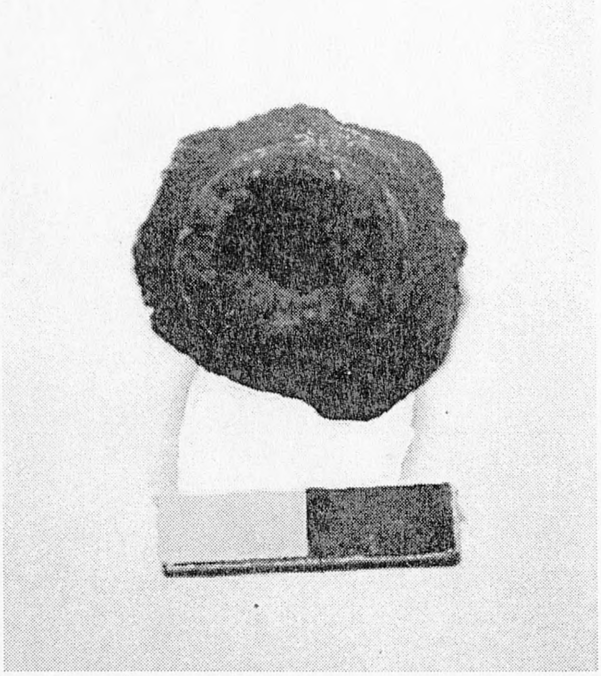
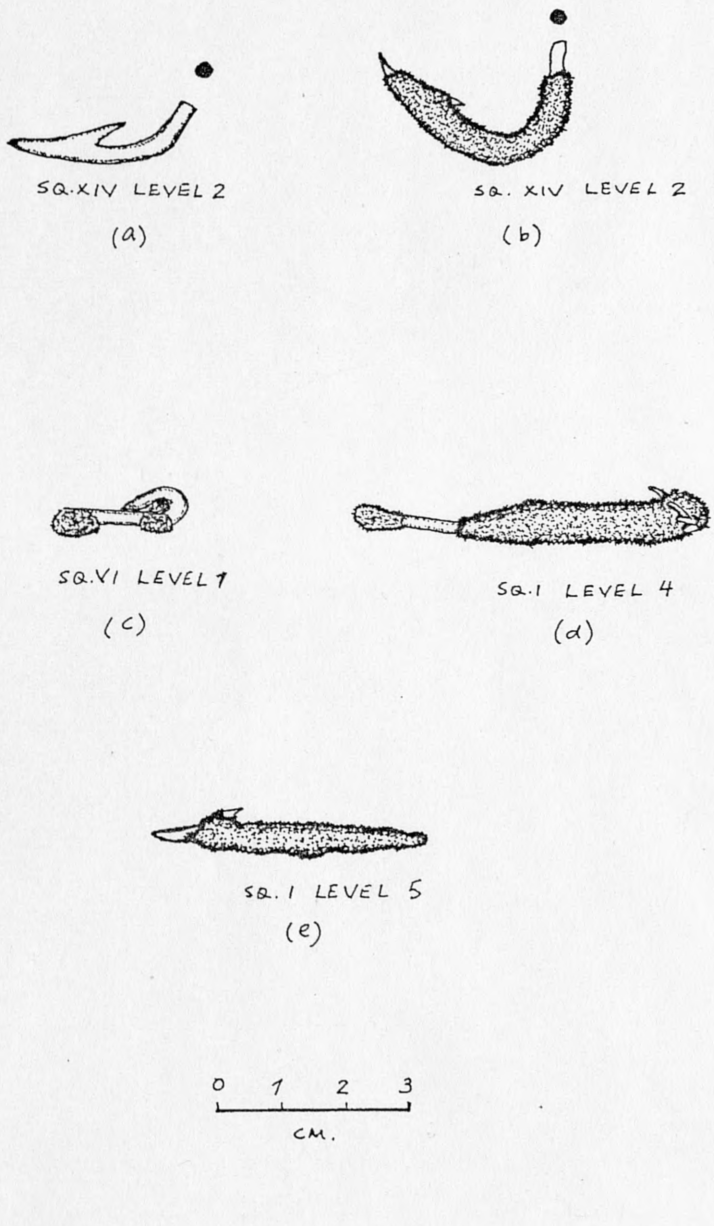


FIG. 22:

IRON FISH HOOKS



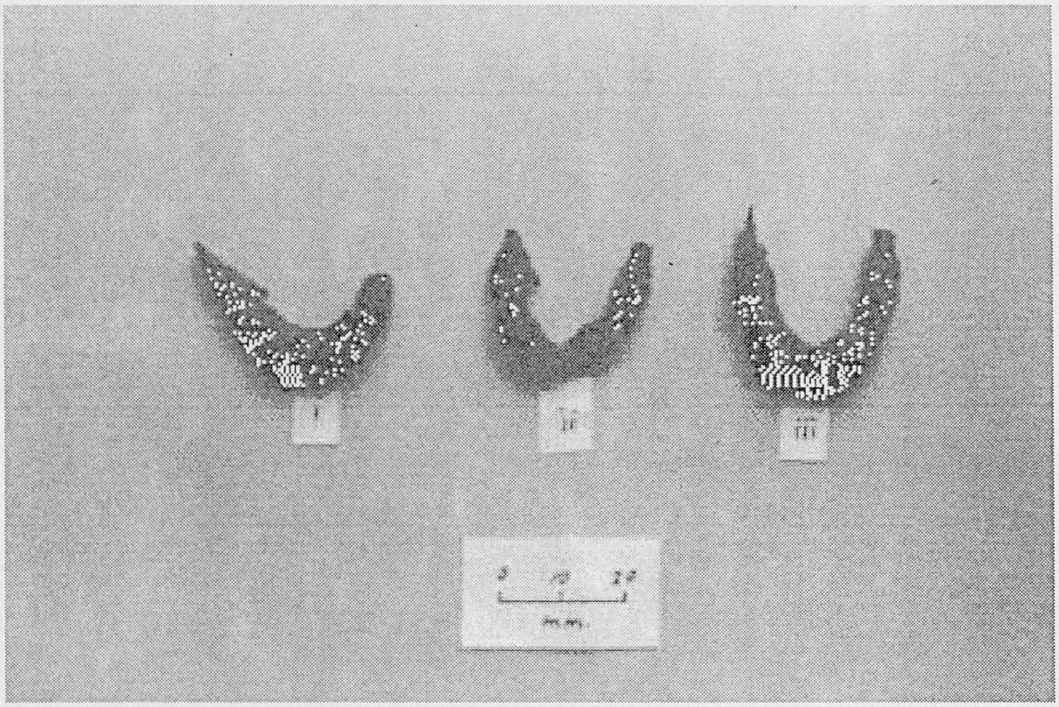


Fig. 23 Iron fish hooks

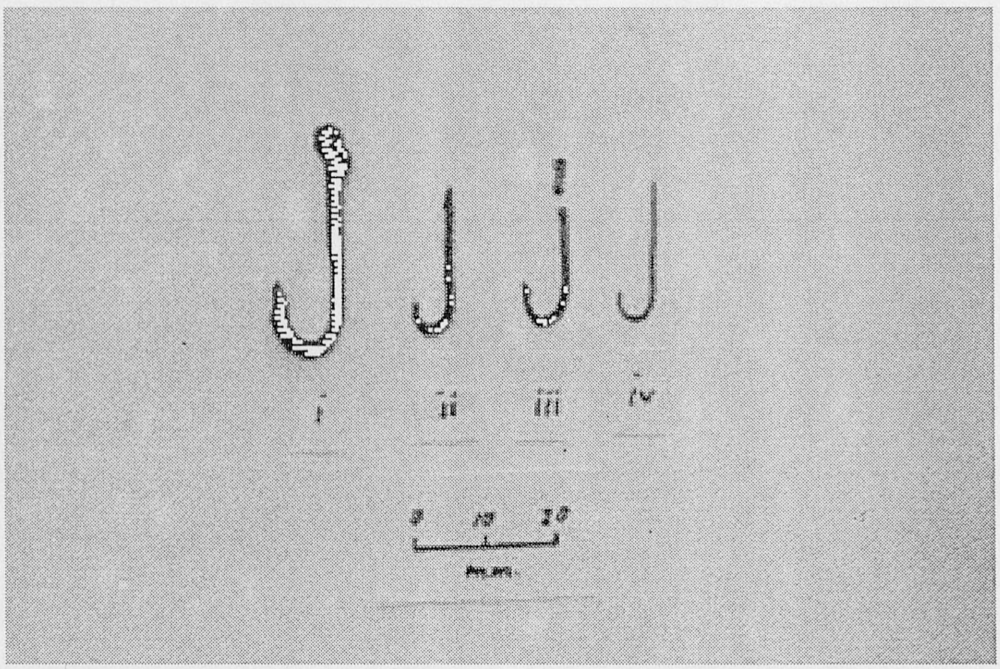
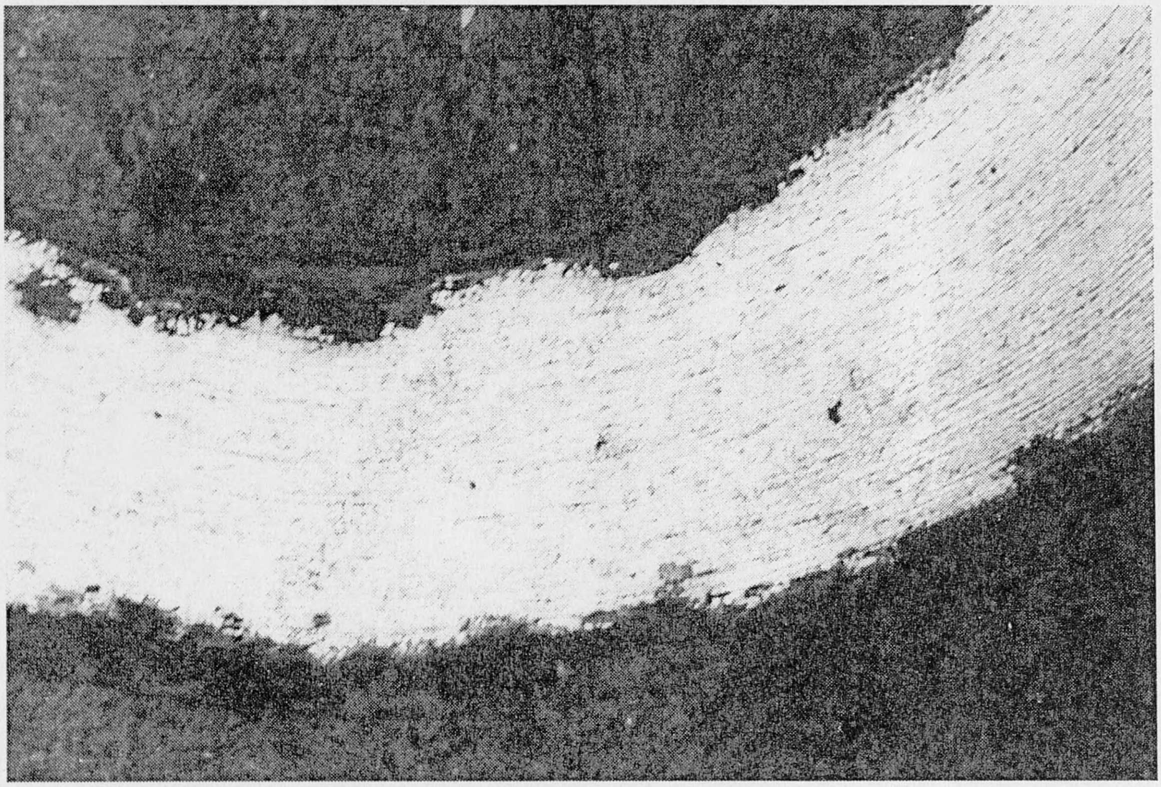


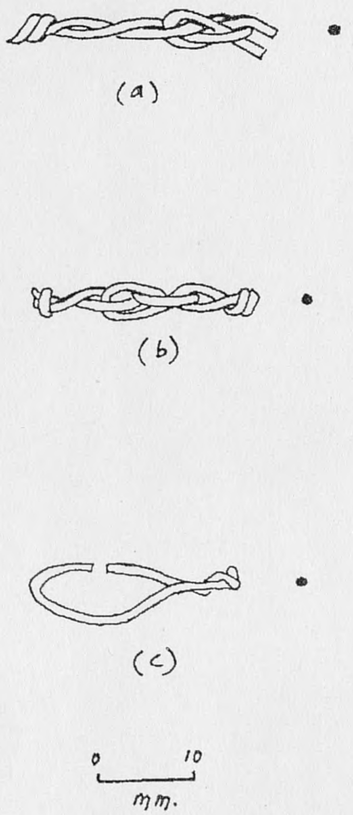
Fig. 24 Bronze and Copper fish hooks

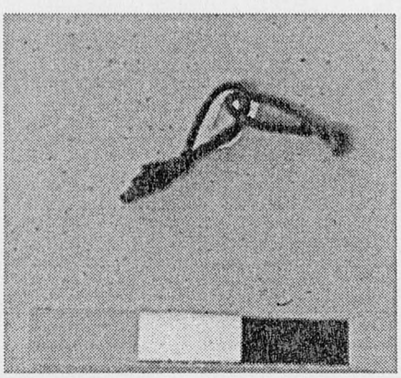


25. a. Copper fishhook 50x

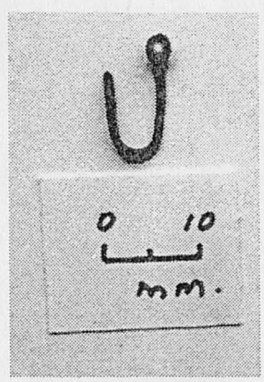
26. b. Copper fishhook 400x.

FIG. 26 : COPPER WIRES





d.



e.

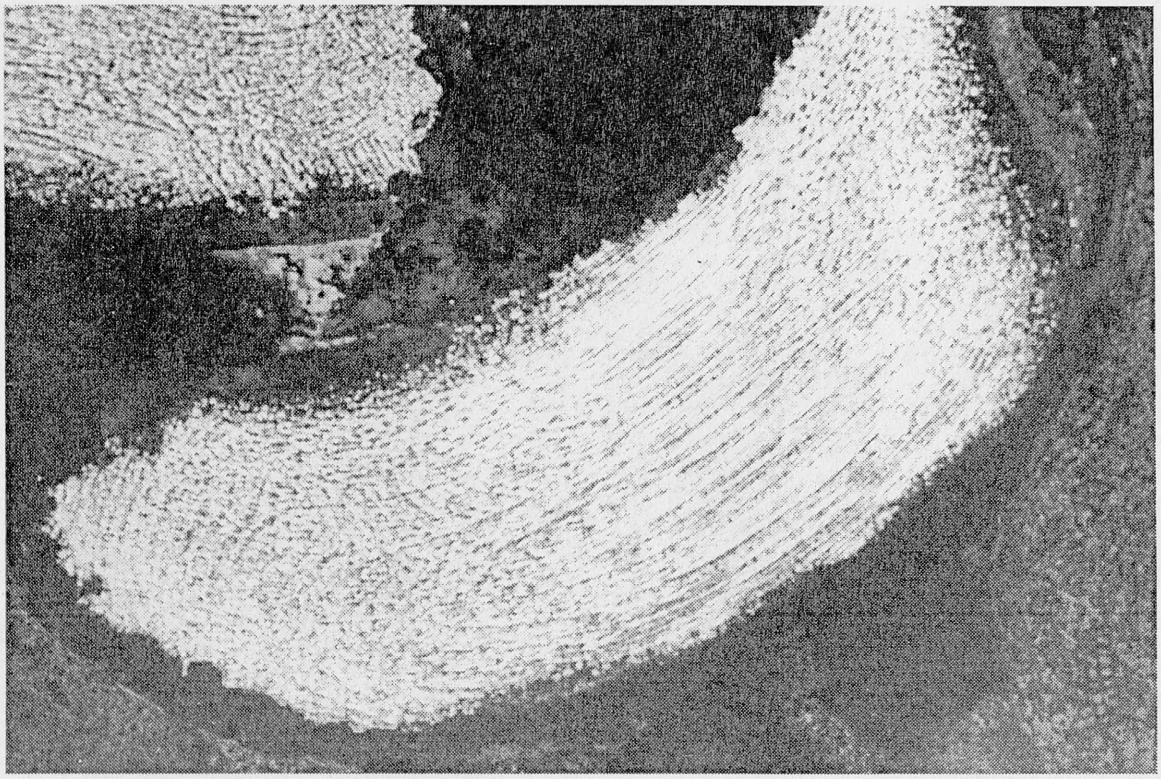
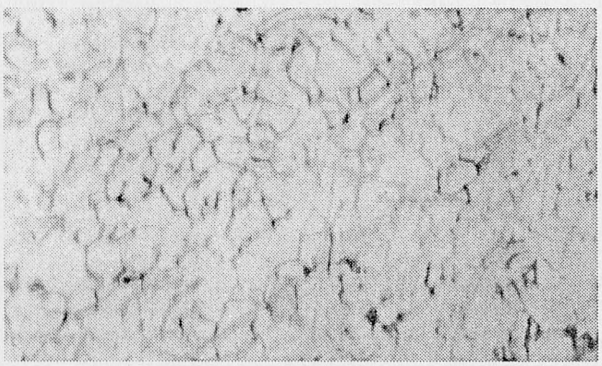
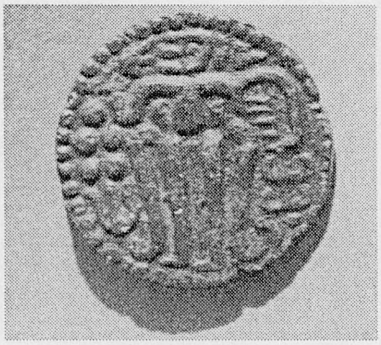


Fig. 27 a. Copper Wire 50 x.

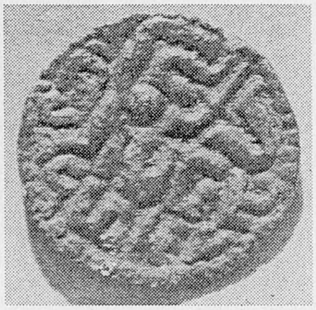


27 b. Copper Wire 400 x.

Fig. 28
(figures not to scale)



a. Sri Lankan coin
obverse

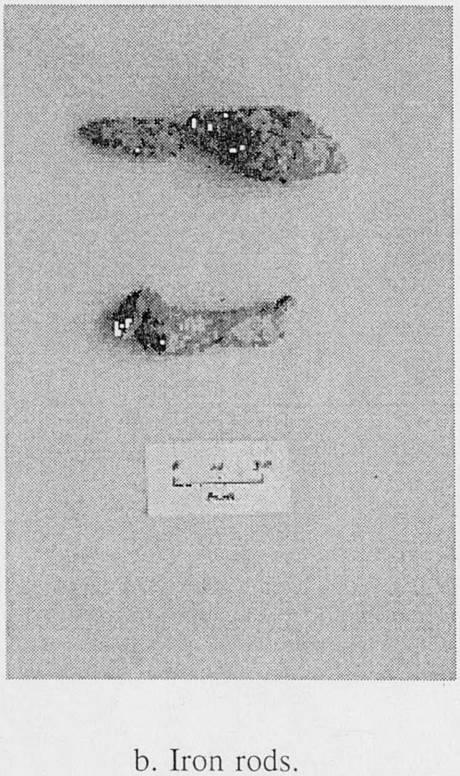


b. Sri Lankan coin
reverse

c. Melaka/Johor coin
obverse

Fig. 29 : Metal finds from Fort Canning

a. Bronze rim.



b. Iron rods.

Fig. 29 c : Fort Canning metal finds,

Flat iron pieces.