

# Glass Beads in Asia

## Part Two. Indo-Pacific Beads

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PETER FRANCIS, JR.

THIS PAPER DEALS WITH a type of bead that persisted for some two thousand years. Beads of the type are found, often in great quantities, throughout much of the eastern hemisphere. The beads are small, usually under 6 mm in diameter. They are undecorated and come in a limited range of colors: various hues of opaque red, orange, green, yellow, and "black," translucent blue and green, and, less often, translucent violet, amber, and clear and opaque white. In shape they may be oblates, tubes, or discs, but because the beads are so small the shape is often not recorded; because of their nature it is not usually necessary to do so.

If these beads were not so ubiquitous they would be easy to overlook. But ubiquity is one of their hallmarks. They are found up and down the East African coast and penetrate far to the west. They are less common in the Persian Gulf and northern India, but again very numerous in southern India and Sri Lanka. They are found in great numbers throughout Southeast Asia and into southern China, Korea, and Japan. There is probably not a country in Asia that does not have them.

Due to their sheer numbers, scholars have discussed these beads for six decades, mostly with an eye to discovering where they were made. Rather early in the search Evans (1928) found that some were made at Kuala Selinsing, Malaysia. Scholars who have been aware of his finds have referred to this site, but the majority of opinion preferred India as a source. Most conclusions have been vague and subject to change. Lamb (1965a:95) postulated "a nomadic bead making group . . . which established itself at various South-east Asian centres." As we shall see, this was the closest anyone came to the truth as it is now understood.

The beads have been given two names by other scholars. Van der Sleen (1956, 1958:210–211) introduced the term *Trade Wind Beads*, for beads found in East Africa. Though evocative, the term does not describe a class of beads, but all those coming via the trade winds, including both drawn and wound beads. As discussed in the first part of this series, drawn beads are cut from glass tubes and wound beads are made by twirling hot glass around a mandrel. They are very different beads, and the distinction is so basic that they cannot be considered together.

Davison (1972:149) adopted this term, although she was most interested in the drawn beads. Among those was a group with a similar chemical formula, which she named the "Trade Wind Beads Chemical Group," distinguished chiefly by a trace of

Peter Francis, Jr., is director of the Center for Bead Research, Lake Placid, New York.

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uranium. By inference in her publications and in private correspondence she indicated that she thought of these as "true Trade Wind Beads." As we shall see, there were so many makers of these beads that a single formula based primarily on one or a few trace elements can help distinguish only a single center, not the whole class.

Lamb (1965a, b) introduced English readers to the term *mutisalah*, Indonesian/Malay for "false pearl" and used in the Lesser Sundas, especially Timor and Flores, to refer to small opaque orange or red heirloom beads. Van der Sleen (1966) criticized this term, claiming that *mutisalah* were not drawn beads but even smaller wound beads with a heavy lead content. Both were correct. The term is applied locally to both drawn and wound beads as long as they are the right size and color (S. Adhyatman, pers. comm.). The drawn ones are our Indo-Pacific beads; the wound ones are Chinese "coil" beads, to be discussed in part three of this series. In addition to this confusion, there is no reason to concentrate on only one or two colors of a class of beads.

It is appropriate to introduce a new term for these beads and to define it precisely. *Indo-Pacific* is a shortened form of "Indo-Pacific Monochrome Drawn Glass Beads," which indicates the beads' distribution, color, method of manufacture, and material. It is further defined as such beads made by the *lada method*, which we shall discuss presently.

## THE BEGINNINGS OF INDO-PACIFIC BEADS

As far as can be determined, the first Indo-Pacific beads were made at Arikamedu, in the Union Territory of Pondicherry, India, on the southeast coast (Fig. 1). Arikamedu, a modern name for the site, is universally believed to have been the city at which Romans established an emporium and which they called Poduca or Podouke. Its ancient Tamil name was something like Puduchcheri, which survives today as Pondicherry.

The site was first investigated by Jouveau-Dubreuil, who collected finds he picked up from the surface or bought from the villagers of nearby Virampattinam (Virampattinam) from 1937 or 1938 until 1940. Among these was a seal he described on the envelope where he kept it as "[une] intaille copie d'une monnaie d'Augustine." Some of his finds were sent to the École Française d'Extrême-Orient in Hanoi (Malheret 1959), from which the "Augustinian gem" has never been returned. Under the direction of Father Faucheux, the Service des Travaux Publics undertook some digging at the site in the early 1940s (Surleau 1943, 1944; Pattabiramin 1946). These excavations left much to be desired.

Examples of the finds were sent to several museums, including the Bangalore and Madras museums. At the latter institution, the last English Director-General of the Archaeological Survey of India, Mortimer Wheeler, noted among the Arikamedu objects sherds of Arretine ware, a well-known northern Italian ceramic. Somehow he obtained permission to dig at Arikamedu from the French authorities, and for a season he worked on the site, training several of the next generation of India's leading archaeologists (Wheeler et al. 1946). Unfortunately, he left with an erroneous impression of the importance of Arikamedu and its status:

This village, like its modern equivalents in the neighbourhood, doubtless consisted of simple fisher-folks, who caught the gullible fish of the region from the shore or from

small outriggers, gathered the fruits and juices of the palms, cultivated rice-patches, and lived in a leisurely and unenterprising fashion just above subsistence level. To it suddenly, from unthought-of lands 5,000 miles away, came strange wines, table-wares far beyond the local skill, lamps of a strange sort, glass, cut gems. . . . A small foreign quarter . . . came into being, and finally the village was replaced by a brick-built town (Wheeler 1954:147).

Even more unfortunately, this view of Arikamedu became standard, despite the far more extensive excavations carried out after the war by Casal (1949), which showed that the urban phase of Arikamedu was much longer than the century or so Wheeler suggested. More recently, renewed attention has been focused on the site. Begley's (1983) careful work has demonstrated that Arikamedu was a city by about 250 B.C. and lasted to sometime after A.D. 200—centuries before the Romans came and long after they left.

As for the beads, Wheeler knew little and cared little about them. His plates (1946:98–101) show pendants upside down, modern intrusions, and several objects that are not beads. Casal was not much more helpful. A very few beads excavated under Wheeler are in the Pondicherry Museum. The rest are supposed to be in Delhi, but despite attempts on two different occasions, I have not been able to locate them. Some of Casal's material is in Musée Guimet in Paris, while the rest is in the Pondicherry Museum. The paper bags in which they were stored have badly deteriorated. One that is still identifiable comes from trench R 4N, called by Casal "megalithic" and by Begley "phase A," ca. 250–150 B.C. It includes a "knot," a piece of beadmaking waste, confirming the early age of the industry there.

Thus, Arikamedu was making drawn Indo-Pacific beads two hundred or more years before the Romans arrived and a century or so before the invention of the blowpipe in the western Mediterranean region (Avigad 1972:199–200). The blowpipe is important, as it is commonly used to put a cavity into a gather of glass to be drawn out subsequently into a tube for making beads, though glass tubes can also be made by manipulating the glass in various ways. Was the blowpipe invented at Arikamedu and brought to the west by Roman traders? This seems unlikely, as during the first millennium of the current era India did not make blown vessels, and the few found there are presumed to have been imported.

The Roman presence at Arikamedu must not be exaggerated. Archaeological evidence shows that it was not a sleepy village eating gullible fish and suddenly awakened by the coming of strangers. This ethnocentric view reflects a misunderstanding of the nature of Roman *emporía*. The word comes from the Greek. Homer referred to an *emporos* as a merchant sailing on a ship owned by someone else. Within the Roman Empire an *emporium* was a quarter where merchants lived or the seaport itself. Outside the empire it was a colony of Roman merchants living abroad (Huvelin 1904:1733–1734; Peck 1962:592). Thus it was a small trading colony, not the spearhead of Roman imperialism but a bastion of personal enterprise. Emporia doubtless meant more to the Romans than to the locals, by whose permission these colonies existed. Most emporia seem to have been abandoned by the reign of Marcus Aurelius (A.D. 161–180), when internal strife led to decreasing interest in the East (Charlesworth 1924:70; Toussaint 1966:41).

Why Arikamedu was favored for trade is a question that has been discussed at some length. Its location, inside the turn of the Ariyankuppan River, affords a good harbor, but the items used in trade are of importance as well. Wheeler identified

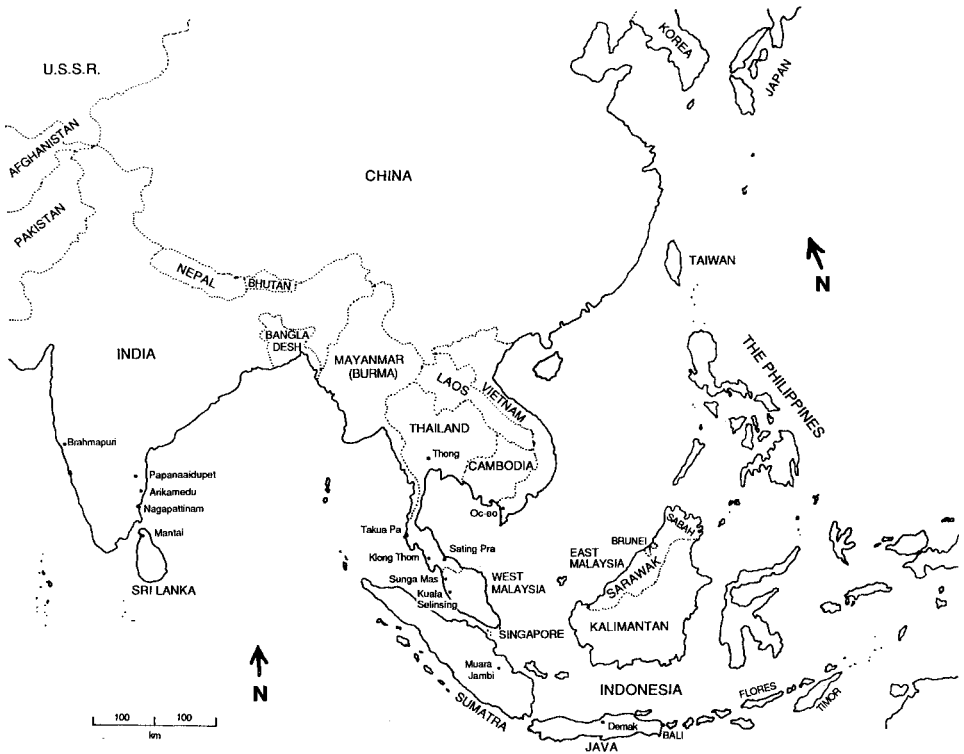


Fig. 1. Map of South and East Asia. The sites shown on the map are confirmed or possible centers of Indo-Pacific beadmaking.

some structures as dyeing tanks and emphasized the importance of cloth. Leather has been put forward as an important product. Spices from the hinterland, pearls from the Gulf of Mannar, beryls from the Coimbatore region, and other products may have been exported as well. Most of these have disappeared from the archaeological record or do not survive in any quantity (only one aquamarine has been identified in the Arikamedu material). But by bulk, beads of glass and stone call attention to themselves. Nearly fifty thousand beads and wasters are in the Pondicherry Museum, and thousands more in other institutional collections (Francis 1987:35, n.d.a). Among these are 54 agate/onyx blanks in various stages of manufacture, which were destined to go to Rome to be cut into cameos.

Arikamedu's position in the trade between India and Rome has been a favorite topic, but here I wish to call attention to its position vis-à-vis the rest of Asia. Three sites in particular seem to have had special relations with Arikamedu. They are: Oc-Eo or Go Oc Eo (Viet Nam), Mantai (Sri Lanka), and Klong Thom (Thailand). Arikamedu and the other three sites were the first urban centers in their respective regions, and all have been identified as having had Roman emporia (Fig. 1).

Mantai has been excavated by John Carswell, who was then with the University of Chicago. It dates from about the first to tenth century A.D. and was the key trading station between east and west, situated as it is at the point where seaworthy vessels cannot pass between India and Ceylon (Adam's Bridge) and where merchants from abroad would take advantage of the reversal of the monsoon winds to

take them home soon after they arrived. Beads made in Arikamedu have been found there (Francis n.d.b). It has been identified with Ptolemy's Modutti emporium (Francis n.d.c).

Klong Thom, in Krabi Province, Thailand, has been heavily looted, largely because of its beads (it is locally called Khuan Luukpat or "Bead Hill"). Many despair of its ever being excavated properly (Rutnin and Ketudhat n.d.; Francis 1985a; Jivananthaprawat 1987). Recent finds include Roman glass beads (Srisuchat 1987), a bronze Han mirror (Charoenwongsa 1985:110, 1989), the earliest inscriptions on seals in Thailand, dating from the first to the sixth centuries (Veeraprajak 1985), and other seals, including Persian or Indo-Persian ones (Division of Archaeology, pers. obs.). Beads of a soft green stone crudely cut into collar beads and often incised are found there in some numbers, and are present in small numbers at Arikamedu and Oc-Eo (Malleret 1962:224). Braddell (1949) has identified Ptolemy's Takkola as being near Trang, and many scholars agree with him. Gerini (1909:85-94) had suggested Takua Pa, with several other possible candidates, but Takua Pa is too late for this identification. The site with the proper age near Trang is Klong Thom; it would have been a staging post for the trans-isthmus trade, somewhat analogous to Mantai's position.

Oc-Eo was the port of Funan, the first state in Southeast Asia, occupied from about the second to the sixth century A.D., and excavated by the French (Malleret 1962). It also has beads from Arikamedu. There seems to be something of a consensus upon Malleret's (1962:421-454) identification of it as Ptolemy's Kattigara (Chakravarti 1972:110). It was the chief relay port in the Malay-Chinese trade.

That these four contemporary sites may have traded with each other comes as no particular surprise, but what is more significant is that they shared technology with each other—namely, the making of Indo-Pacific beads. Mantai, Klong Thom, and Oc-Eo were making these beads by at least the second century A.D., sometime before the abandonment of Arikamedu. After Arikamedu was gone they continued this operation, and as each of them was abandoned, the beadmakers moved elsewhere. We probably have not yet identified all Indo-Pacific beadmaking sites, but a large part of the story is now at hand.

#### INDO-PACIFIC BEADMAKING AFTER ARIKAMEDU

Mantai, Klong Thom, and Oc-Eo began making Indo-Pacific beads while Arikamedu was still occupied, as far as can now be determined, although it may be that the industry was set up in these places when Arikamedu was abandoned. It is not certain how Arikamedu met its end, but it may be that invasions by the Kalabhras, whom the Tamil-language Sangam literature refers to as "barbarians," were responsible (Ramasamy 1987:14).

Mantai was best positioned to sell its beads to southern India and later to the West. Arab and Persian merchants controlled trade with Mantai, much to the distress of the Chinese pilgrim Fa-hsien, who visited in 414 (Giles 1923:65-83), and of Justinian the Great of Byzantium in the next century, as Procopius reported (Dewing 1929:193). In the sixth century, Cosmas Indicopleustes also confirmed Persian domination (McCrinkle 1897:365-366). One of the few places Indo-Pacific beads have been found in Iran is at Siraf, from where they were no doubt to be exported to Africa (Francis 1989).

Oc-Eo may have served a luxury trade for eastern Asia. The *Wou li* (*Annals of Wu*)

of the Wu kingdom (A.D. 222–280) during the Three Kingdoms period, record that envoys of Funan brought *liu-li*, that is opaque glass, as tribute (Pelliot 1903:283). This word would not have been used to describe Western glass vessels; the only opaque glass made at Oc-Eo was for Indo-Pacific beads. In 519 the king of Funan, Rudravaram, sent tribute to the Liang court at Nanjing, the Liang kingdoms (502–556) being a southern dynasty during the Southern and Northern Dynasties period. The presents included *houo-tsi* pearls, taken to be beads of glass or possibly stone (Pelliot 1903:270). There was no question that Indo-Pacific beads were worthy of being worn by royalty. The kings and queens of the Paekche and Silla dynasty of southern Korea were buried with them in the tens of thousands in the fourth to seventh centuries (Francis 1985b:11, 13).

As for Klong Thom, its market may have been the more pedestrian trade of Southeast Asia. These beads are found in enormous numbers through the first millennium A.D. They vastly outnumber all other beads at sites in Sarawak and the Philippines, and had made their way to Gilimanuk, Bali, as early as the first century A.D.

The precise distribution of these beads from given manufacturing centers to particular importing sites will be made clearer when samples from these sites are analyzed. The results of those analyses will be reported in a later installment of this series.

Of these three sites, Mantai lasted the longest, finally being destroyed by the Cholas in the tenth century. There is some historical indication that the city was occupied for several centuries thereafter (Perera 1951:112–113). The archaeological evidence does not reflect that, but the upper layers are quite disturbed. Sooner or later, the beadmakers at Mantai moved back to India. J. Lavanaha, a Portuguese writing in Mozambique in 1593, said that the Europeans had to go to India to fetch Indo-Pacific beads (mistaken, as is often the case, for clay beads) because they were the only ones demanded in East Africa: “they are made in India at Nagapatam [Nagapattinam], whence they are brought to Mozambique” (Theal 1898:303). Carswell suggested that Mantai refugees may have gone to Nagapattinam in the tenth century (1983:85); there is no question that it was an important port then and later. However, a ten man-hour surface survey conducted under my direction in 1988 over the old city of Nagapattinam failed to find a single piece of evidence for glassmaking, much less glass beadmaking. There was probably an industry nearby, which later moved again to its present location at Papanaidupet.

Klong Thom and Oc-Eo were both abandoned in the late sixth or early seventh centuries. Oc-Eo was overrun by the Khmers; we do not know what happened to Klong Thom. It is possible that Indo-Pacific beads continued to be made in the Khmer kingdom, but there is no information on that score at present. It is also at this time that Mantai began making stone beads, which it had not done before. Stone beadmaking was very important at Arikamedu, Klong Thom, and Oc-Eo, and it is tempting to think that Mantai accepted some lapidaries from Klong Thom and/or Oc-Eo.

At about the same time, two new sites in Malaya become identifiable as Indo-Pacific beadmakers. They are Sating Pra, on the eastern side of the peninsula in southern Thailand and Kuala Selinsing, about a third of the way down the western coast of Malaysia.

Sating Pra was a large city in its day, with an estimated population of one hun-

dred ten thousand. It had many connections with Oc-Eo, including the building of canals for inland transportation and even one that is said to have connected the South China Sea with the Andaman Sea (Klong Doang). It was an important trading link in the Srivijaya system (Stargardt 1973:12-14; Bentley 1986:281). The Chinese annals speak of Ch'ih-t'u, originally a vassal of Funan, and the major Chinese trading partner in Southeast Asia after the demise of Funan (Wang 1958:68); perhaps it can be identified with Sating Pra.

Kuala Selinsing in Perak is an island in the Selinsing River estuary and not very suitable as a port. Its products, including tin gathered from the interior and beads made on the site, were shipped up to Kedah for export. Kedah, the valleys of the Merbok and Muda rivers, with its excellent port facilities and Kedah Peak (Gunang Jerai), visible 30 miles (about 50 km) out to sea, was developing as the most important trading region of Malaya. Braddell (1980) stresses the associations between Takkola-Trang (Klong Thom) and Kedah, and it seems that Klong Thom beadmakers moved to Kuala Selinsing, although why they did not go directly to Kedah is not clear. Kuala Selinsing was excavated in the 1920s and 1930s by Evans and is currently being excavated by Nik Hassan Shuhaimi and Latib Ariffin.

In the tenth century another major change occurred. Mantai was overrun by the Cholas, and beadmakers moved back to southern India, to "Site X," apparently somewhere near Nagapattinam. There may be more than one Site X, but histories, gazetteers, and corpora of inscriptions do not yield any hints of the location of the industry. Eventually it moved to the modern village of Papanaidupet. It is not known when this happened, but a worker interviewed in 1985, who claimed to be 80, said his father and grandfather had done the same work, putting beadmaking there back to the middle of the nineteenth century.

The Cholas also invaded Southeast Asia in the early eleventh century and might have put an end to the occupation of Kuala Selinsing. The site may also have been abandoned for ecological reasons. Where there had been 1 island there are now 11, and this dissection may have forced abandonment. The beadmakers moved up to their distribution area, to Kedah, to settle at Sungai Mas. It was here, and not at the port of Pengkalan Bujang, across the River Merbok, that beadmaking was carried out.

This leaves Sating Pra and what was apparently its successor, Takua Pa, although the connections between these two sites are not clear. Takua Pa (the site is actually on Kho Khao Island) was briefly excavated by Lamb (1961), and is currently being excavated by Bennet Bronson and the Archaeology Division/Department of Fine Arts, Thailand.

The western (Indian) branch of the industry continued and, indeed, continues to this day. The eastern (Southeast Asian) branch, however, was gone by about A.D. 1200. Takua Pa and Sungai Mas are the last known beadmaking sites. Indo-Pacific beads disappear at importing sites in Sarawak and the Philippines at this time, to be replaced principally by Chinese beads. At the moment it is not possible to say why this happened. The Chinese certainly moved in with alacrity to fill the vacuum left by the demise of Indo-Pacific beadmakers, but whether they caused the demise through competition remains to be learned. Some other internal or external force(s) may have been responsible.

There may well have been other Indo-Pacific beadmaking sites. Nan Yong and U Thong in central Thailand and Demak (Java) and Muara Jambi (Sumatra) in Indone-

sia are possible candidates. As we have observed, the Khmers may have continued the industry after defeating Funan. "Site X" in India must have existed; we just have not found it yet. Karaikadu, not far from Arikamedu and contemporary with it, may have made Indo-Pacific beads, perhaps after Arikamedu exhausted the local wood supply (Ghose 1966:21; K. Raman, pers. comm.). Brahmapuri (Kolhapur), India, is said to have been a major beadmaker, but the report (Sankalia and Dikshit 1952:87-115) is so unclear and the collection now so mixed up (Kolhapur Museum, pers. obs.) that no more can be said about it at present. All of these sites need more investigation.

## THE INDO-PACIFIC PROCESS AND THE IDENTIFICATION OF THE INDUSTRY

The evidence that confirms a particular site as an Indo-Pacific beadmaker is the waste glass found there. A large number of beads does not mean that they were locally made, as is sometimes asserted. Nor does the presence of chunks of glass (often erroneously called "slag," but actually ingots or cakes) or bits of melted glass. Nor does the presence of knots (tubes with refractory matter caught in them that clogs them), as has recently been asserted (Stern 1987). Rather, confirmation of the process must rely on a complex of glass wasters and the absence of other explanations for their presence (Pl. I).

The lone survivor of the once widespread Indo-Pacific industry is Papanaidupet, Chittor District, southern Andhra Pradesh, India, a village of about fifteen thousand people, whose major industries are farming and beadmaking. Until quite recently, Papanaidupet furnished all small drawn beads for the Indian market (Francis 1982a:16-18).

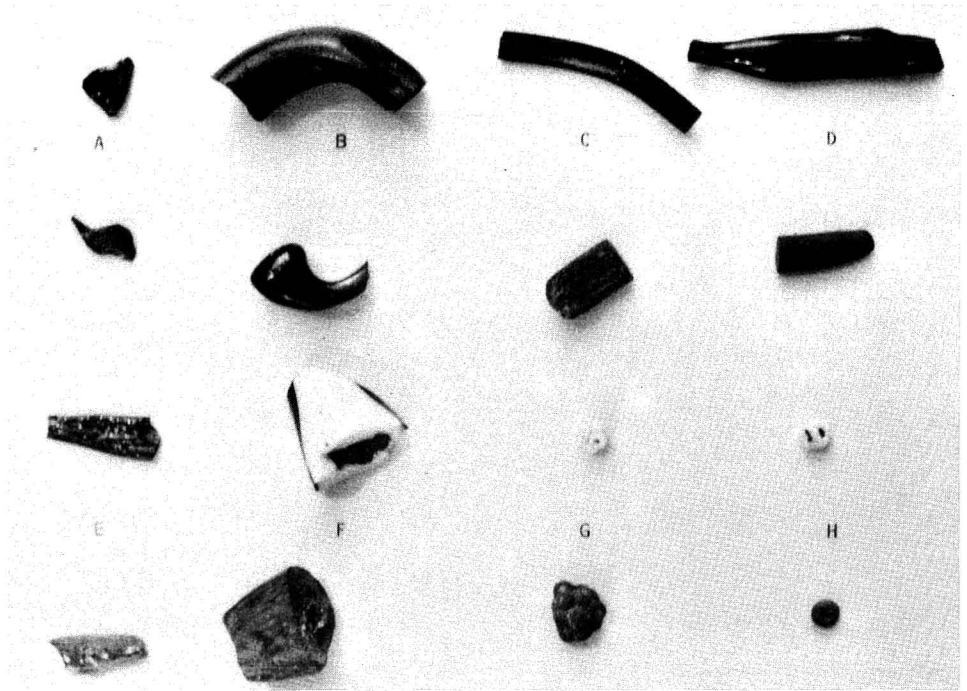
Drawn beadmaking may be divided into three stages: glassmaking, tube making, and the making of beads from the tubes. Each of these stages will produce waste, which is so specific for each operation that workers can identify the step at which wasters were made—identifications that I have confirmed by observation. Neither the glassmaking nor the making of beads from tubes is specific to Papanaidupet or the Indo-Pacific industry. It is the making of tubes that is unique and requires a unique set-up and a cadre of at least a dozen trained workers. To describe the wasters made by the industry, we shall move through the process step by step.

### *Glassmaking*

Today at Papanaidupet much of the glass is bought from large factories in Firozabad, the "glass capital of India." What glass is made locally is manufactured in a relatively sophisticated way, and the ingredients are purchased commercially. Hence, the glass of modern Papanaidupet beads is of better quality and more uniformity than the usual Indo-Pacific beads.

Traditionally, glass in India was made by taking sand and what is called in the south *sondu* and in the north *reh*, both of which are soil efflorescences. The glass made from this process is called in the north *deshi kanch* or "country glass." At what was probably the last furnace to make this glass in Purdalpur, Uttar Pradesh, the *reh* was placed in a low domed closed furnace (without any sand) and fired for a couple of weeks. The bubbly semitranslucent glass that resulted was then crushed, had





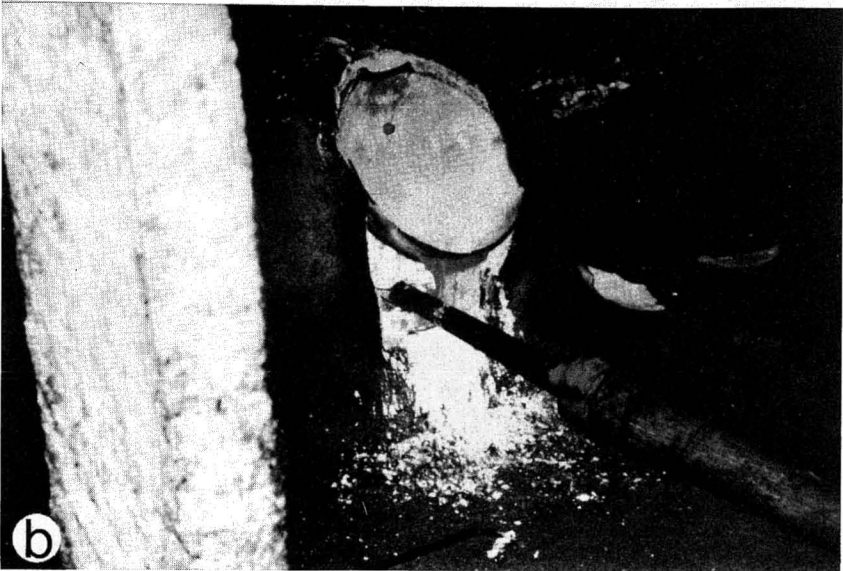
Pl. I. Glass wasters indicative of Indo-Pacific beadmaking. The piece above each letter is from the modern village of Papanaidupet; those below each letter are from Arikamedu. *A*, *gedda paru* flakes, which come off the large tools to stir the glass; *B*, horns; *C*, bangle-like pieces; and *D*, amorphous pulled pieces are all made at the beginning of the drawing of the tubes. *E*, collapsed tubes, formed at the end of the draw; *F*, knots made by refractory material caught in the tubes; *G*, clumps of beads that stuck together while being stirred over heat to round them off; *H*, clogged beads with tiny knots and the resulting concentric perforations.

colorants added to it, and was remelted to refine it and make it into beads and bangles (Francis 1982a:5-6, pl. 3).

Identification of glassmaking can be made from the ruins of a furnace (not yet discovered at any of our sites) and three products. One is commonly called *glass slag*, although glassmakers refer to it as *gall*. It is light in color and weight and heavy in alkalis, and is the residue of materials that do not melt into the glass. This floats to the top of the batch and is skimmed off. Another is "bottle-green" glass, the first glass made in the absence of any colorizers, deriving its color from the universal impurity of iron. Chunks or cakes of this glass, especially when no objects are made of it, suggest glassmaking or at least coloring. Finally, chunks of remelted beads, tubes, and sherds often point to glassmaking, as such remelted pieces were used as *cullet*, waste glass that aids in the production of new glass.

### *Glassworking*

Colored chunks or pieces of ingots or cakes of glass suggest that some use was being made of them, especially if they are found in any quantity. Small melted pieces of glass, shaped like drops, reniform shapes, small circular shapes, and the like, are

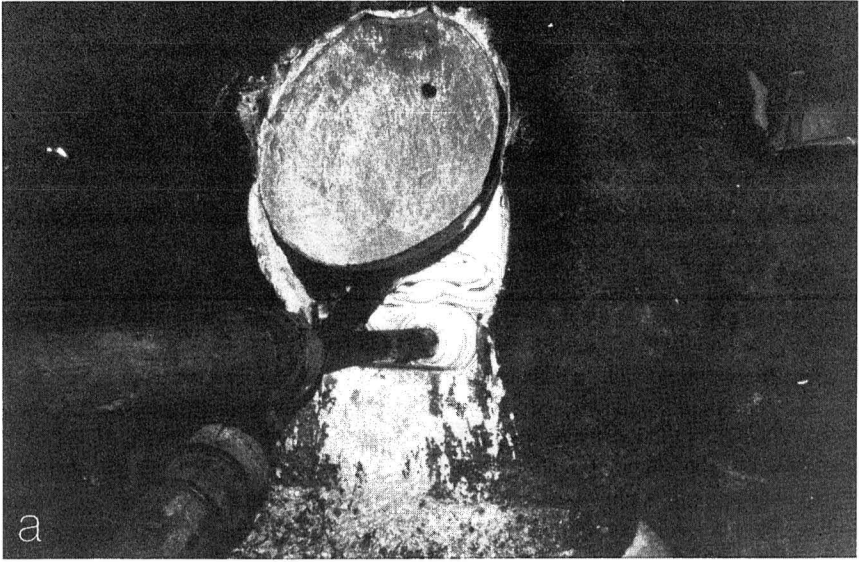


Pl. II. *a.* *Gedda paru* tools, the Tamil name for the stick used to stir mud for building a house. *b.* Glass chunks, having been heated on the trough (Pl. III *b*) are picked up on a *gedda paru* for further melting in the furnace.

grouped under the term *drips and splatters*. These indicate glassworking where there is no indication of a conflagration, which can melt glass objects into such forms.

### *Tube Drawing*

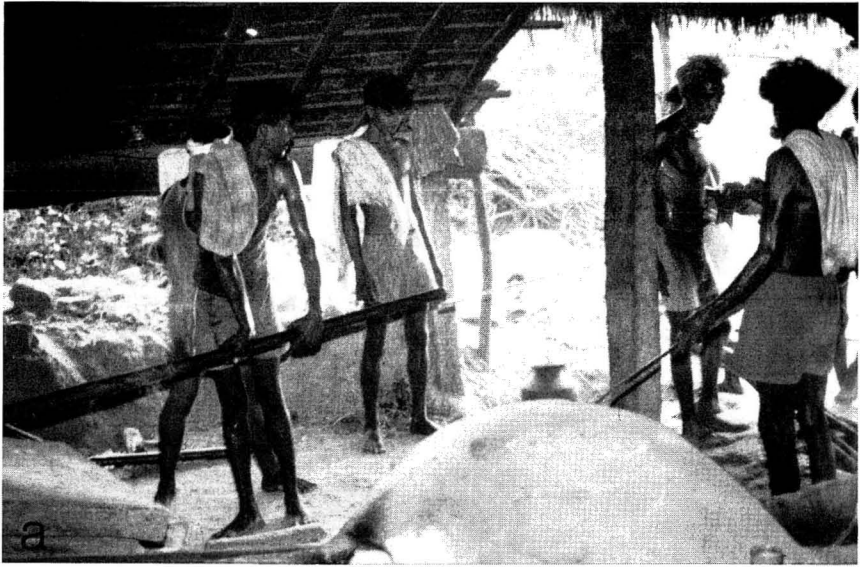
The method for making tubes at Papanaidupet is at the heart of the Indo-Pacific process. Some 50 kg (110 lb) of glass cake is broken up and placed on a trough



Pl. III. *a*. Glass on the *gedda paru* melting in the furnace. *b*. Once the glass is melted it is put on the *lada* and shaped into a cone. The trough for initial melting is visible in the foreground.

adjacent to the furnace (seen on Pl. III *b*). The furnace is fired up, and the crew goes to sleep, to be awakened at about 12:30 or 1:00 A.M. by the one worker who keeps the fire going.

The glass is picked up on two metal-sheathed poles called *gedda paru*, the Tamil name for the stick used to stir mud for housebuilding (Pl. II *a-b*). It is kneaded in the furnace until completely melted (Pl. III *a*), and then put onto a long iron tube, called a *lada*. On the *lada* it continues to be heated and is then taken out of the furnace to be



Pl. IV. *a*. The long iron *cheatleak* is being inserted into the *lada* so that it can be forced against the base of the glass cone in order to pierce it. *b*. The master drawing out a continuous glass tube, which he breaks with each backstroke into 1m lengths.

run atop a low wall to form the glass into a cone (Pl. III *b*). Then a longer iron rod, the *cheatleak*, is put into the *lada* and thrust at the base of the cone until it breaks through, perforating the cone from base to apex (Pl. IV *a*).

The whole is placed back into the furnace, and on the opposite side a master takes a metal hook and grabs at the tip of the cone. After a few attempts he has a tube, walks back about 5m, drops the hook, and pulls the tube out hand over hand,

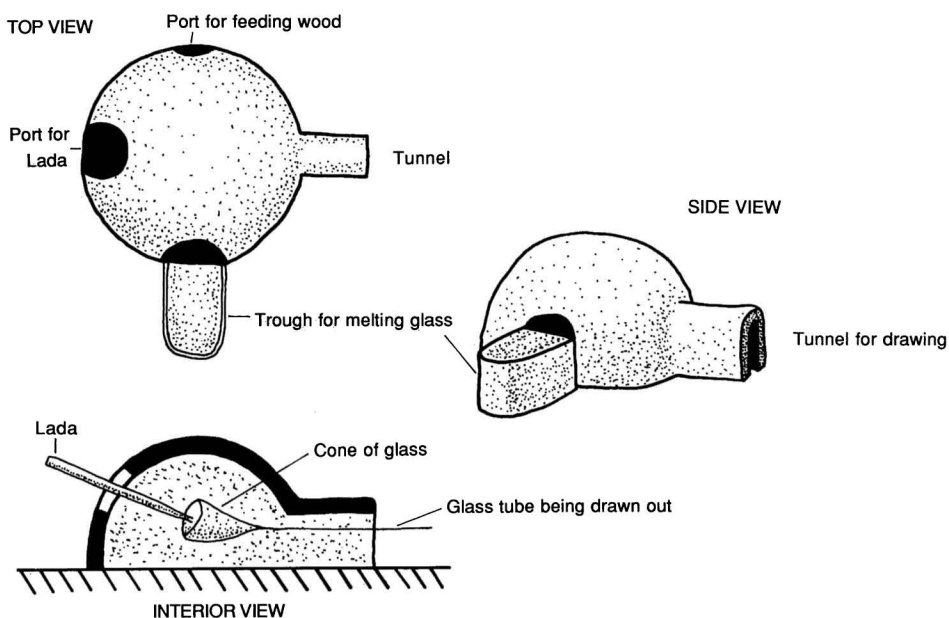


Fig. 2. Schematic drawing of the unique furnace used to draw tubes for Indo-Pacific beads.

breaking it into 1m lengths (Pl. IV *b*). The drawing (two masters relieve each other) takes about three hours.

The furnace is uniquely constructed, with a high port for the *lada*, a low one for fuel, a trough on one side, and a small igloo-like tunnel on the fourth side. Excavators should be alerted to the possible discovery of such a furnace (Fig. 2).

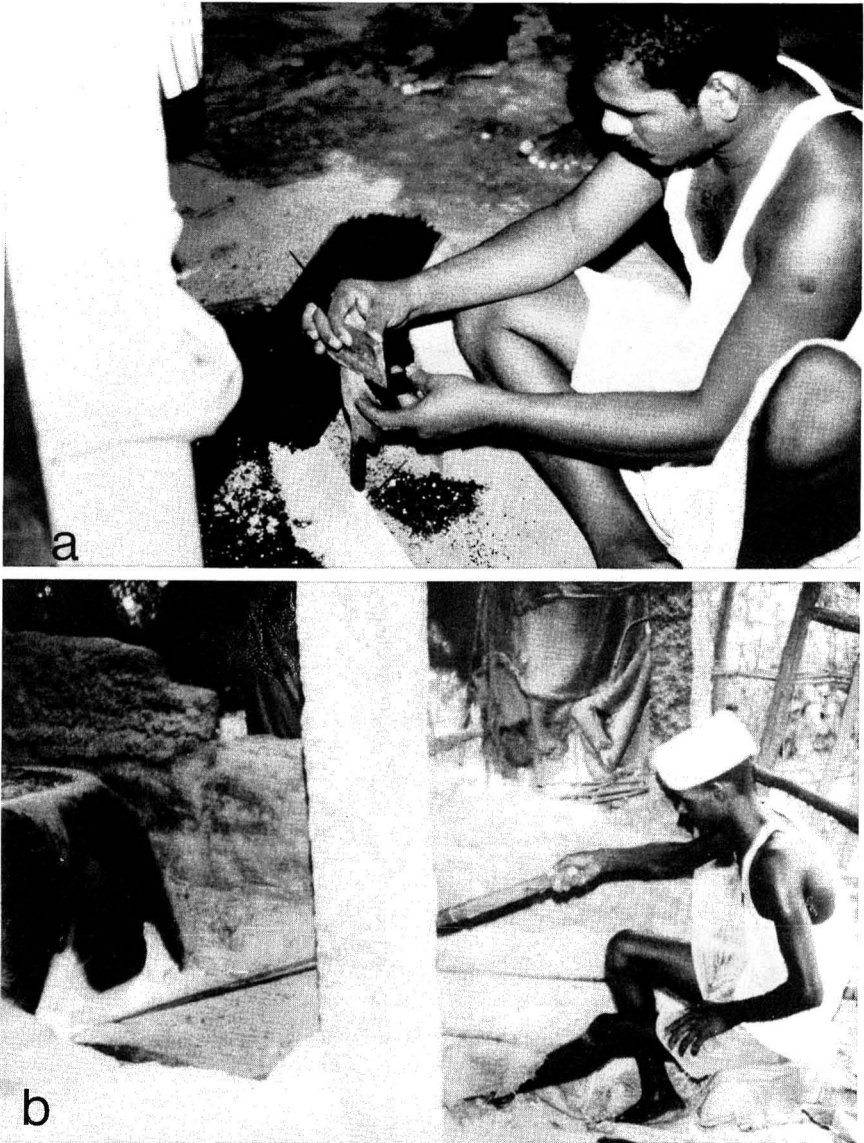
The metal tools are not likely to be uncovered, but thin, slightly curved glass flakes, often with a "tail," form on the *gedda paru* during the process (Pl. I, *A*). "Gedda paru flakes" indicate working glass with these tools.

The wasters likely to be found in the largest numbers are those produced by the master as he attempts to draw out the tube. This usually takes several tries, and it produces waste in the shape of horns, twisted tubes, bangle-like pieces, and amorphous unperforated pieces. They are all imperfect tubes and often twisted (Pl. I, *B-D*).

At the end of the drawing process as the last bit of glass comes off the *lada*, the tube expands to produce a flare. The very end of the glass comes off the *lada* as a thin, wide tube, falls to the ground, and collapses of its own weight, making a distinctive waster (Pl. I, *E*).

### *Cutting the Tubes*

A worker takes about a dozen tubes in his hand, lays them on a blade driven into the ground, and with another blade slices pieces off them (Pl. *Va*). The segments scatter everywhere. It is not unusual for a few to be missed when they are gathered to be reheated, leaving sharp-edged unheated segments. Short (usually under 2 cm long) tubes with sharp ends were not beads, but the ends of tubes, which the cutter



Pl. V. *a.* Cutting the tubes into short, sharp-edged sections. *b.* The sharp segments are packed in ash and stirred over heat for about a half an hour to round them off.

dared not hold any closer to the blades. This is often the step at which knots, tubes clogged with refractory material (Pl. I, *F*), are recognized, cut out, and discarded.

#### *Reheating the Cut Segments*

The cut segments are packed in ash and stirred on a flat ceramic tray in a small kiln (Pl. V*b*). This operation is done by a husband and wife team. He does the



Pl. VI. The finished beads are strung by women and girls in Papanaidupet and surrounding villages.

stirring, and she packs the beads in ash to prevent them from sticking together or collapsing, and knocks them out of the ash later. The heating lasts about a half-hour, and it smooths off the sharp cut ends. Sometimes beads stick together in this operation, forming small clumps (Pl. I, G). Beads melted to the tray may also be found on sherds of the heating pan.

### *Stringing the Beads*

Stringing is not necessary to the operation, but it has several advantages. Beads are easier to handle and sell when they are strung, and stringing ensures that the beads can be used. This adds value to the shipment, and this value can be plowed back into the beadmakers' economy. At Papanaidupet some two hundred fifty men actually make beads, but five thousand women and girls string them part time. The operation is done by putting the loose beads in a flat winnowing basket and passing a dozen or more long thin needles through the mass of beads. One or more beads will be caught on each needle per pass (Pl. VI).

Stringers will discard beads that cannot be strung: those broken before reheating, those that collapsed upon heating, those with small knots (typically making a crescentic hole; Pl. I, H), bead clumps, and beads too tiny to string. There is no data for the discard rate at Papanaidupet, but in Venice before the invention of the *tamboro*, a machine to check holes in small beads, in the 1890s, about 20 percent were discarded (Carroll 1917:11–12).

Beads may also be sold in bulk (they are sometimes called “pound beads” in English for this reason). When this happens, beads unsuitable for stringing are not discarded until the customer discovers them. Along with beads, such shipments

might include (accidentally or purposely adulterated) drips and splatters, cut segments with knots, and so forth. The finding of such material indicates stringing, but not necessarily beadmaking. An example of this is Laem Pho, Thailand, a site contemporary with Takua Pa and the eastern terminal of the trans-peninsular route that begins there. Takua Pa was an Indo-Pacific beadmaker; there is no such evidence at Laem Pho. However, there are many discarded beads at Laem Pho, indicating that some or perhaps a great deal of the stringing of Takua Pa's beads was done there.

A summary of the evidence of the wasters from the Indo-Pacific process found at various sites is given in Table 1. It will be noted that the evidence is most detailed for those sites that have been most closely examined, such as Arikamedu and Mantai. The information for this table comes primarily from personal investigation of the assemblages, supplemented with excavation reports and discussion with the excavators (especially for Sating Pra). It will also be noted that Muara Jambi has rather little evidence beyond bead stringing, but the excavation was in the courtyard of a temple, hardly an industrial zone.

### THE BEADMAKERS AND THEIR INDUSTRY

Who were the Indo-Pacific beadmakers? As a working hypothesis it is suggested that they were ethnically Tamil Indians. This is obvious in the case of Arikamedu and Mantai. All of the other sites are known to have had strong Tamil presences. The one exception may be Kuala Selinsing, where the present excavators (N. H. Shuhaimi and L. B. Ariffin, pers. comm.) do not see Tamil influence at the site, though Evans (1932:85) did see connections with South India. We have to ask how much evidence of ethnic affiliation industrial workers would leave in any case.

The method by which Indo-Pacific beads are made is complex. It requires a specialized knowledge, a unique furnace and tools, and a dozen trained workers. The *lada* process is nontransferable in the sense that it would be extremely difficult for someone to observe it and then take the idea home and replicate it. Glassmakers and beadmakers traditionally hand down their craft from father to son. Assuming that the beadmakers in Mantai, Klong Thom, and Oc-Eo were Tamils from Arikamedu, there would have had to have been a good reason for a relatively small expatriate community to divulge the secrets of its livelihood to outsiders.

We might think of some situations where this could have happened. If the beadmakers became too wealthy to want to do such hard work, they might have trained local, non-Tamil workers. Perhaps more likely would be a situation where the Tamil community grew too small to continue the work and had to hire others. But aside from such scenarios, it is difficult to think of a case where the beadmakers would let others in on their processes.

What was the status of the beadmakers? The status of the industry must have been high. In the early centuries Indo-Pacific beads were fit for kings and queens, and even if they lost that high estimation later, they were still a valuable product. They are virtually the only imported beads, and one of the few imported items, to be found in the hinterland regions of Borneo and the Philippines for a thousand years. They were not traded into these areas to make friends, but in exchange for valuable raw materials. It is inconceivable that they would *not* have been regarded as important industrial commodities by the merchant and ruling classes.

Would this esteem have been passed onto the beadmakers? There is an anomaly



TABLE 1. EVIDENCE FOR INDO-PACIFIC BEADMAKING

MATERIAL	SITE* (date)	ARK (-3/+3)	MAN (1-10)	PAP (19-20)	O-E (2-7)	KT (2-6)	SP (7-10)	KKK (9-10)	KS (6-10)	SM (9-10)	MJ (13?)
Glassmaking											
Slag		×		×			×		×		
Bottle-green chunks		×	×	×	×	×		×	×		
Remelted pieces			×	×		×		×	×		×
Glassworking											
Colored glass chunks		×	×	×	×	×	×		×	×	
Drips & splatters		×	×	×	×	×					×
<i>Lada</i> tube drawing											
<i>Gedda paru</i> flakes		×		×							
Twisted, etc. tubes		×	×	×	×	×			×		
Flares		×	×	×							
Collapsed tubes		×		×							
Beads from tubes											
Knots in tubes		×	×	×				×	×		
Cut segments		×	×	×	×	×	×	×	×	×	
Tube ends		×	×	×	×	×	×			×	
Bead clumps		×	×	×	×	×		×	×	×	×
Beads on clay tray		×				×					
Discarded Beads		×	×	×	×			×	×	×	×

\* Abbreviations: ARK = Arikamedu, India; MAN = Mantai, Sri Lanka; PAP = Papanaidupet, India; O-E = Oc-Eo, Viet Nam; KT = Klong Thom, Thailand; SP = Sating Pra, Thailand; KKK = Takua Pa (Koh Kho Khao, Kho Khao Island), Thailand; KS = Kuala Selinsing, Malaysia; SM = Sungai Mas, Malaysia; MJ = Muara Jambi, Indonesia.

Note: All dates given in centuries A.D. except ARK (= 3rd C. B.C. to A.D. 3rd C.).

involving the Indo-Pacific beadmaking sites. In each case (save Kuala Selinsing) the beadmakers lived and worked in leading urban areas. Left to themselves glassmakers usually choose a locale with good raw materials (sand and wood for fuel and ash) and adequate communications to import a few things they need (cobalt, manganese, and so forth) and export their products. Glassmakers are often asked to move their furnaces away from cities built largely of wood. Sometimes they do not move far away (Murano near Venice, Gorece near Ismir), but they often prefer a more rural setting.

Yet the Indo-Pacific beadmakers lived in the cities. It seems unlikely that the city sites were chosen *because* they were ideal for glassmaking. It also seems unlikely that the glassmakers chose to stay in the cities *only because* of the convenience of markets, to the detriment of other considerations. But if the Indian beadmakers had any of the status given to other things Indian in Southeast Asia, they (or at least some of them) may have been among the richest and most powerful citizens and could have had some input in the choice of a new site. It may be even more likely that the sites were chosen for other considerations, such as their harbors, and that the beadmakers were then invited, cajoled, or forced to set up shop in the new city-state. They were making a profitable product, and from the looks of it, much profit was made.

One theme that strikes us again and again is that the earliest urbanized settlements in the area were all somehow linked with each other. Mantai, Klong Thom, and Oc-Eo—the first cities of Ceylon, the Malay peninsula, and Indo-China—all share characteristics with Arikamedu, the first city of Tamil India. They were all Indo-Pacific beadmakers, all made stone beads, all imported some Roman beads, all were likely Roman emporia, and all imported at least of some of each other's beads. Klong Thom and Oc-Eo passed on their skills to several other sites, and perhaps stone beadmaking to Mantai.

Others have noticed the strong relationship between some of these sites, which is visible not only in beads but in other artifacts as well. This prompted Cady (1964:51–61) to write of a “Funan Empire” and “vassal cities.” But the empire did not stretch as far as Sri Lanka, and it was Arikamedu that was the “mother city.” Rather than an empire, are we seeing some other form of polity? Perhaps more of a federation based on trade opportunities, something like the Hanseatic League? Dare we nickname it the “Arikamedu League”?

We can even go one step further. At the break-up of this “league” we have the formation of an “empire,” Srivijaya. Although Srivijaya is traditionally supposed to have been centered in Sumatra, much modern scholarship has begun to question its imperial character and even the location of its capital (SPAFA 1985). Malaysia has been cited as the true heart of Srivijaya. Could the impetus for Srivijaya have come, in fact, from Malaysia, a somewhat stronger version of the “Arikamedu League”? These questions cannot be answered at present, but as they have never been proposed in just this way before, they open fields of possible investigation.

## DISTINGUISHING INDO-PACIFIC BEADMAKERS

Is there any way of identifying Indo-Pacific bead assemblages as regards their origin at a given beadmaking site? Full glass analyses should go far in this respect, allowing us to “fingerprint” glass compositions from the beadmakers and compare them with beads found at importing sites. Some 160 bead samples from Southeast

TABLE 2. DEGREE OF ROUNDEDNESS (*R*) IN INDO-PACIFIC BEADS

	SAMPLE SIZE	<i>R</i> 1 (%)	<i>R</i> 2 (%)	<i>R</i> 3 (%)
Takua Pa	49	59.2	34.7	6.1
Mantai	82	18.3	54.9	26.8
Sungai Mas	27	18.5	51.9	29.6

Asian sites, mostly Indo-Pacific beads, are on hand to be analyzed, and funds are being sought for this work. But for the benefit of most researchers who do not have access to the complexities of glass analyses, we might ask if there are gross characteristics of the beads that can help identify those from particular sites. At least two characteristics are relevant.

One of these is color. Certain sites made beads of some colors and not of others. Arikamedu did not make orange beads, but most of the succeeding sites did; Arikamedu did make violet beads, but they are rare elsewhere. Kuala Selinsing made very few black beads. Unfortunately, this is negative evidence. If an importing site has beads of some color we can rule out certain suppliers, but if a site does not have these colors it may be due to selection on the part of the trader or buyer.

A second characteristic that helps identify the beads of one site, is roundedness. When the segments of cut tubes are reheated to smooth them off, the longer they are heated the more rounded they become. While it is difficult to quantify this, a scale of 0 to 3 can indicate the relative degree of roundedness (*R*). An *R* 0 bead was not reheated; retains sharp, shiny ends; and is probably a cut segment, not a finished bead. An *R* 1 bead was heated only enough to have the glass flow at the end and remove the sharp edge, but its profile is still angular. An *R* 2 bead has a beveled profile, and an *R* 3 bead is quite rounded. Noting the dimensions of the bead, the *R* factor, and whether the bead was cut from the tube at an angle is enough to reconstruct the shape of the bead, so the difficulty of describing such tiny shapes can be left aside.

At most Indo-Pacific beadmaking sites, beads are commonly *R* 2 and *R* 3. At Takua Pa, however, most were only barely reheated. As an example, we may compare beads from Trench F, levels 2–4 at Takua Pa from the 1989 excavation with contemporary beads from Trench H, levels 1–7 at Mantai and surface finds from Sungai Mas (Table 2).

Although the samples are admittedly small, they are representative. *R* 1 beads are found at Takua Pa much more often than at any other Indo-Pacific beadmaking site. Confirming this is the observation of many *R* 1 beads at Laem Pho Chiaya, across the peninsula from Takua Pa and its partner in the transisthmus trade.

## SUMMARY AND CONCLUSIONS

The story of Indo-Pacific beads can serve as a paradigm for the story of beads everywhere. Small, individually nondescript, and easily overlooked, they have not commanded the attention they deserve. The only factor that cries out for their study is their ubiquity.

Whether they be found in the Painted Caves of Niah in Sarawak; an eleventh-

century shipwreck off High Island in Hong Kong; slab graves in Perak, Malaysia; megalithic tombs in southern India; the ruins of Siraf, Iran, or those of Great Zimbabwe, they are there. There is even evidence that they inspired the early glass beadmakers of Venice, Italy, to make imitations to sell around the Indian Ocean, which for independent reasons caught the fancy of Native Americans (Francis 1982*b*).

It is clearly impossible to seek *the* source of these beads. We have identified nine sites that must have made them and another half-dozen that are good candidates; there may be more. They are Indian at heart, as the industry began in India and has its last remnant there, but their story is much broader than that, being largely played out in Southeast Asia. Along with beads made as subsidiaries or by-products to the Indo-Pacific beads, which will be discussed in the next part of this series, Indo-Pacific beads were *the* trade bead of the ancient world, and as such are deserving of much more attention than they have received.

The work that has been done thus far on these beads is by no means the last word on them. There is much more to be learned. This report is offered in the hopes that interest will be sparked in the role that the humble bead has played in past human affairs and that it will suggest avenues of further research.

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#### REFERENCES

- AVIGAD, N.  
1972 Excavations in the Jewish Quarter of the Old City of Jerusalem, 1971. *Israel Exploration Journal* 22(4):193–200.
- BEGLEY, VIMALA  
1983 Arikamedu reconsidered. *American Journal of Archaeology* 87(4):460–481.
- BENTLEY, G. CARTER  
1986 Indigenous states of Southeast Asia. *Annual Review of Anthropology* 15:275–305.

- BRADDELL, ROLLAND  
 1949 Notes on ancient times in Malaya 4. Takola and Kataka. *JMBRAS* 22(1):1-16.  
 1980 Most ancient Kedah, in *Lembah Bujang: The Bujang Valley*: 32-54, ed. I. Chandran and J. Baharuddin. Kuala Lumpur: Persatuan Sejarah Malaysia.
- CADY, JOHN  
 1964 *Southeast Asia: Its Historical Development*. New York: McGraw-Hill.
- CARROLL, B. HARVEY, JR.  
 1917 Beadmaking at Murano and Venice. General Records of the Department of State (RG 59). State Decimal File 1910-1929, File No. 165.184/3. On file, Department of State, Washington.
- CARSWELL, JOHN  
 1983 Medieval trading post in the Indian Ocean. *Illustrated London News* (October): 84-85.
- CASAL, JEAN-MARIE  
 1949 *Fouilles de Virampatnam-Arikamedu*. Paris: Imprimerie Nationale.
- CHAKRAVARTI, ADHIR K.  
 1972 Early Sino-Indian maritime trade and Fu-Nan, in *Early Indian Trade and Industry*: 101-117, ed. D.C. Sircar. Calcutta: University of Calcutta.
- CHARLESWORTH, M. P.  
 1924 *Trade-Routes and Commerce of the Roman Empire*. Cambridge: Cambridge University Press.
- CHAROENWONGSA, PISIT  
 1985 A confusing picture of Srivijaya history, in *SPAFA Consultative Workshop on Archaeological and Environmental Studies on Srivijaya*: 105-112. SPAFA/WS15/85. Bangkok: SPAFA.
- DAVISON, CLAIRE C.  
 1972 Glass beads in African archaeology. Ph.D. diss., University of California, Lawrence Berkeley Laboratory. U.S.A.E.C. Report No. 1240, Berkeley.
- DEWING, H. B.  
 1929 *Procopius of Caesarea, Vol. 1: History of the Wars, Books I and II*. Loeb Classical Library. 7 vols. Cambridge: Harvard University Press; London: William Heinemann Ltd.
- EVANS, I.H.N.  
 1928 On ancient remains from Kuala Selinsing, Perak. *Journal of the Federated Malaya States Museums* 12(5):121-131 + 7 plates.  
 1932 Excavations at Tanjong Rawa, Kuala Selinsing, Perak. *Journal of the Federated Malaya States Museums* 15(3):79-133 + plates, map.
- FRANCIS, PETER, JR.  
 1982a *The Glass Beads of India*. World of Beads Monograph Series 7. Lake Placid: Lapis Route Books.  
 1982b Bead report VII: When India was beadmaker to the world. *Ornament* 6(2):33-34, 56-57.  
 1985a Bead report XVI, the Asian bead study tour II, Thailand: Revolution and ruin, tradition and change. *Ornament* 9(2):43-48.  
 1985b *A Survey of Beads in Korea*. Occasional Papers of the Center for Bead Research 1. Lake Placid: Center for Bead Research.  
 1987 *Bead Emporium: A Guide to the Beads from Arikamedu in the Pondicherry Museum*. Museum Publication 2. Pondicherry: Pondicherry Museum.  
 1989 Preliminary report on the beads from Siraf, Iran in the Department of Oriental Antiquities, British Museum. Contributions of the Center for Bead Research 3. Lake Placid: Center for Bead Research.  
 n.d.a The Arikamedu bead census. Lake Placid: Center for Bead Research/Pondicherry Museum. In preparation.  
 n.d.b The beads from Mantai, in *Mantai Excavation Report*, ed. John Carswell. In preparation.  
 n.d.c Western geographic knowledge of Sri Lanka and Mantai, ca. 325 B.C. to A.D. 1170, in *Mantai Excavation Report*, ed. John Carswell. In preparation.
- GERINI, G. E.  
 1909 *Researches on Ptolemy's Geography of Eastern Asia (Further India and Indo-Malay Archipelago)*. 1974 rpt. New Delhi: Oriental Books Reprint Corporation.
- GHOSE, A., ed.  
 1966 *Indian Archaeology—A Review (1965/66)*: 21.
- GILES, H. A.  
 1923 *The Travels of Fa-hsien (399-414 A.D.), or Record of the Buddhist Kingdoms*. Cambridge: Cambridge University Press.

## HUVELIN, P.

- 1904 Mercator, Greek, in *Dictionnaire des Antiquités Grecques et Romaines, Tome Troisième, Deuxième Partie L–M: 1731–1736*, ed. Ch. Daremberg and Edm. Saglio. 1969 rpt. Graz: Akademische Druck u Verlagsanstalt.

## JIVANANTHAPRAWAT, BOONMEE

- 1987 'Bead Hill'—Ancient wealth of Krabi. *Bangkok Post* (14 July): Sect. 3, p. 1.

## LAMB, ALASTAIR

- 1961 Some glass beads from Kakao Island, Takuapa, South Thailand. *FMJ* n.s. 4: 48–55.  
 1965a Some observations on stone and glass beads in early southeast Asia. *JMBRAS* 38(2):87–104.  
 1965b Some glass beads from the Malay Peninsula. *M* 65: Art. 30.

## MCCRINDLE, J. W.

- 1897 *The Christian Topography of Cosmas, an Egyptian Monk*. Hakluyt Society Series 1, Vol. XCVII. London: Hakluyt Society.

## MALLERET, LOUIS

- 1959 Les lapidaires et artisans du verre de Virampatnam. *Arts Asiatiques* 6(2):93–106.  
 1962 *L'Archéologie du Delta du Mékong, Volume 3, La Culture du Fou-Nan*. Paris: École Française d'Extrême-Orient.

## PATTIBIRAMIN, P. Z.

- 1946 *Les fouilles d'Arikamedu (Podouke)*. Pondichéry: Bibliothèque Coloniale; Paris: Presses Universitaires de France.

## PECK, HARRY THURSTON, ed.

- 1962 *Harper's Dictionary of Classical Literature and Antiquities*. New York: Cooper Square Press.

## PELLIOT, PAUL

- 1903 Le Fou-Nan. *BEFEO* 3(2):248–303.

## PERERA, B. J.

- 1951 The foreign trade and commerce of ancient Ceylon I.—The ports of ancient Ceylon. *The Ceylon Historical Journal* 1(2):109–119.

## RAMASAMY, A.

- 1987 *History of Pondicherry*. New Delhi: Sterling Publishers.

## RUTNIN, SOMSUDA, AND PTHOMRERK KETUDHAT

- n.d. The 1963 test excavation at Khlong Thom: An interim report. Copy on file, Center for Bead Research, Lake Placid.

## SANKALIA, H. D., AND M. G. DIKSHIT

- 1952 *Excavations at Brahmapuri (Kolhapur) 1945–46*. Deccan College Monograph Series 5. Poona: Deccan College.

## VAN DER SLEEN, W. G. N.

- 1956 Trade Wind Beads. *M* 56: Art. 27.  
 1958 Ancient glass beads with special reference to the beads of East and Central Africa and the Indian Ocean. *JRAI* 88(2):203–216 + plate.  
 1966 Correspondence: Trade Wind Beads. *M* n.s. 1:244.

## SPAFA

- 1985 SPAFA Consultative Workshop on Archaeological and Environmental Studies on Srivijaya (I-W2b). Jakarta, Padang, Prapet and Medan, Indonesia, September 16–30, 1985. SPAFA/WS15/85. Bangkok: SPAFA.

## SRISUCHAT, AMARA

- 1987 Archaeology of the Andaman Sea: Old and new data. *Silpakorn Journal* 31(3):15–27. (In Thai.)

## STARGARDT, JANICE

- 1973 Southern Thai waterways: Archaeological evidence on agriculture, shipping and trade in the Srivijayan period. *M* n.s. 8(1):5–29.

## STERN, E. MARIANNE

- 1987 The secret of Papanaidupet. *Glastechnische Berichte* 60:346–351.

## SURLEAU, RAYMOND

- 1943 Rapport sur le fonctionnement du service des travaux publics pendant l'année 1942. Pondichéry: Etablissements Français dans l'Inde, Service des Travaux Publics.  
 1944 Rapport sur le fonctionnement du service des travaux publics pendant l'année 1943. Pondichéry: Etablissements Français dans l'Inde, Service des Travaux Publics.

THEAL, GEORGE MCCALL

1898 *Records of South-Eastern Africa, Vol. II.* Cape Town: Government of the Cape Colony. 1964 rpt, 9 vols. Cape Town: C. Struik.

TOUSSAINT, AUGUSTE, trans. June Guicharnaud

1966 *History of the Indian Ocean.* Chicago: University of Chicago Press.

VEERAPRAJAK, KONGKAEW

1985 Inscriptions from South Thailand, in *SPAFA Consultative Workshop on Archaeological and Environmental Studies on Srivijaya*: 131–143. M SPAFA/WS15/85. Bangkok: SPAFA.

WANG GUNGWU

1958 The Nanhai trade. *JMBRAS* 31(2):1–127.

WHEELER, R. E. M.

1954 *Rome Beyond the Imperial Frontiers.* London: Bell and Sons Ltd.

WHEELER, R. E. M., A. GHOSH, AND KRISHNA DEVI

1946 Arikamedu: An Indo-Roman trading-station on the east coast of India. *Ancient India* 2.