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Shell Industries at Moenjodaro, Pakistan

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Introduction

For many years, archaeologists studying the Indus Civilization have concentrated on the major features of pottery, architecture and the enigmatic Indus script, giving only passing attention to the numerous varieties of „minor" artifacts. Among the most common of these „minor" artifacts are fragments of marine shell ornaments, utensils and manufacturing wasters. The deemphasis of shell artifacts is entirely unjustifiable in view of the fact that, after terra cotta and stone, shell is one of the most durable materials found in the archaeological context. Because of their durability, shell artifacts are among the few objects that have survived to help us reconstruct the ancient trade networks within the Indus valley, as well as between the Indus valley and adjacent regions. Some shell species have isolated or limited distributions along specific coastal regions and by determining the ancient source areas for these species, we can gain a new perspective on the trade networks and the exploitations of marine resources by protohistoric coastal populations.

The Moenjo Daro Shell Industry

Even though the site of Moenjo Daro is located far inland *(Fig. 1)*, a large number of shell artifacts were recovered during the early excavations from 1925 to 1938. These artifacts are spread out in numerous museums and reserve collections throughout both India and Pakistan. In 1980-81 I was able to make a detailed study of most of these collections by the kind permission and encouragement of the Department of Archaeology, Government of Pakistan, the Archaeological Survey of India and the different Museum Institutions. In 1983, I was fortunate to be invited by the IsMEO/RWTH Joint Moenjo Daro Project, to participate in the collection and analysis of shell artifacts in the surface survey of the site. This additional research was supported by a grant from the Smithsonian Institute, Foreign Currency Program.

By combining the data collected from the earlier excavations and the important new data recovered from the recent surface survey, it has been possible to gain a new understanding of the outstanding technological developments of the Harappan shell industry and its socio-economic role at a large urban center such as Moenjo Daro.

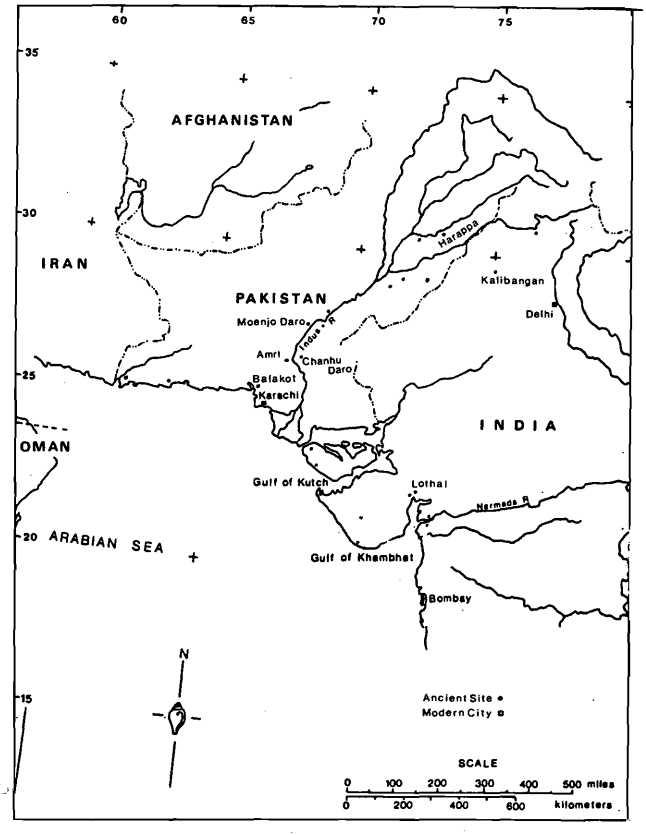


Fig. 1 *Major Sites of the Indus Civilization*

Species of Mollusca Used as Raw Materials

Although many different species of marine and fresh water mollusca have been recovered from Moenjo Daro, the shells of only a few of these were actually used as a raw material for the manufacture of ornaments and utensils such as bangles, inlays, ladles, figurines, etc. (Natural shells that have simply been perforated for use as ornaments are not included in this present discussion.) All of the species used as raw materials are still found in the Arabian Sea and come from different areas of what used to be the coastal regions of the Indus Civilization, extending from Sutkagen-dor on the Makran coast, to Lothal on the Gulf of Khambhat (Cambay). Each species is adapted to a specific habitat area in the coastal environment. A brief review of their basic physical characteristics, habitat and distribution is important for better interpreting their archaeological occurrences and understanding how the protohistoric coastal populations exploited their marine resources.

Major Gastropods Used in the Shell Industry at Moenjo Daro
Turbinella pyrum (Linnaeus)
Chicoreus ramosus (Linnaeus)
Lambis truncata sebae (Röding)
Fasciolaria trapezium (Linnaeus)

Turbinella pyrum was the species most commonly used as a raw material at Moenjo Daro. In its natural form, the shell is ovate with a well balanced spire and a smooth globose body whorl that has no external protruberances *(Fig. 2)*. Underneath the protective exterior covering or periostracum the white shell is extremely hard and sturdy. Its structure is quite massive, with thick walls spiraling around a solid columella, joined together by thick, reinforced sutures. This columella can be distinguished from that of other large gastropods by the presence of 3 or 4 prominent ridges, to which the major muscles are attached. Average adult specimens can reach 150 to 200 mm in length and 100 to 150 mm in breadth. Because of its ovate shape and well joined sutures, this shell provides a unique structure that is suitable for the manufacture of several circular bangles from a single shell.

Being a gregarious species, it tends to form colonies on sandy bottoms or in sandy areas between coral reefs or rocky areas. Occasionally specimens are washed up on the reefs, but they generally live in the shallow littoral zone, to depths of 20 meters *(Mahadevan, Nagappan Nayar, 1974: 118-119)*.

Turbinella pyrum has a fairly restricted distribution, occuring only in the protected bays of the Indian subcontinent. This limited distribution makes it possible to trace the movement of the shells from their source areas to distant inland markets. At present there are major concentrations of *Turbinella pyrum* at the southern tip of India, in the Gulf of Mannar, all around Sri Lanka and as far north on the eastern coast as the mouth of the Godavari River. These source areas, however, were not exploited during the Indus period. On the western coast of the sub-continent it is not so common, but in the Gulf of Kutch and along the coast of Sind and Baluchistan, west of Karachi, large populations are to be found. Harappan shell collectors probably used these source areas to supply inland manufacturing centers *(Fig. 5)*. The westernmost occurrence of this species is reported from Pasni, on the Makran coast *(Khan, Dastagir, 1971: 56-57)*, but it is not found in the Arabian/Persian Gulf itself (hereafter referred to as the Gulf).

Another commonly used species was *Chicoreus ramosus*, a large shell characterised by an inflated body whorl, covered with sets of 3 long curving varices or spines and numerous smaller tubercules *(Fig. 3,c)*. Adult specimens range in size from 70 mm to 250 mm in length and 60 mm to 200 mm in width, including the varices. Although generally larger than the *Turbinella pyrum*, it has much thinner body walls and a hollow, spiraling columella. The sutures are quite solidly joined making it possible to produce several circlets from each shell, providing all the exterior spines are first removed. However, the shell of this species is usually perforated by numerous holes from boring organisms, because it has only a very thin periostracum and lives primarily in rocky areas or near reefs where such organisms abound.

Even though this species has a wide distribution throughout the Indo-Pacific region, its actual distribution along the coasts of the subcontinent is somewhat limited. It is quite common in South Indian waters and also along the southern shore of the Gulf of Kutch, becoming less common further west along the Sindh and Makran coasts. One modern source is noted in the Gulf of Oman around Fahal Island near Muscat *(Bosch and Bosch, 1982: 89)*, but is either extinct or extremely rare in the Gulf. Smythe *(Smythe, 1982: 59) (Fig. 5)* suggests that this is only a recent development based on the fact that she has seen well preserved specimens purported to have come from inside the Gulf itself.

Lambis truncata sebae is the most massive shell used at Moenjo Daro, ranging in size from 200 mm to 300 mm in length and 130 mm to 200 mm in width, including the dig-

itations *(Abbott, 1961: 156) (Fig. 3b)*. One of the characteristic features of this genus are 6 or 7 digitations extending from the outer lip. In *sebae* these are not very distinct due to the massive build up of porcellaneous, enamel layers on the outer lip and over part of the spire. The spire itself is well balanced and has a series of small tubercules along the shoulder ridge near the sutures. As in most gastropods, the columella is solid and spiraling, but it is not as massive as would be expected for a shell of this size. In fact, except for the heavy accumulations on the outer lip, the remainder of the shell is quite thin, and the sutures are relatively weak.

This species is also gregarious, and large numbers are found on sandy or coral rubble bottoms, especially on the seaward side of the reefs *(Abbott, 1961: 155)*. Occasionally, specimens can be found washed up on the reefs, and since they have a very thin periostracum most specimens are covered with calcareous algae and honeycombed by numerous burrows *(Abbott, 1961: 155)*.

There has been some confusion regarding the distribution of this subspecies, due to the occurrence of the flat-spired subspecies *truncata* in an intervening geographical region. *Sebae* is basically found throughout the Pacific region and then again along the western coasts of the Indian subcontinent from Kutch to the Makran. It is also reported from the Gulf, the Gulf of Oman and the Red Sea *(Fig. 5)*. *Truncata* on the other hand is found from South Indian waters across the Indian Ocean to Zanzibar and the east coast of Africa. *(Abbott, 1961: 156)*.

Fasciolaria trapezium is similar in form to the *Turbinella pyrum*, but slightly more elongate, reaching 200 mm in length and 150 mm in width *(Fig. 3a)*. A series of short nodes or tubercules is located on the shoulder of the spiraling whorls and the spire is well balanced. Although the columella is solid, spiraling and massive, it can be distinguished from that of the *Turbinella pyrum* by the presence of two or three low columellar ridges or folds. Traces of the thick periostracum are often fused in the center of the columella and in the spiraling sutures, resulting in a less homogeneous columella and weak sutures.

Occuring in habitats similar to the *Turbinella pyrum*, these two species are often found together on sandy bottoms *(Hornell, 1951: 27)*. In some regions however, *Fasciolaria trapezium* occurs around rocky areas or reefs, where it is exposed to the predations of burrowing organisms. Most specimens found at Moenjo Daro are badly damaged by their interlacing burrows.

Unlike the *Turbinella pyrum*, this species has a widespread distribution, and is common throughout the Indo-Pacific region. Along the coasts of the Indian subcontinent, it is found from South India to Kutch, with occasional specimens reported from the Sindh and Makran coasts. Like the *Chicoreus ramosus* it is found in the Gulf of Oman around Fahal Island and off the coast from Muscat *(Bosch and Bosch, 1982: 107)*, but it is quite rare or possibly extinct in the Gulf itself *(Smythe, 1982)*.

In studying the various coastal changes that have occurred over the last 5000 years in western India and Pakistan, we see that the most drastic changes have taken place in delta regions or rocky coasts, where *T. pyrum* do not normally live. Snead's study of the Makran coast indicates that there has been some tectonic uplift, about 2 meters along the Karachi coast and increasing westerly to as much as 30 meters near Ras Jiwani near the Iranian border *(Snead, 1967: 564-565)*. The absence of sub-fossil examples of *Turbinella pyrum* and the other large gastropods in the uplifted beaches may indicate that, as is the case today, there were no major concentrations of these species along the western Makran coast or in the Gulf. In the east, however, the coast has been more stable and there has been relatively little silting. In view of these factors, we can assume that there has been little change in the marine habitats of this region during the last 5000 years, and that the *Turbinella pyrum* beds found west of Karachi, near Ras Mauri, were probably located in the same general areas during the 3rd millennium B.C. In Kutch and Saurashtra, recent changes have been primarily due to silting and not because of tectonic activity *(Gupta, S.K., 1977, a)*. Major silting has completely changed the present ecology of the Little and Greater Rann of Kutch. On the basis of an average silt rate of 2 mm per annum, Gupta has calculated that as late as 2000 years ago, the Little Rann of Kutch was about 4 meters deep and was inundated throughout the year *(Gupta, S.K., 1977, b)*. This silt factor may have destroyed many shell beds further in the Gulf of Kutch, but it has not affected the shell beds on the southern shore and nearer the mouth of the Gulf. In view of these studies, it is probable that the distributions of shell beds as we see them today is very similar to the distribution during the 3rd millennium B.C.

Keeping in mind the variable distributions and habitats of these species, we can see that a wide range of marine eco-systems were being exploited by the Indus peoples in their collection of food and suitable raw materials. Bivalves and smaller gastropods were undoubtedly gathered from beaches, protected lagoons and estuaries simply by digging in the sand at low tide, but the larger gastropods could only be obtained from less accessible areas. Some gastropods were probably collected from reefs and rocky areas by wading and submerging at low

tide; while others were obtained by making shallow dives, possibly from reed or wooden boats. The fishing seasons for the intertidal species could have extended throughout most of the year, but the use of boats and diving was probably limited by seasonal weather conditions, such as the monsoons. Present day weather conditions do not appear to have changed drastically since the 4th and 3rd millennium B.C. so the ancient shell fishing season probably followed the same pattern as the modern shell fisheries in Kutch and South India. These fisheries begin around April and continue through June, until the onset of the monsoon storms, after which they continue from October to the beginning of January.

The collection of shells is relatively simple once they have been located, but the sea is not a gentle playground and it contains numerous other creatures that must be respected and avoided. Sharks do not pose a grave problem to divers, since collection areas are in relatively shallow water and large sharks do not normally haunt these regions. However, several species of poisonous fish and snakes inhabit the coral reefs, along with moray eels, and when the wind blows them inshore, there are the extremely poisonous *Pysallia (Portugese Man-o-War)* and the *Chrysaora 'jelly-fish' (Hornell, 1914: 20).*

Very little research has been done at the coastal sites of the Indus Civilization, regarding subsistence patterns and social organizations *(see Meadow, 1979),* but it is probable that the collection of shells was a part of the subsistence strategy of those coastal populations specializing in the exploitation of marine resources, and was not done by the groups who actually manufactured the shell objects. It is not improbable that at the coastal sites of Balakot, Allahadino, Nageshwar, or Lothal, for example, there may have been a close relationship between shell collectors and shell workers, while at larger inland centers they were undoubtedly quite removed from one another, both physically and socially.

The Moenjo Daro Shell Industry

Looking now at the shell working industry at Moenjo Daro, we are confronted with a vast array of shell objects made by various technological processes, from several different species. During my research over the past three years it has been possible to examine and record over 2800 shell artifacts collected during the early excavations and the more recent surface surveys. In order to facilitate the study of these numerous artifacts it was necessary to devise a recording system that could be transfered to a computer readable format for efficient data processing. By classifying all of these artifacts on the basis of morphological and possible functional variables, we can group them into eight basic categories:

1) Finished Ornaments,
2) Unfinished Ornaments and Manufacturing Waste,
3) Finished Utensils,
4) Unfinished Utensils and Manufacturing Waste,
5) Finished Inlay,
6) Unfinished Inlay and Manufacturing Waste,
7) Other Special Objects,
8) Unfinished Objects and Manufacturing Waste

Ornaments

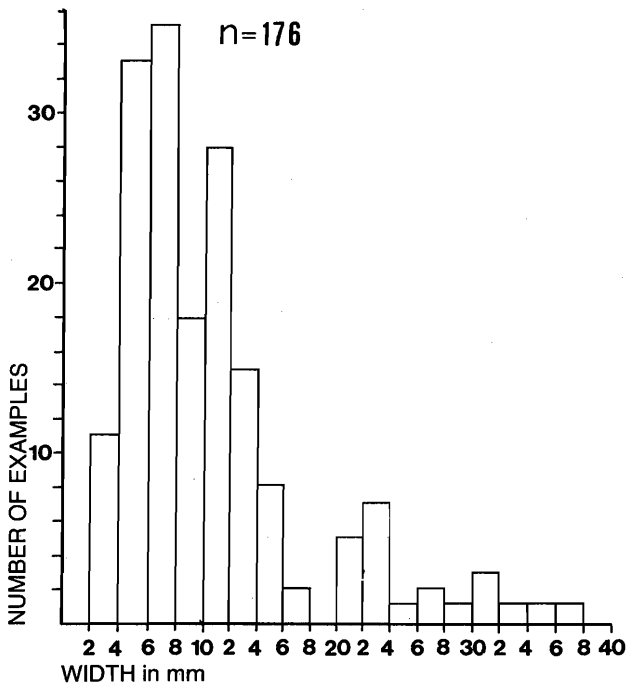
The most common shell ornament at Moenjo Daro is represented by shell bangle fragments. These bangles were produced almost exclusively from the *Turbinella pyrum,* using a variety of specialized and unspecialized tools. First, the shell was prepared for sawing by hollowing out the interior and breaking the thick columella *(Fig. 6 a-f).* A stone or metal hammer was used to perforate the apex and then a metal pick (or hammer and punch) was used to break the internal septa. Once the shell had been hollowed out in this manner, it was sawn at a diagonal to avoid the aperture and remove the irregular anterior portion *(Fig. 6 g-i).*The remaining hollow spire was then sawn into rough circlets of the desired width *(Fig. 6 j-k).* These circlets were ground on the interior using a cylindrical piece of sandstone or some other type of abrasive tool, while the exterior was probably ground on a flat sandstone slab *(Fig. 6 m-n).*

Most of the finished bangles have an incised design carved into the shell at the point where the suture joins the whorls together.*(Fig 6, o).* The motif is generally in the form of a chevron, "V", which very neatly transforms the natural irregularity of the shell circlet into an attractive design. During the surface survey, one unique bangle fragment was discovered with a single Indus script character inscribed over the more common chevron motif *(Fig. 10-1).* This is the only example of script occuring on a shell bangle, and could indicate a specific socio-ritual use of this specific bangle.

Usually the bangles are thin and have a basically triangular or peaked section *(Fig. 10-3.7),* but others are quite wide, each bangle being made from a single shell *(Fig. 10-9, 10).* The range of bangle widths in our sample (176 measurable bangle fragments) shows a definite bi-modal and perhaps even a tri-modal distribution *(Table 1).* First there is a narrow group that could possibly be divided into

Tab. 1 *Shell Bangle Width Distribution*

two sub categories, those having widths of 6 to 8mm, and those from 10 to 12 mm wide. The second group is much more varied, ranging from 20 to 38 mm in width, but there is a slight concentration between 22 to 24 mm. Preliminary analysis of the entire sample of shell bangles recorded from the earlier excavations shows a similar distribution in bangle widths, but further studies may be able to isolate specific widths and bangle styles temporally and spatially.



Getting back to the manufacture of these ornaments, the incised design could have been made using a chert blade or a more specialized copper/bronze file, and a study of the striae suggests that both types of tools were used. Sawing, on the other hand, was not done with stone tools, as has been suggested in the past, but with a highly specialized form of bronze saw. A detailed study of sawing wasters from various Indus sites indicates that the saw had a long convex cutting edge, that was extremely thin; between 0.4 and 0.6 mm. Usually, this saw was only needed to cut through the thickness of the shell body wall, about 5 to 7 mm, but the maximum recorded depth of the cut is between 20 to 30 mm. The section of the saw edge is generally slightly rounded, and the cutting striae indicate that the saw was bi-directionally denticulate, cutting equally well with each thrust as it was moved back and forth. There is no evidence to suggest that any form of abrasive was used in the cutting process. Several convex saws have been recovered from the earlier excavations, but none of them fit the requirements indicated by the shell wasters. The only ethnographic example of a similar saw is the large crescent saw used by modern shell cutters in West Bengal and Bangladesh.

In addition to *Turbinella pyrum,* two other species, *Chicoreus ramosus* and occasionally *Pugilina buchephala* were used for manufacturing bangles *(Fig. 10-5)*. It is usually difficult to determine the species of a shell from a small bangle fragment, but if the shell suture is present one can distinguish bangles made from *Turbinella pyrum* (thick, heavy), from those made from *Chicoreus ramosus.* Out of 183 bangle fragments found during the surface survey, only five were made from *Chicoreus ramosus.*

Other ornaments made from shell include various sizes of rings, beads, perforated discs, pendants etc. *(Fig. 11-5 to 18)*. Although for a small fragment it is often impossible to determine which species of shell it was made from, some artifacts portray characteristic structural features of the original shell. On the basis of this type of evidence, it appears that rings were generally made from the spire portion of the *Turbinella pyrum*, and perforated cylinders from the columella; while the remaining beads, pendants, etc. could have been manufactured from any of the larger gastropods. These objects were produced by various processes of chipping, sawing, grinding and drilling. Many of the circular pieces *(Fig. 11-27)* were made using a tubular drill, which was probably made of copper/bronze. Smaller perforations were undoubtedly made by tiny chert drills using a simple bow drill. Experiments using replicas of these chert drills have shown that a piece of shell 3 mm thick, can be perforated in about one minute.

Utensils

One of the most distinctive utensils found at Moenjo Daro is the large shell ladle or spoon made from *Chicoreus ramosus (Fig 7; Fig. 13-1)*. It is interesting that no other shell was ever used to make this type of ladle, even though it required an unproportionate amount of labour to produce. Before the body of the shell could be cut, all of the exterior spires and varices had to be first sawn or chipped off *(Fig. 7 a-b)*. Then, a diagonal cut was made from the top of the main whorl extending around both sides of the shell and eventually reaching the narrow anterior end of the shell *(Fig. 7 c-d)*. A handle was formed by making two parallel, longitudinal cuts extending from the anterior tip towards the main body whorl *(Fig. 7 e)*. In this manner, a rough ladle was detached from the body of the shell, and by repeating the process on the remaining

half of the shell, a second, but smaller ladle could also be produced *(Fig. 7 d,e)*. These rough forms were then ground smooth and polished, but due to the irregular nature of the exterior surface, traces of the natural shell are usually visible on the exterior of the finished ladle *(Fig. 7 f)*. Another apparent defect in the ladles are the numerous holes left by burrowing organisms. Some of these holes actually perforate the body of the shell and were presumably stopped up with some sort of plaster to make the ladle functional.

Inlay

Due to the small size of most inlay pieces, it is often impossible to determine the species of shell used to make a particular piece, but a study of the shell wasters indicates that all of the large gastropods were used in the production of inlay. Waste fragments of *Turbinella pyrum* left from bangle manufacture were recycled to make various flat geometric designs. *Chicoreus ramosus* fragments were also reused, but it is interesting that on the evidence from the types of manufacturing waste recovered throughout the site, *Fasciolaria trapezium* appears to have been used solely for the manufacture of inlay *(Fig. 9)*. Numerous examples of this shell have been found where only the thick body whorl was removed by chipping or sawing, leaving the columella and spire as waste. The large pieces of body whorl were sawn, chiseled, drilled and ground to produce various geometric shapes *(Fig. 11-19 to 35)*. Another species, *Lambis truncata sebae,* was used primarily for making exceptionally large, solid plaques *(Fig. 8; Fig 12-11)*. The outer lip was sawn into thin sheets or planks, that could then be cut into the desired designs. Saw marks on many of the inlay wasters, especially those cut from the *Lambis,* appear to have been sawn by a saw having a fairly flat cutting edge. This saw was also bi-directionally denticulated, but the saw cuts are slightly thicker, indicating that the saw edge was about 0.7 mm thick

Shell inlay was probably used in wooden furniture or paraphernalia, and occasionally was used for accentuating features or decorations on statuary. On most inlay pieces, the edges have been intentionally bevelled to facilitate setting, which was done using a form of gypsum plaster *(Marshall, 1931: Vol. I: 566)*. Some pieces also have traces of red, and occasionally black pigment around the edges or inside the incised designs. Unfortunately, no examples of inlaid wooden objects have been recovered from Moenjo Daro, but ceramic motifs can provide us with some idea of the exquisite geometric and floral designs made from the white shell, outlined in red and black.

Special Objects

This group includes all of those shell objects not covered by the above categories, and only a few of the major types are discussed below, because it is not in the scope of this paper to present a detailed discussion of all the different varieties. The craftsmen at Moenjo Daro were extremely skilled at working shell and they chose different species to produce a wide range of objects that were often made in terra cotta or other materials. Below is a list of the most common objects, and the species from which they were manufactured.

Object	Species and Portion
CONE	*Turbinella pyrum,* columella
CYLINDER	*Turbinella pyrum,* columella
GAMING PIECE	*Turbinella pyrum,* columella
SPHERE	*Turbinella pyrum,* columella
„WAVEY RING"	*Turbinella pyrum,* columella
„CAP"	*Turbinella pyrum,* *Fasciolaria trapezium* *Chicoreus ramosus* body whorl and spire
TOY CART FRAME	*Lambis truncata sebae,* outer lip
ANIMAL FIGURINES	
BULL, FROG	*Lambis truncanta sebae,* outer lip
TORTOISE, BIRD	*Lambis truncanta sebae,* outer lip
GHARIAL, SNAKE	*Lambis truncanta sebae,* outer lip
„LIBATION" VESSEL	*Turbinella pyrum,* entire shell

Most objects in this group are solid, heavy pieces made from the thickest portions of various shells. The massive columella of *Turbinella pyrum* was used to produce a wide range of these objects *(12-1, 2)*. Numerous pointed cones have been found that are similar to the more common terra cotta cones *(Marshall. 1931: 476),* but unfortunately the examples in shell do not shed any more light on possible uses for this simple object. The columella was also used to make various sizes of solid and perforated cylinders. Many of the solid cylinders appear to be rough-outs for making smaller objects, such as spheres, „gaming pieces" or „wavey rings" *(Fig. 12-3 to 6,7 to 10)*. Some of the large perforated cylinders are smoothed from wear on the exterior as well as the interior of the hole, suggesting their use as an ornament. Other examples, however, are only smoothed on the exterior, but not inside the hole. These may have been used as components in segmented or composite rods as has also been suggested for the „wavey rings" by Mackay *(Marshall; 1931: 475)*. After considerable detailed examination of these artificats, I would agree with Mackay's interpretation, primarily on the basis of the lack of wear on the interior and the ends of the „wavey rings" and the presence of a high polish on the exterior. The

only major problem is that we have found no evidence of a paste or mastic used to join the rings on a central rod, but this discussion must await further research and exploration.

Another intriguing object is the shell „cap". These objects were comprised of two or three convex pieces that theoretically joined together to form a low, flat-topped dome. The exteriors are incised with single or parallel grooves *(Fig. 12-16)* that were often filled with red coloring. So far, however, no matched sets have been recovered and their function is still a mystery. They were made from three different species, *Turbinella pyrum, Fasciolaria trapezium* and *Chicoreus ramosus.* Although the columella of the *Turbinella pyrum* is massive, it is not quite as large as the outer lip of *Lambis truncata sebae,* and most figurines and toys were made from this shell. Generally, the thick digitations on the edge of the outer lip were sawn off to make the head of bull figurines. These figurines were made in two parts, the head and the hump, but up till now no other body parts have been discovered. It is possible that these fragments were joined onto the composite rods as a carved standard or possibly set into the pommel of a tool/weapon. Other types of figurines include tortoises *(Fig. 12 - 14),* gharials and birds. The carving on all of these objects is so exceptional that one can only assume that Mackay was speaking in a different context when he suggests that the shell workers of Moenjo Daro were not so „adept" as the Sumerians *(Marshall, 1931:568).*

One other group of special objects deserves special mention, particularly because its significance has been overlooked in the earlier reports. These are called „shell receptacles" by Mackay and he mentions that *„In Sumer similarly smoothed shells were used as drinking cups or for libations or ablutions"(Marshall, 1931: 569).* These objects are almost exclusively made from *Turbinella pyrum* (only one possible example is from *Chicoreus ramosus)* and are basically just a hollowed out shell. The apex was left intact, and the columella and internal septa were tediously chiseled out. This difficult process was often even further extended by the careful smoothing of the interior chipped edges, while the exteriors are always smoothed and incised with single or parallel grooves. These grooves were then filled with red coloring.

I have called these „Libation Vessels" because of their special manufacture and shape, which is suited to pouring some form of liquid. There are no evidences of burning at the edges, so we can rule out the possibility of their use as lamps. In South India similar, unincised, but hollowed out shells are used by traditional mothers, to milk-feed infants. More elaborate and carefully manufactured vessels are made in the shell manufacturing centers in Bengal for special ritual libations, but some of the simpler styles are identical to those found at Moenjo Daro. Without getting into the lengthy discussion of cultural continuity or dis-continuity, we can see that there are many new and interesting aspects of the shell industry that will be revealed through more detailed research, and we may find that many of the so called „utilitarian" or ornamental objects, such as bangles and inlay, had more important socio-religious functions in the Indus culture. Looking now at the distribution of shell artifacts within the site itself, we are confronted with some interesting new data regarding the role of this industry at Moenjo Daro.

Distribution of Shell Artifacts

Early excavations: Marshall & Mackay

Our present understanding of the shell industry at Moenjo Daro is based primarily on the data presented by Marshall and Mackay in the original excavation reports (1931 and 1938). Mackay's technological interests led him to study many of the craft activities represented at Moenjo Daro, but shell working was evidently not one of his main interests. In the first report, only ten different species of mollusca were identified *(Marshall, 1931: 664-665)*, whereas now, over 33 species have been recorded. The technological aspects of the shell industry were also dealt with quite briefly; a short reference was made regarding the possible similarity of the bangle manufacturing industry to the modern industry in Bengal, and a general discussion was provided on the possible different manufacturing techniques used to cut and shape inlay pieces *(1931: 563-570)*. Mackay notes that *„in the manufacture of shell inlay, however, the people of Moenjo Daro were not so adept as the Sumerians. In India we do not find the wonderful figurines carved in this material that we find in Sumer. Possibly the people of Mohenjo Daro used wood as their chief medium of expression" (1931: 568).* He also points out that the major species used at the site was *Fasciolaria trapezium.* A reexamination of the shell artifacts indicates that although *Fasciolaria trapezium* was indeed important in the manufacture of inlay, it was by no means the major species used at the site, this position is held by *Turbinella pyrum.* Fortunately, the generalizations and interpretations made by the earlier excavators were based on excavated shell artifacts that were recorded by provenience and preserved for future study. It has been possible to relocate most of the shell objects recorded in the field

registers, but the descriptions are often brief and occasionally incorrect, indicating that the recording was done without making a detailed examination of each object. This lack of interest can be understood in view of the large quantities of artifacts that were being processed, but cannot be ignored when assessing the reliability of the artifact descriptions in the registers.

Another problem in understanding the shell industry at the site, is the relative chronological position assigned to different architectural levels. Both Marshall and Mackay were aware of the stratigraphic complexity of the site, but they were not able to resolve the problem satisfactorily. Consequently, I have hesitated to use their designations of Late, Intermediate and Early when discussing the different shell working areas or proveniences. This problem of stratigraphy also affects the interpretation of the horizontal and vertical distribution of the artifacts. Generally speaking, the excavation reports do not go into detail describing the contexts in which shell artifacts were found. Without this information, it is difficult to understand the processes involved in the final deposition of the artifacts and any conclusions based on the published reports, must necessarily remain generalized and conjectural.

Nonetheless, certain areas of the site appear to have been used specifically for the manufacture of shell objects, and these can be recognised by the presence of raw materials, unfinished pieces, manufacturing waste, finished objects and occasionally even tools. *(Fig. 4)*

In „L" area, south of the stupa mound, a large quantity of unworked and partially worked *Fasciolaria trapezium* were discovered in the partitioned apartments south of the „Pillared Hall". Marshall suggests that shell workers came and occupied these quarters after the original function of the building had ceased, and assigns this occupation to the *„latter end of the Late Period" (1931: 165)*. He mentions that in some areas the „late" floor was still used by the artisans, while in other areas they had built up mud floorings. In one of the adjacent chambers *(Chamber 6)* a large sandstone grinding stone was found, which Marshall interpreted as being a possible leather-worker's whetstone. On the basis of its association with shell fragments and inlay manufacturing waste, it is more likely to have been used as a grinding stone or whetstone by the shell workers. One further point of interest that has come out in the restudy of the shell fragments from this area, is that there is a conspicuous lack of shell bangles and bangle manufacturing waste. From the entire „L" area excavations, only three shell bangle fragments are recorded in the registers, and there are very few examples of *Turbinella pyrum* wasters. Most shell fragments belong to *Fasciolaria trapezium*, with a few examples of *Lambis truncata sebae* and *Chicoreus ramosus*. Almost all of the shell wasters from this area are definitely related to inlay manufacture, or the manufacture of discs and beads.

Another possible workshop for inlay is in the „HR" area (Section B, Block 2, House IX, Room 85), where a mass of inlay and waste pieces were found, together with a copper chisel *(1931: 195)*. The room in which these artifacts were found, was supposedly built in the „Intermediate" period and then rebuilt again in the „Late" period. Not far from this building, another area was located that may have been used for processing „oyster" shells to make lime/gypsum plaster (Block 2, House X, Rms. 134, 135) *(1931: 197)*.

The presence of a wide range of waste fragments from different stages in bangle manufacture, indicates that bangle manufacturing was definitely being carried out somewhere in or near the site. One possible manufacturing area was located in „VS" area (Block 2, House XIII), where numerous broken shell fragments and 41 shell cores were found. After examining many of these cores or rather columellae, it was evident that they were all from *Turbinella pyrum*, and sawn from the shell in the process of bangle manufacture. This collection of columellae could indicate a primary context where the shells were actually sawn, or it could represent a storage area or workshop where they were being reprocessed to make cylinders, cones, beads, etc. If we had more details regarding the stratigraphy of this area it might have been possible to interpret this cache more specifically. In „HR" area (Sec. A, Blk. 2, east of House III) we encounter a similar situation, where a large pot was found containing 15 complete, but unfinished shell bangles. From ethnographic examples in the shell working community in Bengal, we know that merchants often provide workmen with unfinished bangles to be processed at home and then returned after they have been ground and carved. The cache of unfinished bangles could have been passing through a similar chain, when it was lost or abandoned.

These few examples are the only clues provided in the excavation reports regarding the role of shell working at Moenjo Daro. The only way to acquire new data was to prepare a map of the overall distribution of the different artifact types on the basis of my reanalysis of the shell artifacts collected by the early excavators. Presently the artifacts are being recorded for computer analysis, and specific programs are being developed to map the artifacts in the locations that are recorded in the original field registers. This study is being done in cooperation with the more comprehensive program being undertaken by Dr. Michael Jansen and his team on the relocation of all artifacts recorded in the registers. By relocation, we are referring to the three dimensional relationship of specific objects to the architectural features with which they are associated. The results of this study will be presented in more detail when the analysis has been completed.

Surface Survey, 1982-83

One important objective of the surface survey was to sample unexcavated surfaces of the site to try and locate possible shell manufacturing areas. Another objective was to examine the previously excavated sections and dump areas in order to better understand the contexts from which shell artifacts were recovered and also to determine what types of artifacts were discarded in the dumps.

Over 700 shell artifacts were recovered from the exposed surface areas of the site, coming from three basically different contexts, 1) in association with excavated structures, 2) in dump areas, and 3) on unexcavated eroded surfaces.

Only a few artifacts were recovered from the previously excavated areas and these are comprised of fragments of finished ornaments, utensils, etc. The dumps however, yielded a large quantity of wasters as well as semi-finished objects. In the L Area dump *(Fig. 4)* there were 53 wasters of *Fasciolaria trapezium*, variously sawn or chipped and all resulting from inlay manufacture. Only one fragment of *Turbinella pyrum* waste was found in this same area, and this appears to have been a waster from inlay manufacture rather than from bangle manufacture. Only four finished bangle fragments were recovered from the dump, bringing the number of shell bangles from L Area to a total of seven. The evidence of inlay wasters from the dump areas would lend support to the interpretation that this was an inlay manufacturing area, but unfortunately it does not throw any more light on the problems of chronology or rare occurance of shell bangles. Similar concentrations of *Fasciolaria trapezium* fragments were found in the dumps associated with SD Area and the excavation of the so called „Granary". Other dumps from VS Area, HR Area and DK Area were also examined but they do not provide any conclusive evidence for specific types of manufacturing activities, because of the small sample size and the varieties of artifact types.

In the unexcavated areas within the main site we found only two important concentrations of manufacturing waste, one in a recently exposed room eroding out of the ridge to the north of L Area, and the other eroding from the northern face of the southern east-west ridge located to the east of HR Area *(Fig. 4)*. The concentration in L Area consists of inlay waste fragments (8) and unfinished inlay pieces (2). Due to time constraints, this area was not fully sampled, but will hopefully provide an interesting area for study in the following season. It appears that the shell fragments are part of a deposit enclosed by three walls, and as such may indicate a primary manufacturing area where inlay and small ornaments were being processed.

In HR East, the concentration consists of numerous manufacturing wasters from bangle, ladle and also inlay production. The fragments were found eroding from the side of the ridge and lying on the silty aeolian and fluvial deposits at the base of the slope. These fragments could possibly indicate the presence of an ancient dump area, from a nearby workshop, or the secondary deposition of such an area.

The most interesting discovery relating to shell manufacture was on a low mound, several hundred meters northeast of the Moneer Area. Although it has not yet been properly mapped, the eroding structures appear to be oriented in the cardinal directions and the associated pottery and artifacts are all of the mature Harappan period. This mound is isolated from the main site by a recent river flood channel and is cut in two by an old road leading to Dokri village. The eastern portion of this mound was covered with large quantities of tiny chipped fragments of *Turbinella pyrum*. This type of fragment is produced during the preliminary chipping stages of bangle manufacture, when the apex is perforated and the internal septa are broken. The hollowed out shell would then be sawn into rough circlets. Only a few fragments of these subsequent stages of manufacture were found during the sampling of this area, suggesting that this location may have been used for only the preliminary preparation of the shell for sawing.

A brief look at modern shell workshops in Bengal may help provide a possible interpretation for this distribution pattern. In Bengal, shell workshops acquire their raw shells from South Indian suppliers. Coastal fishermen collect the shells and tear off the large meaty parts of the mollusc, leaving the stomach and soft organs to rot inside the apex. These shells are sewn up in burlap sacks and shipped to Bengal by land or by sea, and even before they arrive there, the organic matter in the apex is putrified and reduced to an odiferous, black maggoty mess. The shell workers quarter of any village or town is famous for its stench and generally avoided by other villagers. Even in a large urban center like modern Calcutta, the shell workers live and work on the outskirts of town, along crowded streets characterised by numerous shell wasters and a distinctive odor.

The shell working area on the northeast mound, outside the main site of Moenjo Daro, definitely represents a location where the preliminary chipping of the shell took place, but it also may indicate the segregation of an odiferous task away from the habitation areas in the central parts of the city. In the following season we hope to be able to carry out detailed mapping of this area to learn

more about the surface distribution of the waste fragments and their relationship to portions of architecture that are evident on the surface. This area will provide important comparative information for the concentration of wasters eroding from the room in L Area.

In addition to the location of these important manufacturing indicators, other shell artifacts were recovered that were used by bead drillers as backing for a bow drill *(Fig. 13-3)*. These pieces were made from broken fragments of ladles or sawn wasters that fit easily in the palm of the hand. By placing the concave side against the back of the drill, steady pressure could be applied during the drilling process. Numerous shallow depressions in the concave portion of these pieces indicate that the back of the drill shaft was probably tipped by a stone or copper/bronze point. It is possible that the shell pieces were being used by craftsmen who were drilling shell beads, but they may also have been used in drilling other types of beads or ornaments. Further surface analysis in the areas where these objects were found may help in our understanding of these other important craft activities at Moenjo Daro.

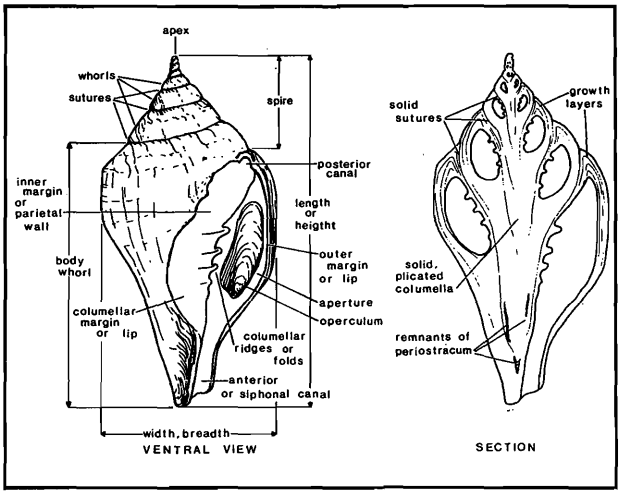
Summary and Conclusion

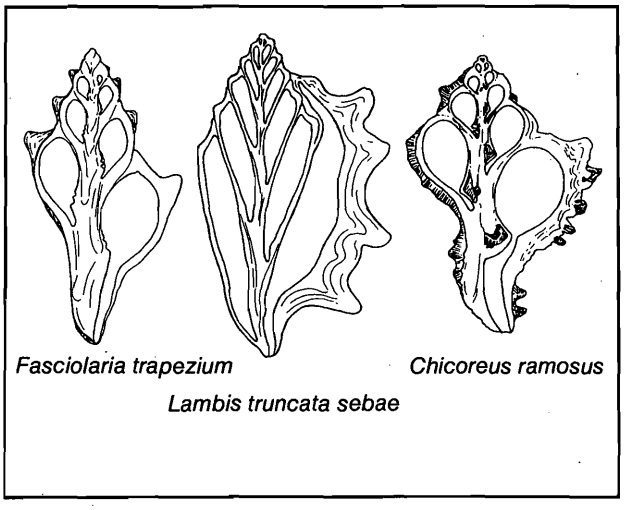
On the basis of these preliminary observations it is evident that Moenjo Daro definitely had workshops that specialized in the production of shell objects such as bangles, beads, inlay, utensils and other decorative objects. The excavated materials and the collections from the surface survey have provided us with a fairly comprehensive set of data representing all of the basic manufacturing stages of the various types of objects, and it is evident that large quantities of bangles, inlay and other special objects were being made at the site. Ladles too, were being made there but on the basis of quantitative analysis of finished to unfinished pieces *(Kenoyer, 1983)*, it is suggested that some finished ladles were being brought to the site from other manufacturing centers. The raw shells, however, were most certainly transported to the site, and three major source areas can be defined on the basis of modern distributions of shell species; the Karachi coast, which supplied *Turbinella pyrum* and *Pugilina buchephala*; the Gulf of Kutch, which supplied the previous two species as well as *Chicoreus ramosus*, and possibly *Lambis truncata sebae* and *Fasciolaria trapezium*; and the coast of Oman, where all of the above species, except for *Turbinella pyrum* are found. The recent discovery of a Harappan potsherd with graffiti in the Harappan script from the site at Ra's Al-Junayz in Oman *(Tosi, 1982)* may indicate that this area had close contacts with the Harappan sites across the Gulf, and raw shells may have been one of the important commodities in this trade/exchange. The raw shells were probably brought to Moenjo Daro along riverine trade routes and from there, it is likely that many shells were traded further into the interior. In terms of finished shell objects the quantity of shell wasters discovered from the site does not indicate a large scale industry manufacturing products for external trade purposes. The size of the work areas discovered so far at the site suggest that the industry was guaged for local markets either within the city itself or at the most for nearby communities that had close contacts with the urban center.

The manufacturing areas in certain rural areas of Bengal, that produce goods only for the local market are very similar to those seen at Moenjo Daro. On the other hand, manufacturing centers that produce semi-finished products and finished products for local and long distance trade are much larger, and have extremely high percentages of waste to finished goods. The recent discovery of a mature Harappan shell working site in Kathiawar illustrates this point. Nageshwar, is a small Harappan site

on the southern shore of the Gulf of Kutch *(Bhan and Kenoyer, 1983)* where extremely large quantities of shell wasters from bangle and ladle manufacture have been found. It is possible that some of the ladles made at this site were traded to the major inland sites such as Moenjo Daro. Bangles too, appear to have been made in unusually large quantities. In one dump area about one square meter in area, there were literally hundreds of columellae from *Turbinella pyrum*, many more than have been found from the entire site of Moenjo Daro. We have not yet discovered any such concentrations of wasters at Moenjo Daro, but before arriving at any conclusions, we must consider that a lot of the shell waste at the site was being reprocessed into ornaments, or inlay, and many of the fragments may have been burned to produce lime. As mentioned above, Marshall does report one room in HR Area (Section B, Block 2, House X, Room 135) where he found a large concentration of „oyster" shells that may have been used for making gypsum plaster. However, even with these factors considered, shell manufacturing at the site does not appear to be in the form of a large scale industry, producing trade items that would comprise a major asset in the overall economy of the site. On the other hand, it was most certainly an important industry, and this is demonstrated by the distances from which raw shells were obtained and the presence of shell artifacts throughout the entire site. As we continue to study the different crafts and small industries at the site of Moenjo Daro we will be able to better interpret the role of various objects, such as shell, in the socio-economic and possibly the socio-religious spheres of this complex culture.

Upper
Fig. 2 *Parts of the Gastropod: Turbinella pyrum*
Middle
Fig. 3 *Internal Structure of other Large Gastropoda*





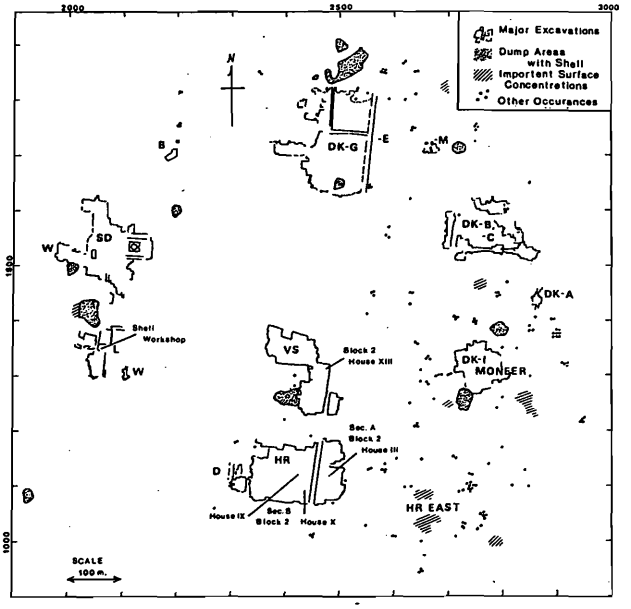


Fig. 4 *Moenjo Daro – Shell Distribution*

Fig. 5 *Distribution of Major Shell Fisheries*

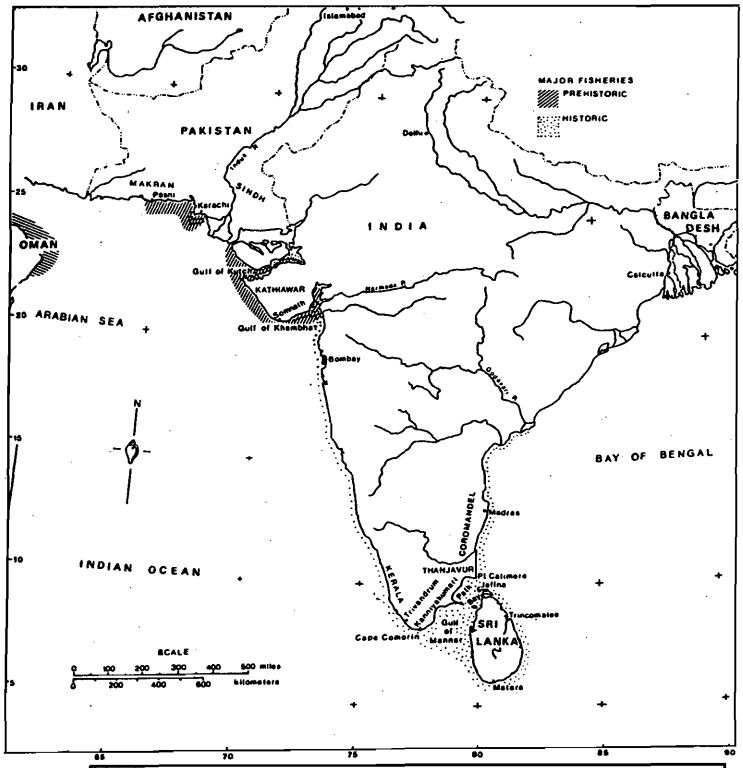
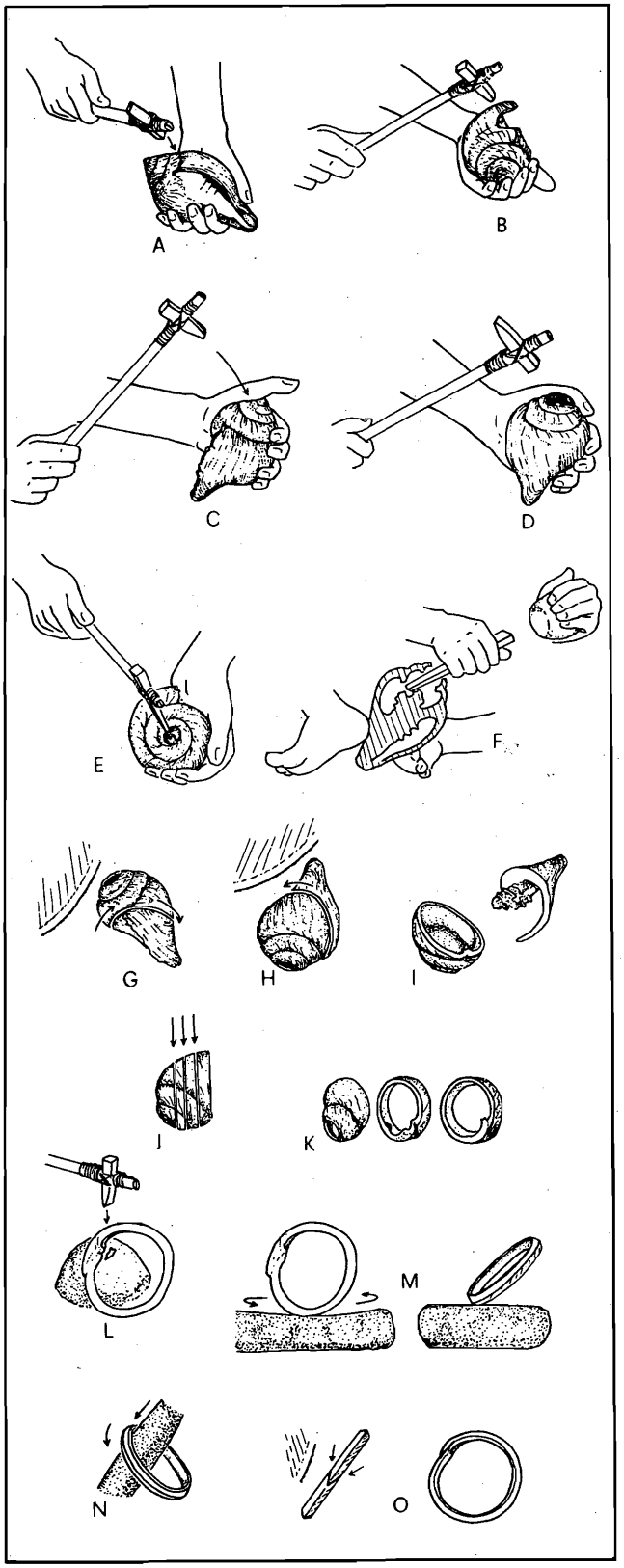


Fig. 6 *Bangle Manufacture with Turbinella pyrum*



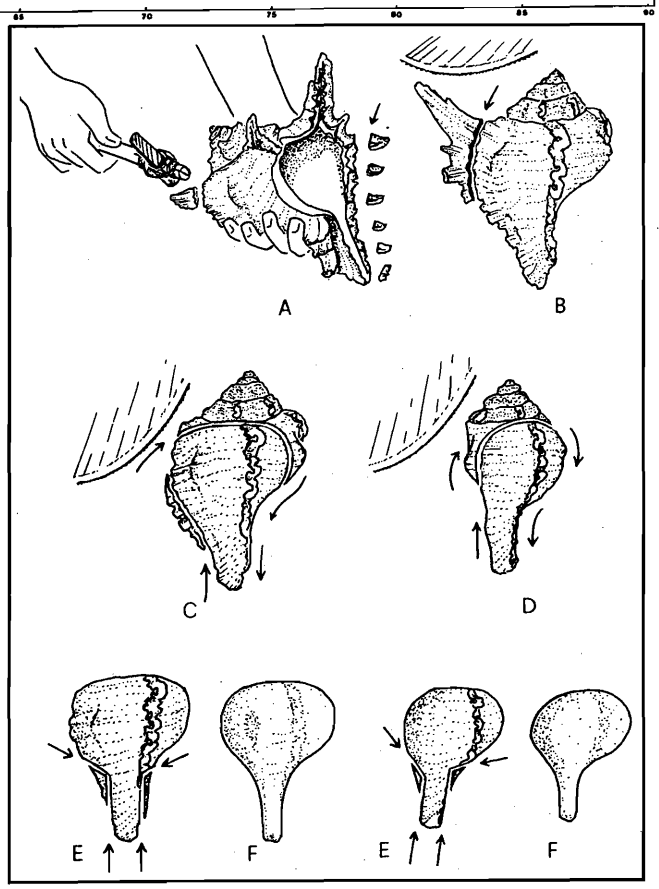


Fig. 7 *Ladle Manufacture with Chicoreus ramosus*

Fig. 8 *Inlay Manufacture with Lambis truncata sebae*

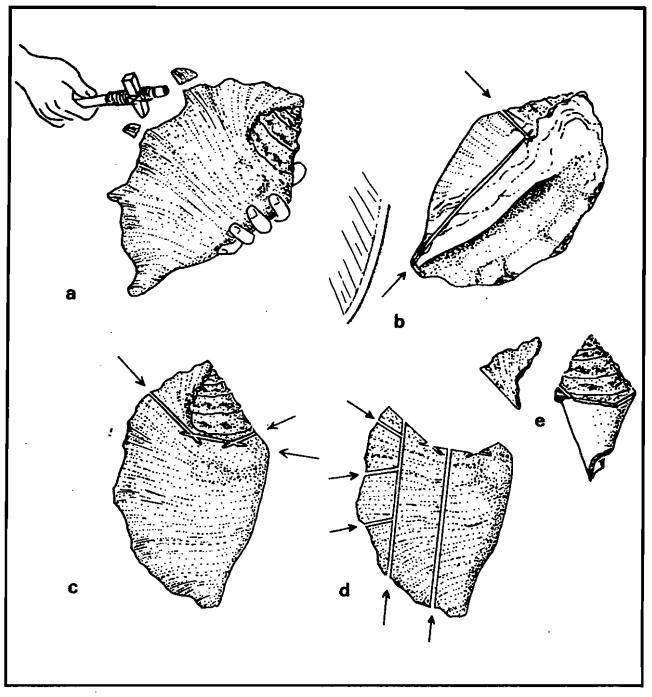
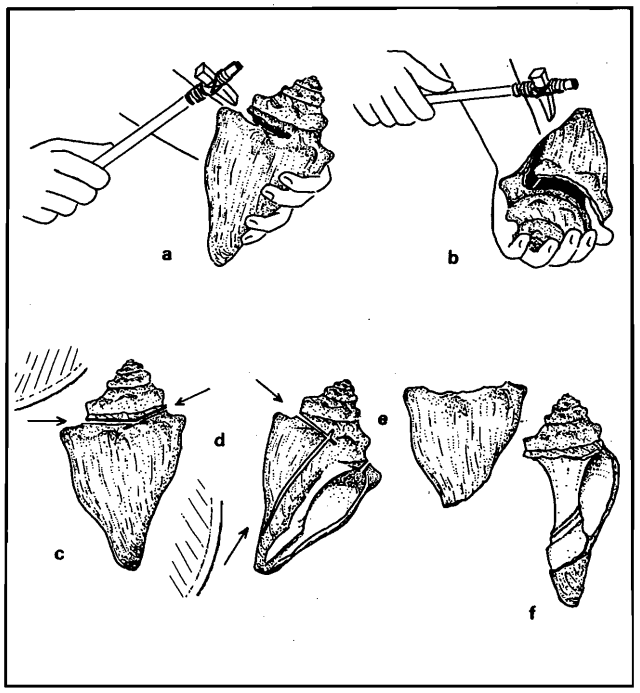
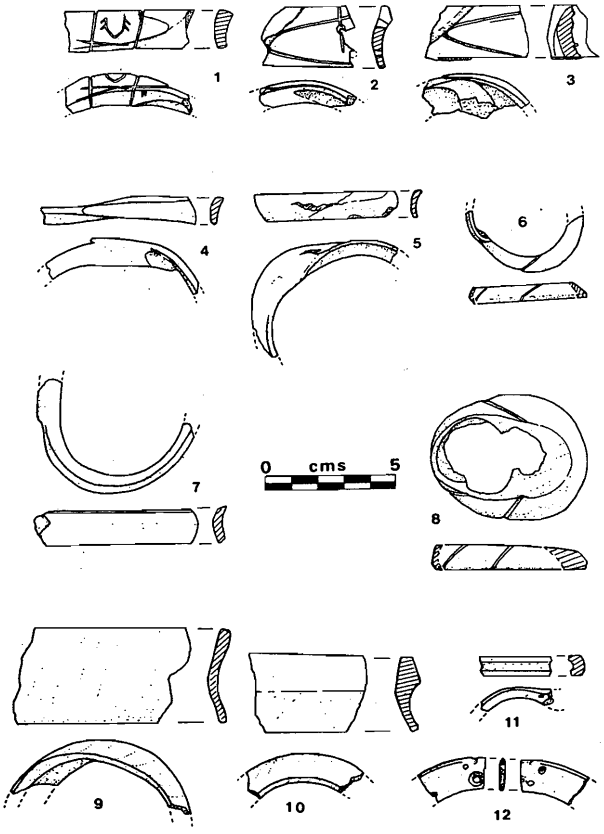


Fig. 9 *Inlay Manufacture with Fasciolaria trapezium*

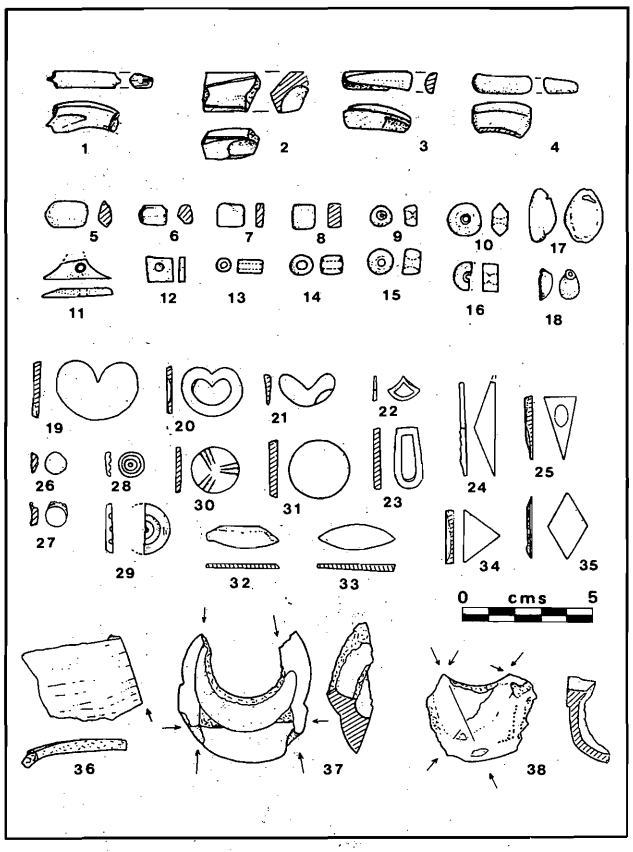




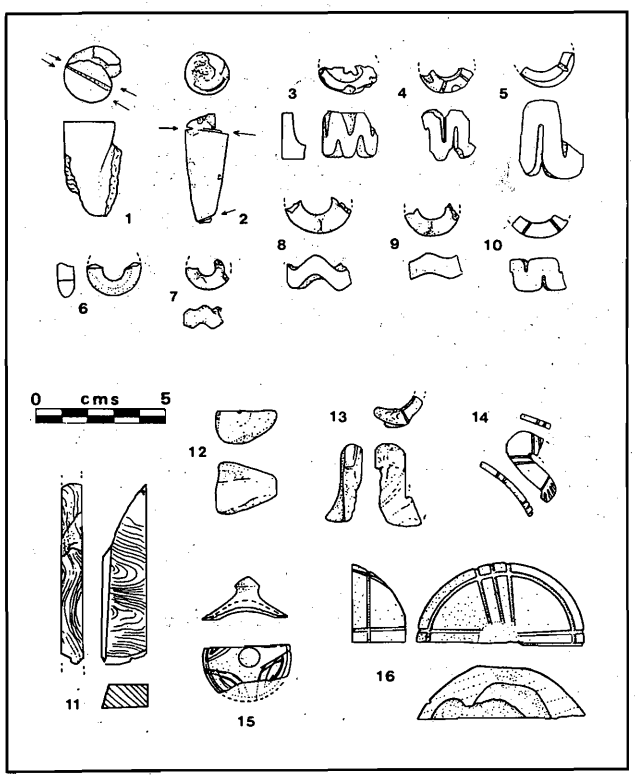
1. *Incised and engraved with script, Turbinella pyrum (MD/83/150)*
2. *Incised and repaired, Turbinella pyrum (HRE/83/554)*
3. *Incised, interior not finished, Turbinella pyrum (Channel/82/107)*
4. *Incised, heavily worn, Turbinella pyrum (MD/83/170)*
5. *Incised, heavily worn, Chicoreus ramosus (MN/83/416)*
6. *Incised, multiple slashes, Turbinella pyrum (MN/83/403)*
7. *Heavily worn, Turbinella pyrum (MD/83/148)*
8. *Incised, multiple slashes, Turbinella pyrum (DK/83/439)*
9. *Wide, heavily worn, Turbinella pyrum (E/83/104)*
10. *Wide, heavily worn, Turbinella pyrum (E/83/105)*
11. *Non-Harappan, ? Buddhist Period, Turbinella pyrum (MD/83/155)*
12. *Repaired, heavily worn, Turbinella pyrum (HRE/83/298)*

Fig. 10 *Moenjo Daro Bangle Fragments 1982-83*

Fig. 11 *Shell Artifacts – Moenjo Daro 1982-83*



1. *Reworked bangle fragment, Turbinella pyrum (MN/83/475)*
2. *Reworked bangle fragment, Turbinella pyrum (HRE/83/432)*
3. *Reworked bangle fragment, Turbinella pyrum (E/83/122)*
4. *Reworked bangle fragment, Turbinella pyrum (MD/83/159)*
5. *Reworked bangle fragment / bead blank, Turbinella pyrum (MD/83/539)*
6. *Reworked bangle fragment / bead blank, Turbinella pyrum (MD/83/540)*
7. *Bead blank, species? (MN/83/549)*
8. *Bead blank, species? (HRS/83/544)*
9. *Unfinished bead, species? (HRS/83/547)*
10. *Finished bead, species? (DKG/83/524)*
11. *Drilled Inlay, species? (MD/83/487)*
12. *Partly drilled fragment, species? (LN/83/418)*
13. *Bead, species? (MN/83/419)*
14. *Bead, species? (DKG/83/493)*
15. *Bead, species? (HRE/83/349)*
16. *Bead, species? (NE, Mound/83/490)*
17. *Pendant, Cypraea turdus (DK/83/525)*
18. *Pendant, Nerita, sp. (HRE/83/413)*
19. *Inlay blank, species? (HRE/83/264)*
20. *Finished inlay, species? (MN/83/71)*
21. *Inlay waster, species? (L/83/46)*
22. *Fretted inlay, species? (MN/83/49)*
23. *Fretted inlay, species? (HRN/83/50)*
24. *Triangular inlay, species? (MN/83/531)*
25. *Triangular inlay, species? (MN/83/417)*
26. *Unfinished ground disc, species? (MN/83/121)*
27. *Tubular drill waster, species? (DK/83/545)*
28. *Inlay, concentric incised circles, species? (DK/83/53)*
29. *Inlay, concentric incised circles, species? (M/83/535)*
30. *Inlay, with incised design, species? (DK/83/(220)*
31. *Inlay / disc, species? (MD/83/201)*
32. *Unfinished inlay, species? (SD/83/330)*
33. *Finished inlay, species? (VS/83/358)*
34. *Triangular inlay, species? (DK/83/304)*
35. *Triangular inlay, species? (MN/83/315)*
36. *Sawn body whorl, Turbinella pyrum (L/83/445)*
37. *Sawn apex fragment, Turbinella pyrum (MN/83/190)*
38. *Sawn and ground apex fragment, Turbinella pyrum (DK/83/523)*

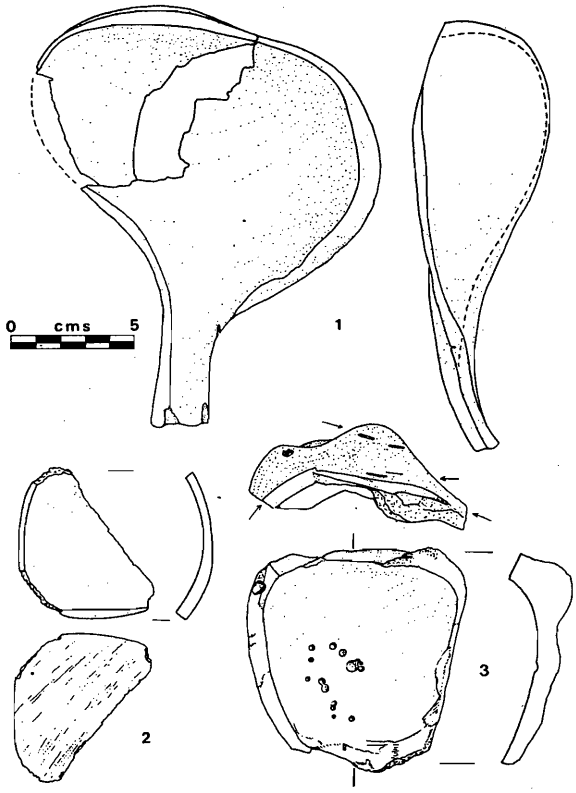


1. *Sawn columella, Turbinella pyrum (MD/83/196)*
2. *Sawn and ground columella, Turbinella pyrum (HR/83/412)*
3. *Unfinished „wavey ring", Turbinella pyrum (DK/83/415)*
4. *Unfinished „wavey ring", Turbinella pyrum (DK/83/546)*
5. *Finished „wavey ring", Turbinella pyrum (HRS/83/110)*
6. *Finished ring, Turbinella pyrum (MD/83/203)*
7. *Finished „wavey ring", Turbinella pyrum (MD/83/191)*
8. *Finished „wavey ring", Turbinella pyrum (MN/83/209)*
9. *Finished „wavey ring", Turbinella pyrum (DK/83/52)*
10. *Finished „wavey ring", Turbinella pyrum (HRE/83/252)*
11. *Sawn plank, Lambis truncata sebae (MD/83/198)*
12. *Sawn and ground columella, Turbinella pyrum (SD/83/542)*
13. *Unfinished object, Turbinella pyrum (DK/83/542)*
14. *Broken figurine, ? Tortoise, species? (HRS/83/526)*
15. *Carved lid, Lambis truncata sebae (MN/83/414)*
16. *„Cap", ½ type, Turbinella pyrum ((MN/83/72)*

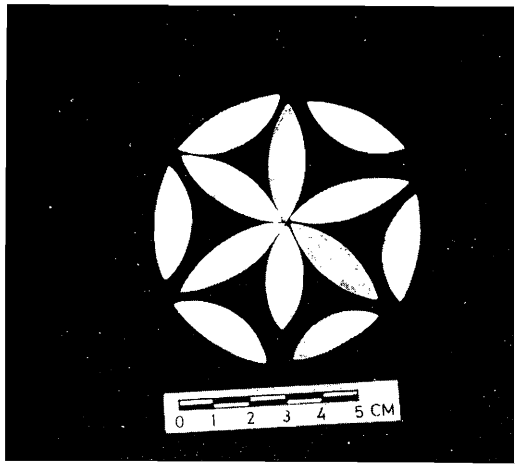
Fig. 12 *Shell Artifacts, Moenjo Daro 1982-83*

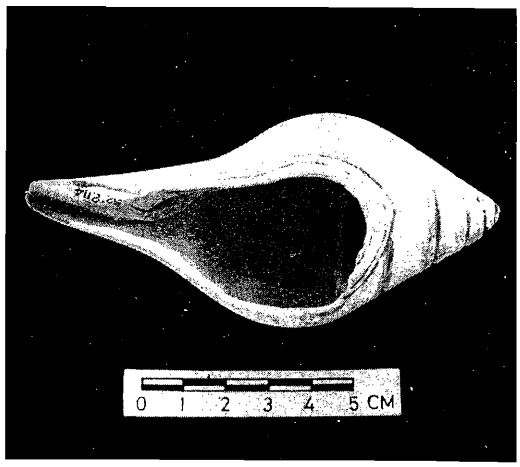
Fig. 13 *Moenjo Daro Shell Artifacts 1982-83*

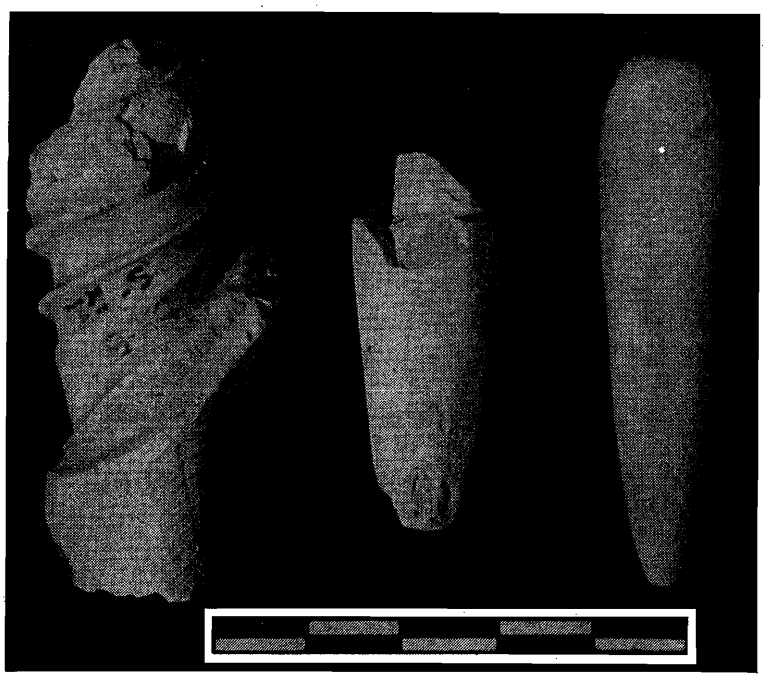
1. *Ladle, heavily worn, Chicoreus ramosus (E/83/99)*
2. *Inlay rough-out, sawn and chipped, Turbinella pyrum (E/83/97)*
3. *Drill back made from inlay waster, Lambis truncata sebae (DK/83/45)*



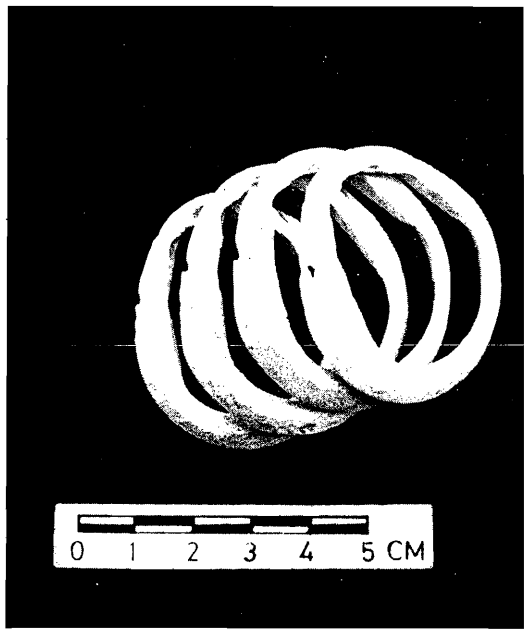
Upper
MD Reserve *Shell Inlay*
Middle
MD Reserve *Shell Container „Libation vessel" Turbinella pyrum*





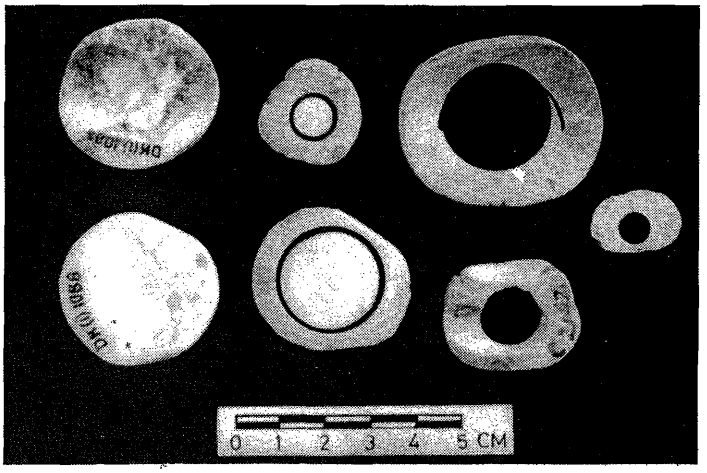


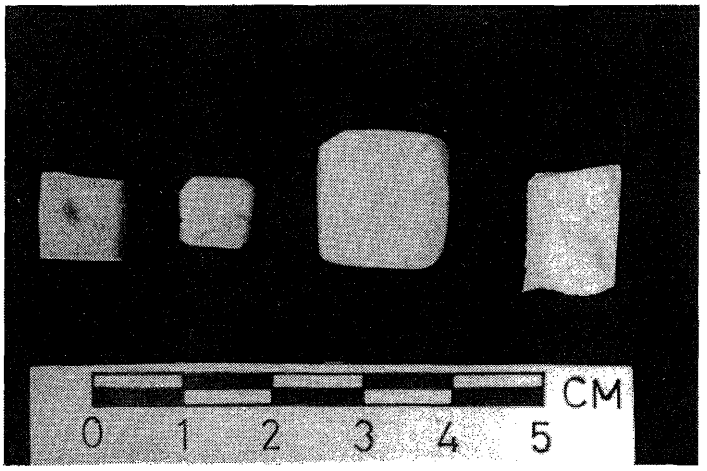
MD 1983 *Cone Manufacture from Columella of Turbinella pyrum*



MD Reserve *Shell Bangles Turbinella pyrum*

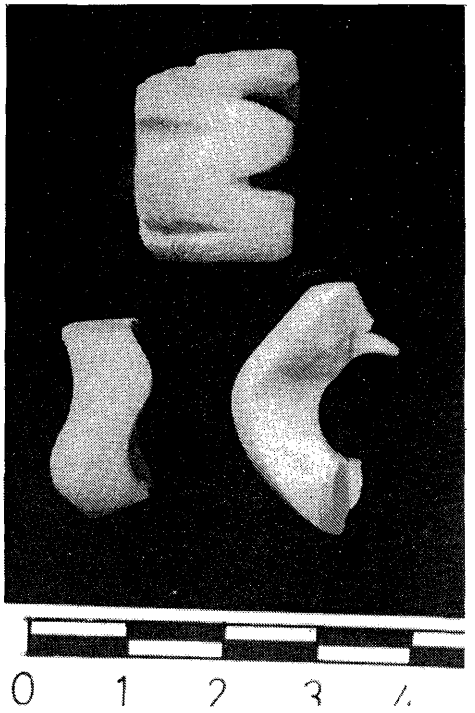
MD Reserve *Tubular Drill Blanks – Discs and Wasters*

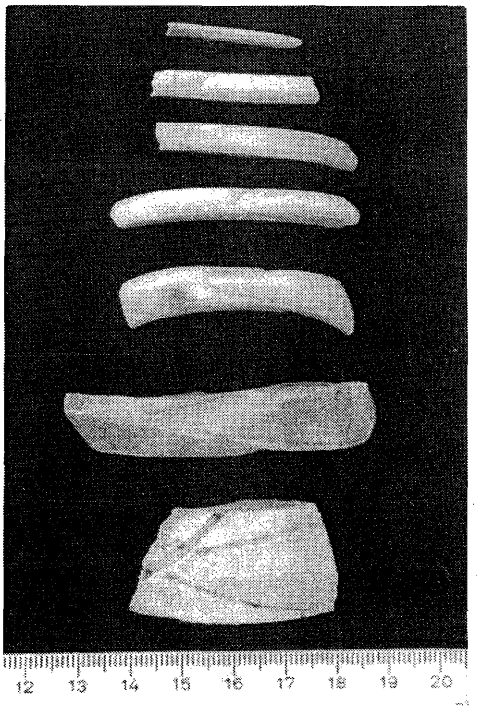




MD 1983 *Bead Manufacture from Small Wasters*

MD 1983 *Wavey Ring Manufacture*





MD 1983 *Turbinella pyrum*

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