

Ancient shell industry at Bet Dwarka Island

A. S. Gaur*, Sundaresh and Vardhan Patankar

*Almost every archaeological site in the Indian subcontinent has the remains of shells. It had been recognized as a major industry during the Indus Valley Civilization, dating back to the mid-Holocene. The most important shell used in the past was *Turbinella pyrum* (chank) shell, which has been found extensively in inter-tidal zones of Saurashtra and the Gulf of Kachchh. The important artifacts include bangles, beads, seals and inlay work. Bet Dwarka has been the major centre of shell industry in the past. Also, its shore is rich in a variety of shells that were picked up by the fishermen till recently. This article discusses the importance of shell artifacts recovered during the excavation at Bet Dwarka Island and their significance in dating of an archaeological site.*

Keywords: Bet Dwarka, Chank shell, Harappan period, marine archaeology, shell industry.

SHELL fishing has been practised by humans since ancient times in different parts of the world. However, it has been recognized as a major industry during the protohistoric period in the Indian subcontinent. Many trade routes of ancient people have been identified by archaeologists on the basis of the sources of shells found during explorations. India has played an important role in Indian Ocean trade and commerce. *Turbinella pyrum* (chank) shells were found in a grave at Kish¹ and Ur (in Mesopotamia). Important artifacts from the shells include ladles, lamps, beads and bangles. They are duplicated from samples at Mohenjodaro² and Chanhu-Daro³ and are clearly imports from India, as the *T. pyrum* shell is only found off the south and west coasts of India and does not occur in the Persian Gulf⁴. Moreover, at Telloh (in Mesopotamia), perforated and engraved amulets were made from pieces of chank shell⁵.

Several excavations have yielded the remains of various types of shells obtained from the sea. The first systematic use of shells for various household purposes in the human history has been noticed during the Indus Valley Civilization. In fact, Harappan sites have yielded shells more extensively than bone or ivory. Shell inlays, beads, bangles, ladles, feeding cups and other objects have been found at several sites. Several sites, including Lothal⁶, Rangpur⁷, Nageshwar⁸, Kuntasi⁹, Surkotada¹⁰, Mohenjodaro¹¹, etc. have yielded rich antiquities on the various uses of shells. Harappans at Balakot were involved in large-scale exploitation of marine resources; Chank shell (Figure 1) was used for the manufacture of beads, bangles, etc.¹². Shell species found at the sites include *T. pyrum* (chank), *Chicoreus ramosus*, *Fasciolaria trapezium*, *Cypraea* (cowries), *Arabica arabica* (cowries), *Babylonia spirata*, dentalium, mussel and *Arca granosa* (marine ark).

All these varieties are available in the Indian waters, including off Sind, Kutch and Kathiyawad coasts^{4,11}.

Bet Dwarka is the second site in the Okhamandal region, where a flourishing shell industry in archaeological context has been noticed. Earlier, Nageshwar, a mature Harappan site, was recognized as a major shell-working centre of the Harappan period⁸ in the Okhamandal region.

Excavations

Onshore excavations in Bet Dwarka Island have been carried out in the season 2001–02, to trace the cultural sequence of



Figure 1. *Turbinella pyrum* discovered from Bet Dwarka Island.

A. S. Gaur and Sundaresh are in the National Institute of Oceanography, Dona Paula, Goa 403 004, India; Vardhan Patankar is in the Department of Marine Sciences, Goa University, Goa 403 004, India.

*For correspondence. (e-mail: asgaur@darya.nio.org)

the Island and also to understand the relation between man and sea. Six places were identified for the excavations (Figure 2) and at each location, trenches were dug to a depth of virgin soil. These trenches were numbered¹³ as BDK-I to VI. Over 3000 shell remains have been noticed from these trenches. Significantly, layers 6 and 7 of trench BDK-I yielded exceptionally higher quantity of shell remains (Figure 3). Many varieties of shells have been noticed from each trench (Table 1). ¹⁴C dates from these shells varied from 3470 ± 80 yrs BP to 1910 ± 80 yrs BP (Table 2). The important shells recovered from Bet Dwarka excavations are the *T. pyrum* (chank), *C. ramosus* and *Dentalium*. The first two shells were generally used for various purposes like making beads, bangles, ladle, spoon, inlay work, seals and other artifacts. The third variety was used for beads only, as it is naturally shaped in such a way that it does not require any rework. *Dentalium* shells are also believed to have medicinal use. Several other varieties of shells from different trenches

have been found, which were used for food, etc. Details of some important shells are described.

Turbinella pyrum (chank)

The largest number of shells of this group has been noticed during the excavation. The important artifacts from this group are beads, bangles, apex (Figure 4 a) and collumella (Table 3). The chank shell is ovate in shape with a thick wall and without any protuberance. The central collumella (Figure 4 b) is solid, spiralling and can be distinguished from that of

Table 1. Shells recovered during Bet Dwarka excavation

Species	BDK-I	BDK-II	BDK-III	BDK-VI
<i>Aadusta onyx</i>		1		
<i>Anadara ehrenbergi</i>	1	4	1	
<i>Arabica arabica</i>	2	1	4	1
<i>Astraea stellata</i>	1			
<i>Babylonia spirata</i>	1	9	18	
<i>Cardita bicolor</i>		1	1	
<i>Cardium flavum</i>	2	4	2	
<i>Chicories romosus</i>	8	34	16	
<i>Circenita callipyga</i>		2	1	
<i>Clavus crassa</i>		1		
<i>Conus aroneosus</i>			1	
<i>Cypraea annulus</i>	1	3	2	
<i>Cypraea tigris</i>		2	1	
<i>Dentalium</i> sp.	271	46	71	129
<i>Electroma alacorvi</i>	1			
<i>Erosaria inocellata</i>	3	1	5	
<i>Erosaria turdus</i>			2	
<i>Hemifusus cochlidium</i>	3		2	1
<i>Hytissa numisma</i>		2	1	
<i>Laevicardium papyraceum</i>	1	2		
<i>Monetaria moneta</i>	32	1	16	
<i>Murex brunneus</i>		15		
<i>Nerita polita</i>	1	6	2	
<i>Paphia malabarica</i>		1		
<i>Potamides cignulatus</i>		1		
<i>Thais carnifera</i>			3	
<i>Thais mutabilis</i>		2	1	
<i>Tonna cepa</i>				2
<i>Tonna galea</i>			3	
<i>Trochus stellatus</i>	1	1		
<i>Turbinella pyrum*</i>	585	61	128	13
<i>Turbo brunneus</i>	13	45	26	
<i>Turbo coronatus</i>	17	21	5	
<i>Turbo ramosus</i>		4		
<i>Turritella terebra</i>			1	
Total	934	271	313	146

*Only collumella counted for number purposes, while waste and artifacts of this shell are give in Table 3.

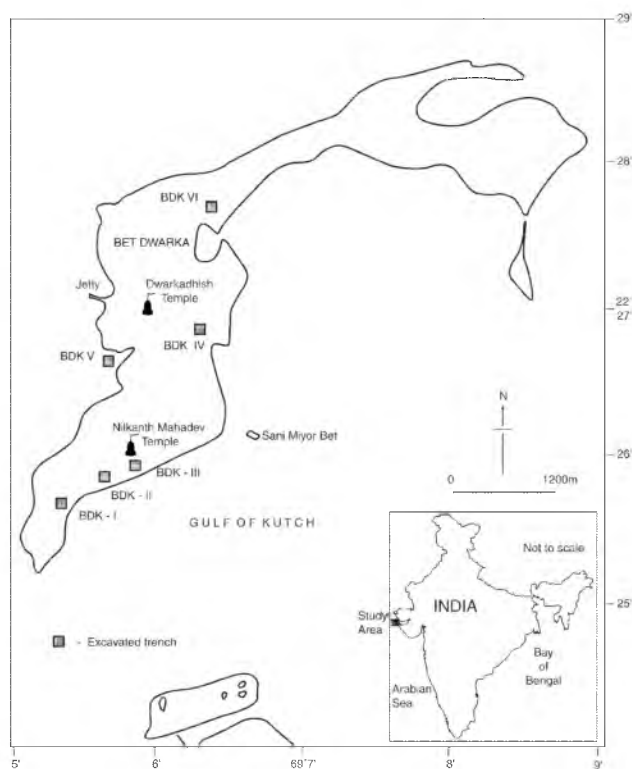


Figure 2. Location of archaeological sites in Bet Dwarka Island.



Figure 3. Layer 6 of BDK-I containing a large number shell artifacts.

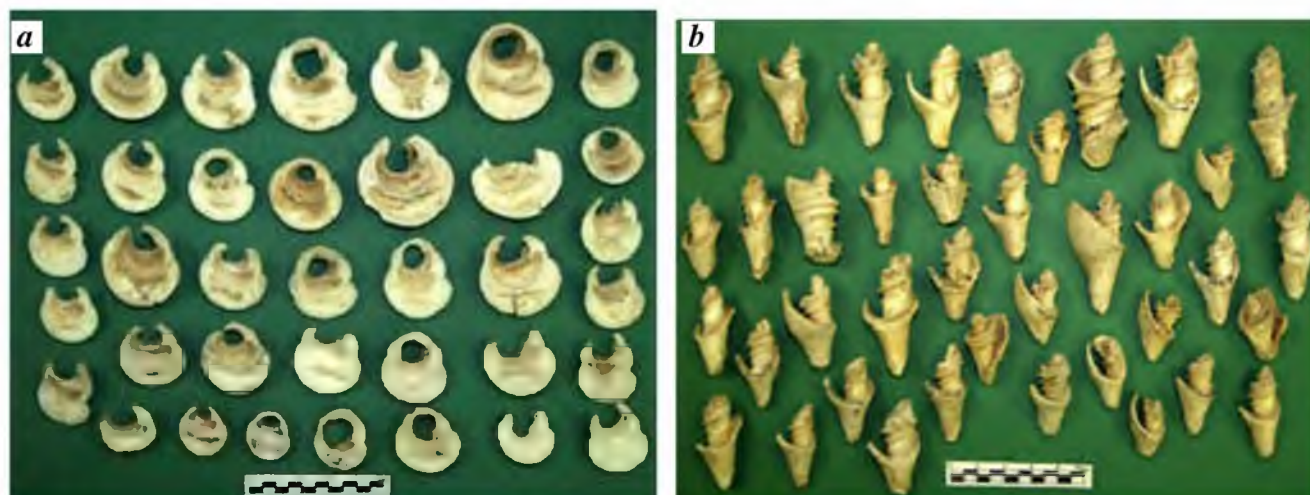


Figure 4. Sawn apex portion (a) sawn collumella (b) of *T. pyrum* discovered during excavation.

Table 2. ^{14}C dates of shells from Bet Dwarka Island

Site	Depth (cm)	Layer	Lab number BSIP	^{14}C date (yrs BP)	Calibrated date
BDK-I	Surface	Surface	BS-1898	2040 \pm 80	2120–1900
BDK-I	Surface	Surface	BS-1899	1910 \pm 80	1950–1730
BDK-II	240	8	BS-1998	1940 \pm 80	1990–1820
BDK-II	275	10	BS-1996	2000 \pm 80	2040–1870
BDK-III	220	9	BS-1997	2000 \pm 80	2040–1870
BDK-VI	20	1	BS-2000	3140 \pm 100	3470–3260
BDK-VI	50	2	BS-1993	3470 \pm 80	3830–3640

Table 3. Artifacts from chank shell at Bet Dwarka Island

Artifact	BDK-I	BDK-II	BDK-III	BDK-VI
Fragments of bangle	183	50	131	4
Apex portion	465	44	72	7
Collumella	587	52	115	13
Waste	217	14	76	8
Bead	1	2	3	–
Total	1453	162	397	32

other large gastropods by the presence of 3 to 4 prominent ridges, to which major muscles are attached. Average length of a shell can be up to 15 to 20 cm and width 10–15 cm⁸. It provides a unique structure for the manufacture of several bangles from a single shell. The organism living inside is also edible and nutritious⁸. Colonies of these shells are noticed generally on sandy bottom or in sandy areas between coral reefs or rocky areas, but they generally live in the shallow littoral zone, down to depths¹⁴ of 20 m.

T. pyrum has a restricted distribution, occurring only in the protected bays of the subcontinent. At present, major concentrations of this shell are at the southern tip of

India, the Gulf of Mannar, all around Sri Lanka and as far north as the mouth of the river Godavari. It is not common, on the western coast of the subcontinent, but large populations are found in the Gulf of Kachchh and along the coast of Sind and Baluchistan, West of Karachi¹⁵. In the Gulf of Kachchh also they are found only along the west shore, occurring at depths ranging from 5 to 20 m. This shell generally rolls up with current from deeper water towards the coast during summer months and disperses back into deeper water during cold winter months¹⁶. *T. pyrum* shells found in shallow waters near the coral reef are often interlaced with boreholes by boring organisms such as *Cliona* sponge. Hornell¹⁷ notes that these bore-holes are not found on shells fished from deeper waters or regularly fished beds.

The Gulf of Kachchh harbours rich gastropod fauna. So far, 72 species of gastropods have been recorded from this area¹⁸. Among them, *T. pyrum* holds a special position, as this is the only species of gastropods of commercial importance. Most important beds of this shell are known to occur in the inter-tidal zones of Okha, Aramda, Posithra, Azad, Wadinar, Bhaana, Salaya, Sikka, Pirotan island and Bedi on the southern bank of the Gulf¹⁹.

Although the sacred chanks are known to occur at depths of 10–20 m with sandy bottom⁴ along the Gujarat coast, they are also found in the proximity of coral reefs and are collected by hand-picking during low tide around Bet Dwarka Island. Presently, chanks are fished from the Jamnagar coast between Sachhana and Okha from the seaward rims of the patchy coral reef areas, from a depth of 4–6 m. Communities such as Sindhis, Vaghers, Meghward, etc. do majority of the shell fishing throughout the year but fishing at low tide (during spring tides) is generally preferred²⁰. The largest number of shell artifacts are made out from this shell (Table 3). The solid massive collumella of *T. pyrum* was used to produce a wide range of objects, but at BDK only a few beads.

Chicoreus ramosus

Another important shell used in Bet Dwarka is *C. ramosus*, which is amply found in the Gulf of Kachchh. The length of the shell ranges between 7 and 25 cm and width between 6 and 20 cm²¹. Structurally this shell is large, inflated with hollow spiralling collumella and numerous spines and nodes covering the entire body surface of the shell. The sutures are solidly joined making it possible to produce large circlets from each shell, provided all the spines are first removed. Unlike *T. pyrum*, it is not suitable for making solid objects from its collumella (Figure 5). The flesh of this species is also edible.

Generally, *C. ramosus* occurs in the inter-tidal zone, especially in rocky or reef areas at depths of 20 m. It preys upon oysters and other shellfish by perforating the hard calcium of the shell with an acidic secretion and consuming the soft part of the organism²¹. Boring worms and sponges also attach to this species, so that the apex and anterior parts of the shell are generally perforated by predator holes.

This species has wide distribution throughout the Indo-Pacific region, but its actual distribution along the coast of the subcontinent is somewhat limited. It is common in shallow bays of South India, Sri Lanka and the Gulf of Kachchh; but not common further west along the Sind and Makran coasts. A large number of wastes from *C. ramosus* have been found during the Bet Dwarka excavation.

Other shells

Other varieties of shells which were perhaps used for food and decoration have been recovered from the excavation (Table 1). The most important among them is *Dentalium* sp., which is available in large scale on the western shore of the Bet Dwarka Island, and is used even now as beads by the local people.



Figure 5. Sawn collumella of *Chicoreus ramosus* found during excavation.

Shell artifacts

A large number of worked shells have been recovered during the excavations, such as sawn apex, collumella, bangles and beads. A seal made of shell has been found in 1986 from this island. A brief description of the findings is given below.

Seal

A unique late Harappan seal made out of the chank shell was discovered from offshore area of Bet Dwarka Island²². It is 20 × 18 mm in size, with a three-headed animal motif representing a short-horned bull, a unicorn and a goat engraved on it and a perforated knob on its back for holding a ring (Figure 6). The seal is similar to the one reported from Mohenjodaro¹¹. It was found during the underwater excavation from layer 2 of a trench UW 6 measuring 1 × 1 m, which was laid 400 m seaward of the rocky promontory projecting between BDK-I and II²³.

Bangles

A large number of fragments of shell bangles have been found during surface exploration and excavation (Figure 7a). They are of various sizes and varieties such as plain surface with square or rectangular section, narrow bangles with a single ridge and triangular section and thin bangle with circular section. A few bangles with 2–3 grooves on the outer surface were also noticed.

Chank shell has been used extensively for manufacturing shell bangles. *C. ramosus* has also been used for making bangles. Primarily the outer body of the shell is used to



Figure 6. Late Harappan seal made of *T. pyrum* discovered during earlier exploration in Bet Dwarka Island.

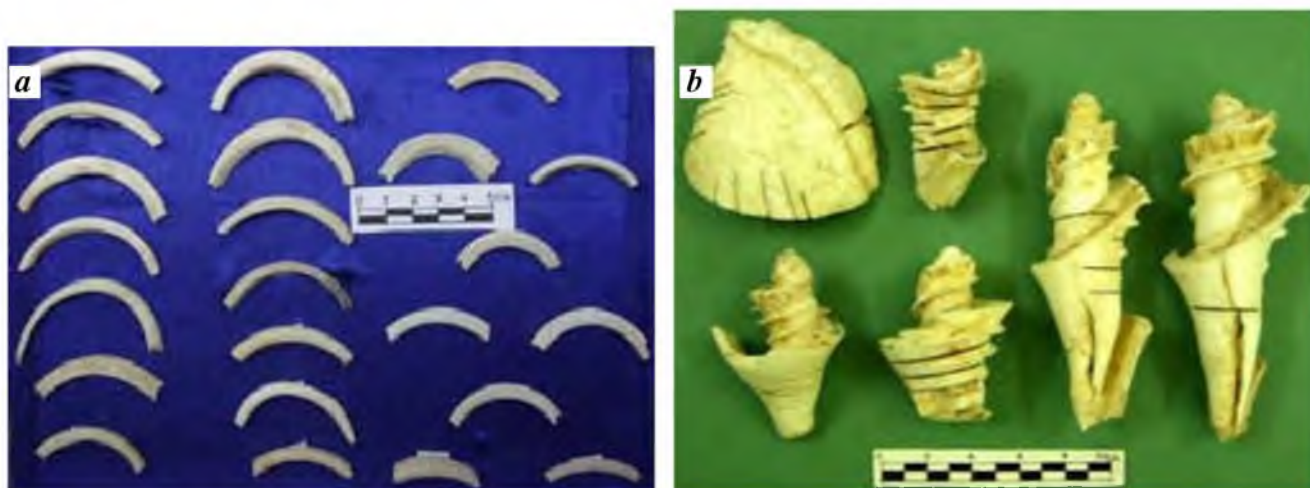


Figure 7. Fragments of shell bangles (a) and saw marks on shells (b) found during excavation.

fashion the bangle. Initially the apex portion is chopped off and then different sizes of bangles were sawn from the body portion. Saw marks on the collumella of many shells have been noticed (Figure 7b); width of the saw marks suggests that the thickness of the saw (which may be of steel or copper) is 1.0 to 1.5 mm. The shell bangle manufacture technology is similar to that noticed during Harappan period at various sites like Nageshwar⁸, Shahr-I-Sokhta¹² and Mohenjodaro¹⁵. This tradition continued during the late Harappan at Bet Dwarka and later on during the historical period. Interestingly, the initial method described for Nageshwar⁸ shell bangle manufacturing is different from that in Bet Dwarka. At Bet Dwarka, the apex has been chopped with a saw, as one can notice saw marks. However, rest of the method is the same for obtaining bangles. A large number of artifacts have been noticed of this shell (Table 3).

Beads

There are six shell beads; four of them are circular in shape like a ball, with a perforation in the middle (Figure 8a). Of the remaining two, one is long with a square section and with a perforation in the middle. The other has a projected circle on one end. In all probability, these beads have been made from the collumella part of *T. pyrum*, similar to those found from Harappan period sites across the subcontinent. Besides, a large number of *Dentalium* shell beads (Figure 8b) were also recovered during the excavation.

Ladle

Ladles were made from *C. ramosus*. Before the body of the shell could be cut, all the exterior spines were first sawn or chipped-off. 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.

A handle was formed by making two parallel longitudinal cuts from the anterior tip towards the main body whorl. In this manner, a rough ladle was detached from the shell and by repeating the process on the remaining half of the shell, a second but smaller ladle could also be produced. Though we could not find a complete, prepared ladle from the limited excavations at Bet Dwarka, there are unfinished ladles. Also the presence of a large number wastes of *C. ramosus* suggests that ladles were manufactured and must have been exported to other contemporary sites in Saurashtra and Kachchh regions.

Absolute dates from shells for archaeological site at Bet Dwarka

Absolute dating from marine shell is common practice and every event of marine geological history has been dated from the shells. In archaeology, many prehistoric sites have been dated using marine shell. However, dating from shells belonging to the protohistoric and historical periods has not received enough attention. From Bet Dwarka, seven shell samples have been dated using conventional ¹⁴C method (Table 2). The dates of Bet Dwarka archaeological sites range between 3470 ± 80 (cal. 3830–3640) and 1910 ± 80 (cal. 1950–1730) yrs BP. They are in agreement with the archaeological findings. The oldest date came from a late Harappan site (BDK-VI), which is generally dated between 19th and 14th century BC. Similarly, historical period sites on the southern coast of the island are dated from 5th century BC to 4th century AD, which corresponds to archaeological findings. Historical period dates have also been reaffirmed by the AMS method from charcoal and thermoluminescence method from potsherds. ¹⁴C dates from the shells of Bet Dwarka Island have opened up another dimension in the field of absolute dating of an archaeological site, particularly of recent times.

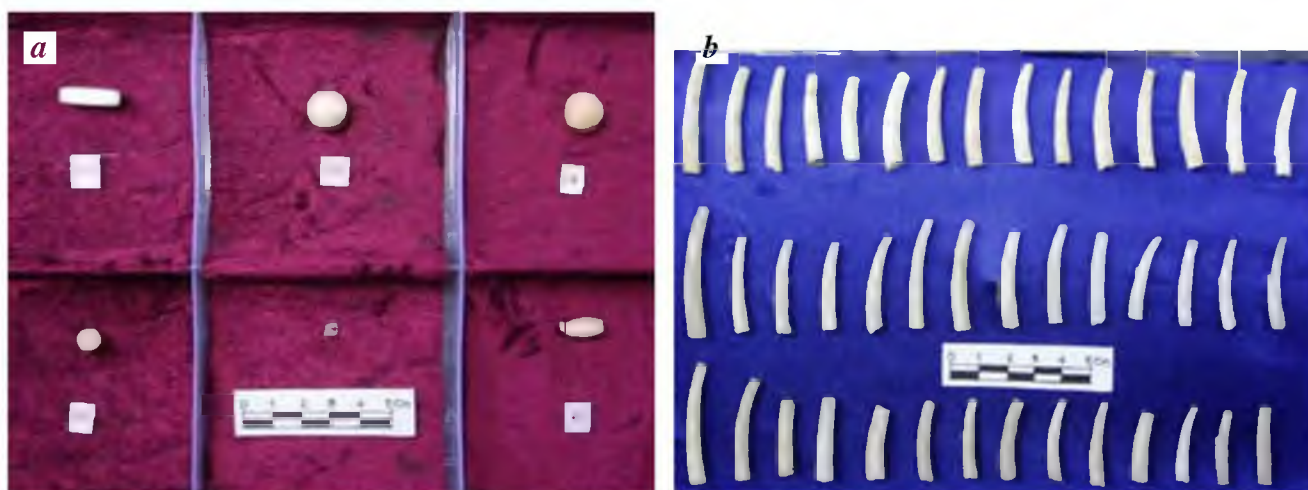


Figure 8. Shell beads (a) and *Dentalium* shell beads (b) found during excavation.

Conclusion

The widespread use of shell objects on many sites in ancient India is well known. Varieties of shells are found in the Gulf of Kachchh, which led to the growth of this industry in the region since the Harappan times. Archaeological findings from Bet Dwarka indicate that marine resources, specially shells attracted early settlers (late Harappan) on the island, which later became a major industry of the island. Perhaps it was one of the biggest shell industries during the historical period. Chank shell is available and fished around Bet Dwarka even today. Products from shell must have been traded within and outside of the country. Shells have been used effectively as ^{14}C dating material, which has provided useful timeframe for Bet Dwarka settlement dating back to protohistoric to historical period.

1. Watelin, L. Ch., In *Excavations at Kish, IV*, Paris, 1934, pp. 25–26.
2. Mackay, E., In *Further Excavations at Mohenjo-Daro*, Indological Book Corporation, New Delhi, 1976, p. 582.
3. Mackay, E., In *Chanhu-Daro Excavation 1935–36*, Bharatiya Publishing House, Varanasi, 1976, pp. 231–233.
4. Hornel, J., In *Indian Molluscs*, Bombay Natural History Society, Bombay, 1951, pp. 24–26.
5. Hornell, J., The chank shell cult of India. *Antiquity*, 1942, **16**, 113–133.
6. Rao, S. R., In *Lothal A Harappan Port Town (1955–62)*, MASI-78, New Delhi, 1985, pp. 614–624.
7. Rao, S. R., Excavations at Rangpur and other explorations in Gujarat. *Ancient India*, 1962, **18–19**, 5–207.
8. Hegde, K. T. M., Bhan, K. K., Sonawane, V. H., Krishnan, K. and Shah, D. R., Excavation at Nageswar, Gujarat: A Harappan shell working site on the Gulf of Kutch. M.S. University, Baroda, 1990, pp. 125–136.
9. Dhavalikar, M. K., Raval, M. R. and Chitalwala, Y. M., In *Kuntasi, A Harappan Emporium on the West Coast*, Deccan College, Pune, 1996, pp. 331–347.
10. Joshi, J. P., In *Excavation at Surkotada 1971–72 and Exploration in Kutch*, Archaeological Survey of India, New Delhi, 1990.
11. Marshall, J., In *Mohenjo-Daro and the Indus Civilization*, Arthur Probsthain, London, 1931, p. 197.

12. Durante, S., Marine shells from Balakot, Shahr-I-Sokhta and Tepe Yayha: Their significance for trade and technology in Ancient Indo-Iran. In *South Asian Archaeology 1977* (ed. Taddei, M.), Istituto Universitario Orientale, Naples, 1979, pp. 317–342.
13. Gaur, A. S. and Sundaresh, Onshore excavations at Bet Dwarka Island in the Gulf of Kachchh. *Man Environ.*, 2003, **XXVIII**, 57–66.
14. Mahadevan, S. and Nayar, K. N., Ecology of pearl oyster and chank beds. In *The Commercial Molluscs of India* (eds Nair, R. V. and Rao, K. S.), Central Marine Fisheries Research Institute, Cochin, 1974, pp. 106–121.
15. Kenoyer, J. M., In *Shell Industries at Mohenjo-Daro, Pakistan*, Istituto Italiano Per IL Medio ed Esteemooriente, Roma, 1984, pp. 99–115.
16. Bhan, K. K. and Kenoyer, J. M., Nageswar: A mature Harappan shell working site on the Gulf of Kutch. *J. Orient. Inst. Baroda*, 1984, **34**, 67–80.
17. Hornell, J., The chank bangle industry: Its antiquity and present condition. *Mem. Asiat. Soc. Bengal*, 1913, **3**, 407–448.
18. Menon, P. K. B., Datta Gupta, A. K. and Dasgupta, D., The marine fauna of Gulf of Kutch. Part-II. Gastropods. *J. Bombay Nat. Hist. Soc.*, 1961, **58**, 475–494.
19. Nayar, K. N. and Mahadevan, S., Chank resources of India. In *Proceedings of the Symposium on Living Resources of the Seas around India*, Central Marine Fisheries Research Institute, Cochin, Special Publication, 1973, pp. 672–686.
20. Pota, K. A. and Patel, M. I., Exploitation of chanks from the Gulf of Kutch. *Bull. Cent. Mar. Fish. Res. Inst.*, 1991, **42**, 445–450.
21. Kenoyer, J. M., Shell working industries of the Indus Civilization: A summary. *Palaeorient*, 1984, **10**, 49–63.
22. Rao, S. R., In *Progress and Prospects of Marine Archaeology in India*, National Institute of Oceanography, Goa, 1987, pp. 45–48.
23. Rao, S. R., Excavations of legendary city of Dvaraka in the Arabian Sea. *J. Mar. Archaeol.*, 1990, **1**, 59–98.

ACKNOWLEDGEMENTS. We thank the Director, National Institute of Oceanography, Goa for permission to publish this paper. We are grateful Shri K. H. Vora, Marine Archaeology Centre for critically reviewing the manuscript. We also thank the anonymous reviewer for suggestions to improve the manuscript. Shri S. B. Chitari and Shri R. Uchil prepared line drawings and Shri Sheikh Ali Karim provided the photographs. This is NIO contribution no. 3982.

Received 20 September 2004; revised accepted 8 May 2005