MARINE ARCHAEOLOGY IN INDIA



S. R. RAO

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DR. S. R. Rao



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PREFACE

Marine Archaeology is a new discipline which has attracted the attention of departments of science, Technology and Humanities all over the world during the last four decades after the discovery of highly significant shipwrecks especially the *Yassiada* wrecks off the Turkish coast in the sixties, King Henry VIII's war ship *Mary Rose* sunk in 1545 and raised in 1982 and the *Titanic* that sank in 1912 and was discovered in the course of several expeditions (1985-1991). Although Treasure-hunting and Souvenir-Collecting from sunken habitation sites and shipwrecks by sponge and pearl divers were in vogue for more than half a century, proposal for scientific investigation of shipwrecks and submerged ports has been seriously considered by the Universities, Archaeology Departments and UNESCO only recently.

The International Committee on Underwater Cultural Heritage (ICUCH) has drafted a Convention for regulating underwater archaeological excavation and preserving the Cultural Heritage of Man. India is represented on ICUCH by the Author. The salient features of the Convention are published in the *Journal of Marine Archaeology* Vol. 7-8, 1997-98 for the benefit of the public and the Expert Committee of the UNESCO has of late discussed the draft which is most likely to be finalised for acceptance by States.

India made a modest beginning by establishing a Marine Archaeology Centre in the National Institute of Oceanography (NIO) in 1981. The infrastructural facilities were provided by NIO and initial grants came from Indian National Science Academy and Department of Science and Technology (DST) and subsequently from the Council of Scientific and Industrial Research (CSIR). Recently the Department of Ocean Development (DOD) has also extended assistance for offshore exploration and the Archaeological Survey of India funded the training programme for a couple of years while the Birla Foundation also gave a grant on one occasion. Marine Archaeology is not a luxury, but as much a necessity as Land Archaeology. Underwater explorations involve a lot of risk. The deployment of highly sophisticated instruments and skilled diving archaeologists is bound to be expensive and State and Central Government funding is an absolute necessity. The discovery of Dwarka and Poompuhar and shipwrecks made within 10 years by a small team of dedicated Marine Archaeologists and Scientists of the MAC is commendable. For a country of the size of India and its long history of maritime activity, a much larger unit of Marine Archaeology with adequate budget and equipment is needed for preparing an inventory of shipwrecks and submerged ports all along the Indian coast. It must be remembered that Marine Archaeology has been generating scientific data also essential for a sustained study of sealevel fluctuations and effect of Marine environment on metals, wood etc., over long periods. Hence both from the point of view of saving underwater Cultural Heritage and generating scientific data, the awareness of Marine Archaeology should grow. In this direction the

Society for Marine Archaeology has been doing yeoman service through its publications and holding periodical conferences on Marine Archaeologists at the national and international level. I hope the Maritime Museum at Dwarka will take shape to preserve the site and antiquities.

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S.R. Rao

Bangalore March 1, 2000

ABBREVIATIONS

ASI	:	Archaeological Survey of India	
A.I.	:	Ancient India - Bulletin of ASI	
IAR	:	Indian Archaeology - A Review	
B.O.R.I	:	Bhandarkar Oriental Research Institute, Pune.	
IBID. (IBEDEM)	:	In the same place	
Op. CIT (Opera Citato)	:	In the work cited	
C.S.I.R.	:	Council of Scientific and Industrial Research,	
		(Government of India).	
C14/14C	:	Carbon 14 (Dating Method).	
T.L.	•	Thermoluminiscence (Dating Method)	
DWK.	•	Dwarka (Modern Town)	
H.W.L.	:	High Water Line (in high tide)	
JMA	:	Journal of Marine Archaeology, NIO/Goa	
L.W.L.	:	Low Water Line (in low tide)	
P.G.W.	:	Painted Grey Ware.	
O.C.P.	:	Ochre Coloured Pottery	
L.R.W.	:	Lustrous Red Ware.	
L.H.P.	:	Late Harappan Pottery.	
M.S.L.	:	Mean Sea Level.	
SMA	:	Society for Marine Archaeology	
NIO	:	National Institute of Oceanography	
IZ	:	Intertidal Zone	
OCD	:	Okha Charted Datum	
PHISPC	:	Project of History of Indian Science, Philosophy and Culture, Delhi.	
INA	:	Institute of Nautical Archaeology, Texas A and M University	
IJNA	:	International Journal of Nautical Archaeology, London	

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Fig.1 Cult image of Dwarkadhish (Lord of Dwarka)in Trivikrame form of Vishnu with all the insignia (lanchhanas) of Shri Krishna.

CHAPTER I

FIVE THOUSAND YEARS OF ADVENTURE ON SEA

Seafaring in the Vedic Age

an, though a creature of the land, has an urge to explore the sea, mainly because a greater part of his evolution, including the vertebrate form, was within the sea. The earliest text of the world, the Rigveda, dated back to 3000 B.C., asserts that without water there is no life (RV. IV. 58.1,11)¹. The sea is a unique 'wonderland', with active volcanoes and hot water streams, high mountains and deep canyons. It is full of plant and animal life and its wealth is proverbial. According to the Mahābhārata, almost all living and non-living things came out in the course of the "churning of the ocean", Samudramanthan - (fig. 2) a feat undertaken by the devas (gods) and asuras (men of demonic traits). The Bhagavata Purana², a text of Srimad Bhāgavatam by Raghunandan — second century, adds that the life-giving nectar as well as the life-destroying poison, the animals and medicinal plants, gems, pearls and shells, came from the sea (Bhāgavata ibid). The pearl divers of yore collected, besides pearls and conch shells, gemstones, for their commercial value. Long before the Homeric Ballads eulogising the voyage of Odysseus, the Rigueda gives a graphic description of the operation of rescuing Bhujyu and his men lost in a storm on the high seas, resulting in the sinking of their ship $(RV.1.116.3.5)^3$. Sayanacharya, in his commentary on the Rigveda, makes the following observation: "Tugra, a rājarishi, was a favourite of Asvina. He was troubled by the

enemies living in the islands (Dvīpāntarvartinbih). He sent his son Bhujyu with an army in a ship to conquer the enemies. The ship, however, was drowned because of the winds, when it was far away in the ocean. Bhujyu gratified the Asvina by prayers. The Asvina went with their army in three ships and brought back Bhujyu to his father Tugra by travelling three days and nights. Srinivas Ritti is of the view that there must have been an ancient port near modern Karachi at the mouth of a river in the Souvira country of ancient days. The island referred to in Rigveda may well be Bahrain. The type of ship used is described as Sataritra and a Ratha with a hundred feet (*satapadbhih*). Perhaps, it was a multi-oared boat⁴ resembling the Egyptian galleys. In this connection, it may be noted that a potsherd from the Harappan port of Lothal in Gujarat (2800 B.C.; calibrated 14C date) is painted with the motif of a multi-oared boat⁵, suggestive of the ship with a hundred oars. M. S. Kirloskar has, in fact suggested that the Ratha was a flat bottomed boat, triangular in shape, with the figure of a horse attached to the tapering end^6 . The Pathyaśvash verses of the Rigveda ordains that the wealth that comes from realms across deserts, over the waters, from the wilderness as well as from highways, from home-stead and from the forest, be blessed⁷.

As advanced mariners, the Vedic Aryans adopted the motto, 'May our ship embark to all quarters of the earth:

मधुमन्मे परायणं मधुमत्पुनरायनं 8

They prayed, "May my going forth be



pleasant, may my home-coming be pleasant". The sea-borne vessels are described as *nāvah samudriyah*, and voyage to near and distant lands *as samudradavarada parasmāt*.

India, the Home of Oversea Refugees

Man has tried to meet the challenge of the sea in his effort to exploit its resources to his advantage and to know the unknown. In the process, he has gained much wealth but also lost many valuable ships, men and cargo. Today, we can rarely write the maritime history of man without a proper study and interpretation of his activities on the sea, which cannot be divorced from those on land. They included not merely the wealth-seeking merchants, the adventureseeking sailors, and the power-seeking rulers who sought new lands, but also great philosophers, teachers, religious leaders, artists and men of letters who migrated to distant lands and carried the torch of Indian Civilization. In turn, India welcomed with open arms the persecuted religious groups seeking shelter here. In the days of Solomon I, merchants came to India, seeking spices, textiles, gems, even birds and monkeys. In the first millennium B.C. 20,000, Jews are said to have arrived at Cranganore after a long voyage of 3 years from Babylon to escape persecution at the hands of Nebuschednazzaar. Later the Syrian Christians and the Parsees, too, came by sea.

Maritime Activity of the Indus Civilization

The Harappan refugees from Sind and Punjab sought shelter in Gujarat and Rajasthan. Later in the 8th Century A.D. the persecuted Parsees who came from Iran to Gujarat made great contribution to the economic progress of India. The partition of India in 1947 brought more than a million persecuted refugees from Pakistan to India.

The Harappan seals, stone weights and beads of gemstones are some of the unperishable articles found in the excavations in Bahrain, Failaka and Oman⁹ in the Arabian Peninsula, and at Ur, Kish and Brak in Iraq, and Hissar and Suse in Iran¹⁰. Socotara was an important entreport for exchanging Indian goods, more than 2500 years ago. The occurrence of the Harappan chessmen in the tomb of Queen Hatchepsout and Egyptian terracotta models of mummies and gorillas in the excavations at Lothal (70°14', 25"E long; 20°31'25" Lat) are clear indications of extensive overseas trade between India and Africa in the third millennium B.C. The spread of Indian culture to the south and southeast was entirely due to overseas trade and migration of religious teachers, artists and craftsmen and, to a limited extent, due to political expansion (Fig. 3). Sanskrit and Tamil languages, temples and stupas built in Indian style, the shadow plays and much of the literature of Borneo, Java and Sumatra are the result of Indian influence¹¹.

Although India was the 'Proud Mistress of the Eastern Seas' from 3000 B.C. up to 1600 A.D. there is hardly any written record, giving a chronological account of shipping, ports, cargo and vessels built in India. Here and there, vague references are made in ancient texts to voyages, shipwrecks and cargo¹². Occasionally, an inscription, a few sculptures and paintings, may throw some light on naval battles, customs paid, and type of vessel used. The earliest archaeological evidence for the type of boats, used in India comes from Harappa and Mohenjo-daro, where seal engravings depict boats with or without cabins.¹³ Lothal, the most important port of the Indus (Harappa) Civilization, at the head of the Gulf of Cambay, has yielded three types of terracotta models of boats.¹⁴ Two types of stone anchors, one of which is spheroid and the other triangular in plan, both having a single hole, were found in the dockyard.

The First Dockyard of the World

The Harappans were great navigators, and the first nautical engineers of the world who could build a tidal dock at Lothal (Rao S.R. 1991) This artificial basin lined with brick walls built in 2300 B.C. (2800 B.C. calibrated 14 C date) is 210 x 35m, with a draught of 3.5 m (Fig. 7). Ships were sluiced at high tide into the basin through the river estuary by an inlet



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channel. Similarly ships had to leave the basin at high tide when the water level in the dock was maintained sufficiently above the sill of the inlet channel. The engineers had introduced a unique lockgate system (Fig. 7) in outlet where a wooden gate was lowered into the grooves at ebb tide and a minimum draught of 1.5 m to 1 m was maintained for easy manoeuvrability of the ships in the dock. The gate was opened at low tide to ensure automatic desiltation of the basin. The dock had a 240 m long wharf for loading and unloading the cargo. The builders selected the site of Lothal, because the tidal range in the Gulf of Cambay was 10m, which enabled ships to sail up the ancient river (Bhogavo or Sabarmati) and enter the dock. Its location is such that ships were safe in the storms and cyclones. The dock was not built in the main stream of the river in order to avoid siltation. The selection of the site and provision of buttresses to the walls of the dock to withstand water thrust and scouring effect, suggest that the Harappans possessed a high degree of knowledge relating to the ebb and flow of tides. The builders of Lothal dock, which is the earliest and the only one of its kind in the ancient world, so far known, must have had a sound knowledge of hydrography and nautical engineering. Their study of tides did not stop with observation alone, but extended to the effect of tides on brick-built structures. To reduce the corrosive effect of salt they used overburnt bricks in the construction of the walls of the dock. One more facility provided at the dock was a 240m long and 31m wide wharf of mud-bricks, adjoining the western embankment for hauling cargo. Nearby was a well-ventilated warehouse divided into 64 cubicle mudbrick blocks with interconnecting channels. The wooden superstructure erected over the blocks gave protection to the cargo stored therein against sun, wind and rain. The analysis of sediment samples collected from the floor of the basin of the dock by R. Nigam, a scientist of the National Institute of Oceanography, Goa, has confirmed the presence of gypsum, and a micro-organism identified as foraminifera¹⁵. This organism lives

in high tidal environment. Obviously, the sea water must have been entering the basin in Harappan times. This fact establishes beyond doubt that the structure served the purpose of a dock, and not that of a reservoir for potable water. It could not have been an irrigation tank either. The stone anchors found in the dock are too heavy to be used as counterweights in lift irrigation. In the Lothal dock $(710 \times 240 \text{ ft})$ 30 ships of 60 tons could berth at a time. The cargo exported from Lothal was sealed in the warehouse, as attested to by the clay labels (sealings) affixed on the packages. They bear impression of the seal on one side, and that of the packing material such as woven cloth, twisted cord and bamboo mats on the other¹⁶. The visitors to Lothal, where the brickbuilt dock, warehouse and various buildings of the neatly built Acropolis and Lower town are well preserved, will also be able to see the pots and pans, seals, gamesmen, jewellery, scientific instruments, stone weights and other artefacts displayed in the Museum at the site.

The discovery of a Bahrainian seal at Lothal dated 2300 B.C. (Fig. 4) and a seal of west Asian origin in Late Harappan levels at Prabhasa, signifies brisk overseas trade between India and Mesopotamia in the 3rd and 2nd millennia B.C. The ivory rods found in the Biblical site Ugarit III (Syria) bear close resemblance to those from Lothal.¹⁷ The Reserved Slip Ware and other ceramic fabrics of Mesopotamian and Ugaritic origin in Lothal are indicative of a two-way traffic. The Meteorologist, Ramaswamy; observes that Harappans experienced monsoons during the period 2500 and 1700 B.C.¹⁸ The Indus seal inscriptions mention trpag (Tarpagga), a type of boat; śaśaka the term for captain of the ship; and *mana*, the sumerian weight.¹⁸ In brief, the Indus Civilization, now being christened as Sindhu-Sarasvati Civilization because of the vast area it occupied from Iranian border to the Deccan, contributed more to oceanic seacraft than any other proto-urban civilization of the Middle East. There is also literary evidence to suggest post-Indus maritime activity. For instance, the Mahābhārata mentions that Krishna

saw some ships laden with cargo going out of Dvārakā, and others coming to Dvārakā.¹⁹ The same text adds that Pandavas escaped destruction, in a boat, constructed by Vidura and provided with equipment suitable for defying hurricanes. The recent underwater excavation in the Arabian Sea, off modern Dwarka, on the Gomati has confirmed that it was a major port 3500 years ago; and long after it was submerged by the sea, people again settled there in the early centuries of this era.

Sea Trade : Post-Harappan and Pre-Mauryan periods

The information on sea voyages shipping and ports in the first millennium B.C., is scanty, spread over a few Buddhist Jātakas and Jaina texts. Broach (21º 29 N Long; 72º42 E Lat) and Sopara (19°10'N; 72°50'E) were two great emporia in the 2nd and 1st millennia B.C. Excavation by the author at Mehgam $(21^{0}42)$; 72º45'E) near Broach in 1957 at the mouth of the Narmada, has yielded evidence of occupation in 1900-1600 B.C.20 Nagal, 8 km west of Ankleswar in the Narmada estuary, was excavated by Soundara Rajan. Perhaps, Bhrugutirtha (Barygaza of the Roman period) was situated in the Late Harappan and Rigvedic Periods at Mehgam (Fig 5). When it was destroyed by the sea, the inhabitants were forced to build a new township near modern Broach. According to K.V. Soundara Rajan, Mehgam situated very near the sea, has a better claim to being identified as Bhrugukaccha, since archaeological remains dated 1900-1600 B.C. found at the site.²¹ The dehave been commissioning of the estuarine ports (Dronimukhas), such as Lothal, Khambhat (Sthambhatīrtha), Bhrugukaccha or Barygaza (Mehgam) Poompuhar (Kaveripatnam) and Kalingapatnam, is attributable to the combined destructive forces of the sea and the great rivers. The chronological sequence of Mehgam, Nagal and Broach suggests that destruction was due to a rise in the sea level.²² The postchalcolithic occupation of Nagal, situated near Broach, partly fills the gap in the maritime history of Gujarat, between the post-Harappan and the pre-Mauryan periods. According to the

Mahābhārata, Sahadev, in his, pursuit of conquests (digvijaya), reached Surparaka (Sopara), which is known for Asoka's Rock



Fig. 4 : Mirror impression of Baharain Seal

Edict a fragment of which has been found, and is now kept in the Prince of Wales Museum, Bombay.

Heritage of Man in the Sea

The archaeologist is concerned with all human activities. In the course of the past one hundred years, he has excavated thousands of sites on land, and brought to light vanished civilizations; he has thereby tried to trace the history of human progress in all fields---scientific, technological, cultural, economic, political and social. But the activities of man on land cannot be isolated from his activities connected with water. He has braved the high seas and gone to distant lands in search of new sources of raw materials and finished products. The interaction of ideas and cultures has hastened the process of sophistication. The archeologist has, therefore, recently taken seriously to the study of the vestiges of man in the water body. Sunken ships, ports, sites of naval battles, anchors lost in voyage, the sacred seas, rivers and lakes into which offerings were made, are great sources of knowledge. The cargo, tools, weapons, ornaments, relics of various religious groups that assembled on ships and boats, also lie buried in water. In India, all seas, rivers and lakes were considered sacred, and offerings were made to them not only by seafarers but also the common man. All the underwater antiquities, portinstallations and ships must be identified, studied, preserved and explained, in writing the maritime history of the world in general and



India in particular. Shipwrecks (fig. 5) and portsites yield a large number and variety of artefacts covering a period of ten thousand years of man's progress.

Birth of Marine Archaeology

Maritime activity is one of the major activities of man involving commerce, science, technology, art, religion and philosophy. A major achievement of maritime activity is the interaction of different cultures leading to better understanding and peace.

The introduction of aqualung and other sophisticated tools for underwater exploration has given birth to a new discipline known as Marine Archaeology, which may be defined as the study of past seafaring from material remains of this activity. Seafaring involves economic and operational activity in which ships are but one of the several elements. There must be good sheltered harbours with docking facilities; warehouses where cargo can be stored, examined and certified besides markets for selling and purchasing goods. Easy communication and transport with the hinterland supplying raw materials and manufactured goods for export are necessary. A boat-building and repairing yard is a pre-requisite for long-distance overseas trade. A system of insuring goods and boats against risks was gradually evolved. Interpreters of foreign languages and provision of rest houses for foreign merchants visiting the port are essential. Advancing money for building ships and purchases abroad and exchange facilities are other requirements of overseas trade. A maritime country like India evolved its own technique of ship-building, acquired navigational skills and provided infrastructural facilities.

In his voyages on sea involving high risk, man is trying to understand nature. Maritime activity has led to better distribution of raw materials and finished products and better diffusion of knowledge.

India occupied a pre-eminent position in overseas trade up to 16th century A.D. but the disturbed conditions in the country in the last days of the Mughal Empire resulted in the decline of trade; and the introduction of modern machines left millions of craftsmen unemployed. With the passing of trade into foreign hands, the indigenous shipping industry suffered heavily. Once again, after regaining political independence, India has been making vigorous efforts to build its own ships, both for the defence of its shores and for carrying goods to overseas markets.

Objectives of Marine Archaeology

The foremost objective is to explore, excavate and preserve the underwater cultural heritage of mankind. It is the duty of the State to endeavour by educational means to create and develop, in the public mind, the value of underwater cultural heritage. This can be done through exhibitions and publicity through media.

The UNESCO has realized the importance of underwater cultural heritage as an integral part of the cultural heritage of humanity, and, in particular, as an element in the history of people, nations, and their relations with each other concerning their shared heritage. Of late, the public interest in the preservation of underwater cultural heritage has been conspicuous. At the same time, threat to this heritage from treasurehunting, constructional and dredging activity, and exploitation of marine resources, has emphasized the urgency of taking effective steps to protect underwater cultural heritage for posterity. Caution is, however, necessary vis-a-vis unscientific excavation of shipwrecks and submerged ports. Realizing that any effective regulation and supervision of exploration and preservation of cultural heritage is possible only with the cooperation of all states, the UNESCO has asked the ICOMOS International Committee to draft a "convention for the protection of the Underwater Cultural Heritage". This committee of 12 experts including the author has discussed various issues and drafted the convention for the approval of UNESCO and UN members.²³ "Underwater Cultural Heritage" means all underwater traces of human existence including (a) sites, structure, buildings, artefacts and human remains together with their archaeological and natural context and (b) wrecks of a vessel, vehicle, aircraft or any part thereof, its cargo and contents". The draft convention seeks to protect underwater cultural heritage, which has been lost, jettisoned or abandoned, and is at the bottom of the sea for at least 100 years. The States will have the right to protect heritage that is less than 100 years old. The responsibility of each State to look after the underwater cultural heritage in its cultural heritage zone is recognized, but India wants that this provision should extend to the Exclusive Economic Zone (EEZ) of the State without being limited to the shelf zone beyond territorial waters. India's EEZ extends upto 200 nautical miles from the coast of the mainland and the islands. One of the articles in the draft convention says that "States shall take all necessary measures to preserve (and dispose) underwater cultural heritage for the benefit of human kind." It encapsulates the principle underlying article 149 of the United Nations Law of the Sea Convention, 1982. The underwater cultural heritage to which this convention applies, is not subject to the Law of Salvage. Another Article in the draft convention makes it obligatory for each State Party to undertake to prohibit the ships of its flag from activities affecting underwater cultural heritage in respect of any area of the sea which is not within its cultural heritage zone, or territorial sea of any other State Party. This shall not apply to the activity undertaken in accordance with the Charter. The state shall have the right to seize any artefact of underwater cultural heritage retrieved in a manner not conforming with the provisions of the Charter. This is meant to stop unscientific excavation and retrieval. The antiquities seized from unauthorized digging shall be recorded, protected and preserved. The convention recommends sharing, as far as possible, the information regarding discovery, location, etc., of underwater cultural heritage with members of the convention.

India took the lead in this matter by establishing (MAU) Marine Archaeology Unit in the National Institute of Oceanography, Goa, in 1981 as a result of the generous funding by the Indian National Science Academy. In its project proposal submitted to the Department of Science and Technology and approved by A.P. Mitra, MAU defined the objective of undertaking as follows: (Progress of marine archaeological research: Report of the Marine Archeology Unit 1987-89)

- (1) To discover, excavate, interpret and preserve for posterity the underwater cultural heritage of India and neighbouring countries, where the impact of Indian culture was felt as a result of maritime activity. This needs cooperation of all the countries involved in Indian Ocean trade.
- (2) To reconstruct the history of maritime trade, docking and harbour facilities, warehouses and repair yards besides tracing the development of boat-building technology by excavating submerged ports and sunken ships.
- (3) To develop indigenously efficient methods of underwater archaeological excavation, documentation and retrieval of wrecks in shallow waters of the tropical region.
- (4) To generate data for eustatic studies in sea level fluctuation, coastal erosion and effect of the environment on metals, wood, paper and other perishable materials.
- (5) To create, through lectures and films, awareness among the public about the need for preserving underwater cultural heritage. Chapter V of this book reviews the work done so far to achieve the objectives of undertaking marine archaeological studies in India between 1982-1994.

Maritime Activity in the Pre-historic Period

The INA Newsletter ²⁴ published a letter from Gary Blair, under the caption "Across seas, along shores,"-which brought to the notice of Marine Archaeologists the likelihood of finding precolumbian shipwrecks. The Mexican survey suggests possible relationships between Mayan coastal ruins and coastwise navigation. Gary Blair writes, " I would like to attach a small addendum to the approaching celebration of the Columbus Quincentennial - a short dedication to the ancient mariners who intentionally - or accidentally but inevitably, traversed natural routes across the earth's two great seas and encountered the coasts of the Americas. That such voyages were possible is indisputable: scholars have described the unavoidable, conveyor-belt quality of primary oceanic winds and currents such as the Gulf Stream, the tropical Atlantic and Pacific trade-wind belts, the south Atlantic drift, the Peru current, the Kuroshio current of the North Pacific and the Indian Ocean trades. However, the influence wielded in the ancient New World by the ancient Old apparently were of a subliminal type, such that, there is clear secondary evidence but nothing as blatant as a handwritten logbook, an officially witnessed land grant, or even the remains of some ancient cargo ship that was swept away on the Canary current into American waters, at least not as yet."

"I beseech all of you at INA to keep a vigilant eye in your searching and travels through underwater America for the artefacts and ephemeral hull-traces of pre-columbian voyagers. However precious are the relics of the ships and men of the Age of Discovery, even more priceless are the clues to the movements of the wanderers, refugees and heroes of ancient times who reached the same distant shores.... is it mere chance that the vast majority of those nonnative embodiments delineate the Chinese, Indonesians, Ainus Romans, Africans, Semitics, Arabs and Europeans?... And were you to measure the distance from the Cape Verde Islands to the bulging northern coast of Brazil and deduct the daily westward set of the current, you might find that this voyage seems far less difficult than the well-documented Phoenician circumnavigation of Africa in 600 B.C"

"The profuse variety of depicted humankind (in pre-Columbian art and culture) takes the breath away; the mind starts spinning out the impossible but unavoidable conclusion that ships must be there somewhere under the silt and muck, or under the embalming coral, rubble and detritus..."

In this connection it is relevant to point out that the Indus valley people had made such progress in navigation that they could build three types of sailing ships which reached the African and Sumerian coast, as is evident from the occurrence of terracotta models of the Egyptian "mummy" and African gorilla, besides the Sumerian "bearded man" at Lothal. The artefacts brought into Lothal port of the Indus Civilization included spiral rings of Minoan type, Bahrain type seal and copper ingots.²⁵ The 3 holed triangular stone anchor of Dwarka is reminiscent of similar ones from late Bronze Age Ugarit and Cyprus. The West Asian seals found in Maski (in Karnataka) Prabhas and Rangpur (Gujarat)⁻ attest to the continuity of overseas trade between India and West Asia.

Scientific Data

Every datable wreck and port-installation in situ acts as a chronological scale on the seafloor. Underwater archaeological excavation generates data pertaining to the nature and rate of sedimentation and coastal erosion on which the naval architect can base his future plans of development of ports. For instance, the investigations into the cause of submergence of Gharapuri port in the Elephanta Island off Bombay and of Kaveripatnam in the first few centuries of the Christian era may throw light on the range of sea level fluctuations and subsidence of the land, as has been the case in Bahrain Gulf. There is strong tradition about the subsidence of some parts of the west coast and uplift of others in India which should be investigated by adopting modern scientific research methods. Marine archaeology furnishes data useful for studying various stages of sea level rise and coastal erosion. The technical knowledge of the ancients in nautical engineering is useful even today.

The Bronze Age naval architects of Lothal had made great advance in building a tidal dock, a wharf and a warehouse in brick. Their successors at Dwarka had evolved a new technique of utilising the ridge for docking ships. They provided stone walls and bastions to withstand battering of waves and scouring by currents as early as 1500 B.C. The Lothal and Dwarka metallurgists also knew how to obtain pure copper and produce low zinc brass.²⁶

Another instance of deriving technical data from shipwreck exploration comes from the Aqaba Bay wreck. It has provided evidence of mercury having been stored in bronze bowls in the ship. Although mercury interacts chemically with the copper in bronze, no evidence of this having occurred was found. An analysis showed the presence of more than 20% lead in bronze; such an alloy apparently resists, or prevents, the rapid deterioration of the bronze. Spectographs of the copper showed an absence of arsenic; this is typical of the copper found in the Levant, but not of that from Turkey or the Caucasus.²⁷ Parts of the large pottery jars have a typical Arab glaze, and are closely related to the everyday pottery of the Levant at the beginning of the Ottoman period. Initial tests on the wood from the beams disclosed that they were from trees that are common around the northern part of the gulf of Aqaba, like the spiral acacia.

It appears that this small vessel, built in Aquaba around 1600 A.D, was wrecked. Her main cargo, mercury, was carried in bronze bowls and glazed jars. It is surmised that the cargo was on its way to the gold mines in Arabia or Africa. The mercury mines of the period are in Teizua (in North Hijaz) and Cyprus. A simple wreck thus reveals the involvement of five different countries in trade and industry, and also adds a new chapter to the history of metallurgy in late medieval times.

The Bronze Age wreck at Cape Gelidonya off Turkish coast has yielded copper ingots and tools of a tinker who produced on board the ship bronze tools required at different ports of call.²⁸

Some of the marine concretions, usually formed on archeological sites by marine organism, can be studied by biologists, and the analysis of dead concretions in successive datable layers gives the chronology of the burying process. It is also useful in determining the rate of sedimentation. Some specimens of seaweeds growing on archaeological sites are noteworthy. The excavation in the Arabian Sea, off Dwaraka on the Gujarat Coast of India, has brought to light profuse growth of *Bodyocladia leptopoda and Coelanthrum mullerii*.

Nautical Archaeology

The study of shipwrecks is known as Nautical Archaeology, which is a part of Marine Archaeology. Most of the wrecks occur due to natural causes; very few are sunk in naval battles and piracy. Human errors, technical defects in the construction of the boat and disregard of safety while loading could be factors contributing to the loss of ships. But these account for only a fraction of the wrecks when compared to the large number lost in hurricanes and storm waves. When a ship gets caught in a storm, hits a rock, it sinks without damage to other parts of the vessel or to its cargo. If it sinks to the bottom of the sea cliff sheltered from currents and swells, if it is covered by sediments as it sinks slowly, and if the wood-borers do not destroy the boat, then it remains intact with nonperishable cargo.

Wood borers are active in shallow waters only. Several ships may sink at the same site. A good example is the Byramgore Reef near Lakshadveep islands in the Indian Ocean, where several East India Company Ships sank in the 18th and 19th centuries. Another example is provided by Yassi Ada, a small island between Kas and Kalymnos and Bodrum on the Turkish mainland.²⁹ Here as many as 16 wrecks including a Byzantine coastal trader, a big cargo ship of Rhodes of the first century A.D. and a nineteenth century warship are found. All of them sank because of a reef 150 yards west of the island a place where a reef is not supposed to be. In the case of Byramgore Reef, the wrong bearings of the reef misled many captains and caused several wrecks.

Cyclones

Tropical cyclones formed over the tropical oceans are known by different names; typhoons in the western North Pacific ocean; cyclones in the Bay of Bengal and the northern Indian Ocean; hurricanes in South Pacific, eastern North Pacific and Southern Indian and North Atlantic Oceans. The tornadoes within the hurricane cause great havoc. The storm waves cause inundation of the low-lying coastal areas. Tides do not overflow. In fact, the so called tides are really not tidal waves, but are the result of the daily ebb and flow caused due to gravity.

The synoptic daily weather chart was invented in 1819 by H.W. Brandes. The circulation of the winds in cyclonic storms was shown by him on weather maps in 1783 itself. Piddington collected weather observations on ships and wrote on the law of storms in 1868. Samuel F.B. Morse invented the electro-magnetic telegraph. From 1854 to 1861 the Smithsonian Institution at Washington collected and displayed weather observations from land. The invention of the wireless telegraphy by Marconi facilitated sending wireless messages from ships about hurricanes.³⁰ John Eliot's Handbook of Cyclonic Storms of the Bay of Bengal is highly informative.

Ivan Ray Teennehile³¹ cites Piddington for the storm wave at Coringa on the Bay of Bengal. Piddington's account runs as follows:

"Coringa was destroyed in a single day. A frightful phenomenon reduced it to its present state. In the month of December, 1789, at the moment when the high tide was at its highest point and that the north- west wind was blowing in fury, accumulated waters at the head of bay, the unfortunate inhabitants of Coringa saw with terror three monstrous waves coming in from the Sea, and following each other at short distances. The first, sweeping everything in its passage, brought several feet of water into the town. The second augmented these ravages by inundating all the low country, and the third overwhelmed everything".

According to Piddington," the town and twenty thousand inhabitants disappeared, vessels at anchor in the mouth of the river were carried into the plains surrounding Yanaon which also suffered considerably. The sea in retiring left heaps of sand and mud, which rendered all search for the property or bodies impossible and shut up the mouth of the river for large ships. The only trace of the ancient town which now remains (1860), is the house of the master attendant and the dockyards surrounding it. However the final result was, in part accomplished by a repetition of the disaster in 1839[°].

The above account should be an eye-opener to marine archaeologists as to cyclones and storm wave that could have destroyed Dwarka on the Coast of India and Poomphuhar on the East Coast.

Another cyclone of greater magnitude on

October 7, 1737 at the mouth of the Hooghly is said to have "destroyed twenty thousand crafts of all descriptions and the storm wave rose forty feet. It is recorded that three hundred thousand people perished in Lower Bengal or in the Bay". It may be recalled here that a cyclone practically wiped out the village of Divi in Andhra Pradesh on the east coast of India. The waves were said to have been as high as the palm trees in the neighbourhood.

It is mentioned in the Mahābhārata³² that warning of the impending calamity at the ancient city of Dvārakā was given by Sri Krishna. Arjuna, acting on his advice had the town vacated and saved the people.

Human Error

An error of judgement in piloting the ship caught in a storm, or in avoiding submerged reefs, is understandable, but an error in loading or reckless sailing is culpable. These factors come to light in the Revenue Marine Records of the British East India Company available in some of the archives in India and in the India House Library, London. The loss of *Verelest*, an East India Company ship near Mauritius in 1771 is due to an error in the ship's reckoning. An extract from the *Fort William India House Correspondence* Public Select and Secret Department 1770-1772, *Indian Records Series* Vol. VI, Gen. Ed. K.D. Bhargava para 5 of a letter dated 18th December, 1771 runs as follows³³:

"By letter lately received from France, an account is brought by the French ship *Tritow* which sailed from Mauritius on the 27th April, of the unfortunate loss of ship *Verelest* the 25th of that month on the rocks of the Amber islands near the coast of Mauritius. No advices of this unhappy event have come to us immediately from the Commander or others belonging to the ship, but we are given to understand that a great part of the crew has been saved and there are hopes that part of the cargo will be recovered."

"By a French pocket which arrived on the 10th instant from Mauritius, we received the very disagreeable news of the entire loss of the ship *Verelest*, Captain Compton, on the windward side of the island on the 25th of last April. From the account in Captain Compton's letter which came by the French Vessel and extracts of the Chief Mates Journal it appears that this misfortune arose from an error in the ship's reckoning occasioned by the uncommon haziness of the weather for some days before which prevented them from ascertaining their longitude and variation by their azymuth and mistook the island of Mauritius for that of Diergo Rayes.... We are sorry to observe from the situation of the ship where she struck, which was on a ridge of breakers nearly five miles from the shore in an extreme high surf, the impossibility of saving any cargo as no boats could come within half a mile of her...."

The Titanic

The Titanic " the unsinkable" was built at United Kingdom in 1912. Carrying 2200 passengers it sank in 1912 in the most infamous marine disaster in 13,000 feet water in north Atlantic. It was again a case of human error and overconfidence. Although the captain was warned of an avalanche, he thought the Titanic would not be damaged or sunk³⁴. After 73 years a joint US-French expedition led by Dr. Robert Ballard of Wood Hole Oceanographic Institution and Jean-Louis Michel of IFREMER located and photographed the wreckage in August, 1985. Klein Associates INC (USA) observe that "the French team, using a newly developed sonar, searched large areas of the ocean bottom but could not find the wreck itself". With the search area narrowed down, the Klein Associates claim "the American team on board the RV Knorr spotted the target. With the Klein sonar mounted on the ARGO it could be positioned directly over the site to collect video and still photography".

Another important find was the wreckage of the Air India flight Kanishka that crashed as a result of mid-air explosion of a bomb surreptitiously placed by terrorists. The wreckage was spotted in water over 6000 feet deep in the Atlantic off the coast of Ireland. The plane's flight and cockpit recorders were recovered after the wreckage was spotted by the sonar. Among other important recoveries mention may be made of the "mother lode" of booty of the *Neustra senora de atocha* sunk in 54 feet water off Florida keys. Treasure Salvors Inc searched for 15 years before locating the wreck.

The *Hamilton* and *Scourge* sunk in 1813 in Lake Ontario and the *Bredalbane* sunk in 1853 in the Canadian arctic are of special interest to historians and marine archaeologists. All the three vessels were in very good state of preservation. They are being studied by deploying remote vehicles and submersibles.

A few hundred yards off the national seashore at Wellfleet Massachusetts, a team used the sonar as a tool to map the site of the buried remains of the private ship *Whidah* which sank in 1717 and was located by them.

" In the Barents Sea, between Norway and Russia, the British searchers located the destroyer *Edinburgh* which was sunk during World war II while carrying over \$ 80 million in gold. It is the deepest such salvage effort to date and divers recovered the gold from the holds of the ship in over 800 feet of water".

One of the most precious treasures of Indian art namely Buddhist's stone cultures of Barhut carried in the ship *Indus* which sank in Sri Lankan water awaits the Marine Archaeologists' spade for retrieval.

Piracy

Philip Gosse³⁵ in his book "The Pirates Who's Who" concludes that the history of piracy is practically synonymous with the history of maritime world³³. As sea-borne trade replaced to a large extent trade by land routes, piracy became common, more so on sea routes between Egypt and India. According to Robert Bristow ³⁴ the offenders were largely Arabs. The objective of Piracy was simple theft and robbery, but a more dangerous though legalised form of piracy is that of privateers at sea. Privateer is a vessel licensed by the ruling power of a state to carry on private trade but in practice it seized and plundered enemy merchant vessels. Pirate forces carrying a commission from a monarch are said to be engaged in privateering rather than piracy, but the activities differ only in the destination of the rewards.



CHAPTER II

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he for sources marine archaeological investigations are meagre. The few books that are available on naval history¹ hardly give any information about the last days of the ship. Even if they are recorded as lost in the sea, the bearings of the region where they were lost are either not given or, when recorded, they are not reliable. A re-survey of the wreck site, as in the case of the wrecks on Byramgore shore of Lakshadveep islands, becomes necessary. If the Marine Records in the Archives are scanned thoroughly, some information on the wrecks may become available. Literary sources are also useful. For instance, references to the submergence of the ancient port of Dwaraka on the west coast of India are made in ancient texts such as the Mahābhārata, Harivamśa, the Bhāgavata, Matsya, Vāyu and Vishnu Purānas and in Ghața Jātaka. The Tamil texts Silappathikāram² and Paddinappālai³ refer to the inundation of the Early Chola Capital Poompuhar on the east coast, while the Buddhist Jātaka stories and the Mahābhārata refer to ancient ports of Surparaka⁴ and Bhrugukaccha⁵ on the west coast.

The Marine Records of the National Archives, Delhi, and those of the State Archives at Madras, Calcutta, Bombay and Panaji, furnish valuable information on ships lost in storms and naval battles during the 16th -19th century A.D., but no records of the ships lost during the preceding 3000 years are available. In fact most of the losses were not recorded at all. On the other hand, the voyages of the merchant captains, religious leaders and royal personages find occasional mention in literary compositions and inscriptions. For example, prince Vijaya's landing in Lanka is depicted in the Ajanta murals (fig. 6) and Chola Ruler's voyage too, but scarcely ships lost in the sea are recorded. Oral tradition is an important source in the case of wrecks in Indian waters. It is, therefore, essential that painstaking archival research and oral enquiries must be made in addition to collecting data from literary and epigraphical sources. The Marine Archaeology Centre in the National Institute of Oceanography(NIO), Goa, has researched in the Archives and collected data on 210 shipwrecks in Indian waters. The information relating to the type of the vessel, the country to which it belonged, the ports of call, cargo and crew in the vessel, its last voyage, the wreck site and cause of the calamity are available in the NIO Inventory of Ancient Shipwrecks of 16th-19th century. A map showing ship wreck sites on Indian coast based on marine records has been prepared (Fig. 5).

Religious considerations also affected shipping activities in India. As early as the times of the Baudhayana's *Dharmasutra*⁶, a ritual text, sea voyage (*Samudrasamyanam*) was one of the five disapproved practices among the Brahmanas of the north. Manu, the author of *Dharmaśāstra*⁷, says that Brahmanas who undertake sea voyage (*Samudrayayi*) are not fit to carry out their religious obligations and so are unworthy guests at religious feasts. According to Narada⁸ a sea going merchant

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(Samudrayanik) is a discredited witness; his evidence in a court of law is liable to be disregarded.

There is evidence to show that Brahmanas undertook voyages in the early centuries. In the medieval period, however, there was a taboo against such voyages. The *Mitākshara* quotes with approval⁹ the earlier views of Baudhayana and Manu. Al-Biruni¹⁰ says that a Brāhmana privileges cannot be restored and he is cut off from his family and friends. P.V. Kane¹² interprets the relevant passages as showing that the prohibition against sea-voyage affected only Brāhmanas and even then they did not altogether become unfit to be associated with. But, if we can rely on the *Vyavahāramayūkha*, of a slightly later period, as reflecting the conditions in the early medieval period, the



Fig. 7 : Lothal Lockgate in the dock

must live between the ocean in the east and the west. The *Brhannāradīya Purāņa*¹¹ mentions the undertaking of a sea-voyage as one of the practices which, being unfavourable for the attainment of heaven and disliked by the people, have been forbidden for the Kali Age. Hemadri, explaining the rule about sea-going being a Kaalivarjya, adds that by penance the offender may regain ritual purity, but his caste taboo was against a *dvija* (Brāhmana, Kshatriya and Vaīsya) who constantly undertakes sea voyages for trade.

The rationale behind the religious objection seems to be that on board a ship one cannot perform the religious rites and rituals, observing the rules of ritual purity. From the times of Vasishtha and Āpastamba, for the brahmanas intercourse with barbarians was prohibited¹². It

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was believed that sacrifices and other religious rites could be performed only within a well defined territory. For this reason, the countries beyond the border were specified by name as unbecoming for living: It may have been felt that with the expansion of Islam the threat of religious conversion increased. It should be noticed that in this period the impact of the Lokayatas and Buddhism had weakened. The ceased to be of much concern. This can be easily inferred from the way Medhatithi and Lakshmidhara, two Smriti writers of the medieval period, dilute the proscriptive emphasis on sea voyages in earlier authorities. There is a provision in Manu that the interest to be paid is to be fixed by persons who are experts in sea voyages. In his comments Medhatithi¹³ remarks that the sea voyages are



Fig. 8 : Indian ship depicted on the Borobudur temple

Lokayatas advocated a more practical attitude for enjoying worldly happiness and did not subscribe to the orthodox religious scruples. The religious objections were not respected by Buddhists, who are known to have undertaken journeys to other countries for missionary work.

There are clear indications of the decline in Indian shipping in one respect at least. For people away from the coastal areas, it had mentioned only by way of illustrating a journey; the sense is that interest is fixed by traders, who know all about journeying by land and water. Likewise Lakshmīdhara explains the expression "experts in sea-voyage" as merchants in general.

It seems that in some areas, at least, there was more active participation in sea-trade which may have resulted in a more intimate knowledge of shipping. The Vaijayanti and the Abhidhāmaratnamālā, two lexicons of the medieval period, have listed terms connected with sea and shipping. The Abhidhānratnamāla provides more space to terms for sea, waves, shore, tide and aquatic animals, while the Vaijayanti gives an elaborate list of terms for different types of ships, the principal parts of a ship, and important categories of sailors and passengers. Of these the testimony of the Vaijayanti is very useful. It mentions Samudram as the name of the mixed caste born of a Karana and a Vaisya woman. This class earned its livelihood from commodities obtained from the sea. The necessity for a special term may refer to conditions when there arose a large number of merchants of this type.

Prof. A. L. Basham¹⁴ is of the view that ancient Indian literature does not praise the seaman's life, and its attitude to the sea is one of fear and distaste. But a glowing description of the sea and its riches is given by Varāhamihira in the Agastyācāra chapter of his work Brhatsamhitā¹⁵. The VarāhaPurāna¹⁶ also refers with admiration to merchants who sailed far into the shoreless, and brave fearful waters of ocean in search of valuable pearls. In the early medieval period, Kshemendra in his Avadānakalpalatā¹⁷ refers to the unbounded zeal of those brave people who treat oceans like ponds. Stories of traders going out for trade with foreign countries are told in the Samaraiccakahā. Upamitibhābaprapancakathā, Kathākosa and Brhatkathākosā¹⁸. The descriptions of sea voyage in the *Tilakamanjari*¹⁹ and Bhavisyattakahā are so graphic that they must have been based on the direct knowledge of the authors. The Siddha poets refer to ships and sea voyages, which suggest that shipping formed part of their common knowledge. The Yuktikalpataru²⁰ gives a detailed account of boats and ships in its section on conveyances. The wood to be used in their construction and the types of the ships and their cabins are mentioned, but the description involves much that is theoretical. What is, however, significant is that ships and shipping evoked the interest of the ruler of a land-locked kingdom such as Malwa.

In the early Bengali literature, there is a description of construction of ships. The parts of vessel mentioned in the text are *dara* (helm) or *patwal*, *malumkastha* (mast), *tala* (hold), *mathakastha* (prow), *chhaighar* (shed), *patatan* (deck), *dandakarwal* (oar), *Bansakarwal* or *dhvaji* (*bamboo - pole*), *fas* (chord) *nangar* (anchor), *pal* (sail) and *dara* (kell). The *Varnaratnākara²¹* mentions the important parts of a ship and varieties of ships known to it.

The Samaraiccakaha²² says a merchant, before boarding the ship, gives alms to the poor, offers homage to the ocean, and bows to the gods and elderly persons. The performance of auspicious rites seems to have been a necessary ritual, part of the observances as a prelude to sailing a ship. The Bhavishyattakaha²³ also refers to the special rites to be performed when launching a ship for the first time. From Tilakamanjari, we learn that before proceeding on a voyage, god Ratnākara (ocean) was worshipped, in the course of which groups of ladies in beautiful attire sang eulogising his serenity, grandeur, honour and other virtues. Before the ship set sail, maid servants applied the auspicious paint of gruel with their five fingers. The Navadhammakaha24 gives more details of these rites and formalities. It says that kinsmen-grandfather, father, brother, maternal uncle, and others, ---wished bon voyage to those on the ship, flowers were offered to propitiate the deity presiding over the sea, impression of five fingers was made with the paste of sandal, dardara and other things, incense was burnt, and other puja rites were performed. The ships started to the joyous roar of the cheering crowd, which simulated the roar of the lion, or of the great sea. The soothsayer was loudly uttering benedictions: "Success to you all, blessed be your desires". Greatly pleased were the crew-the captain, the rowers, the officers of the boats, and the merchants.

The earlier texts mention that sons of chief navigators received education in nautical science, so that they may also become successful sailors and captains. However, the kind of instruction given to these trainees is obscure. According to the Jātakamālā,²⁵ at Sopara, a pilot could handle ships only after he had learnt the Niryāmakasūtra. The reference is probably to some text, not to nautical science. But there is no ancient work of this name. In the library of the old college of Fort St. George, Madras, there were manuscripts of a work on Nāvasāstram (which in one case is called Kappal Sāstram). The text has not been edited and studied. It seems to have been a late text chiefly astrological, with some directions about the materials and dimensions of vessel.

According to *Tilakamanjari*²⁶, the training given to sailors was essentially practical. For instance, Tāraka was made the chief of the sailors by Candraketu, who regarded him as his own son-in-law. Functioning as a chief, Tāraka soon learnt the art of shipping $(n\bar{a}uprac\bar{a}ravidy\bar{a})$, knew all the duties of a helmsman, journeyed back and forth in deep waters several times, visited the countries of dvīpāntara, even though they were far removed, saw with his own eyes even small waterways and carefully observed rough and smooth places there. In a subsequent passage, he is described as having properly practised the works connected with sailing a ship.

Another reference, in the same text, would indicate that the sailors could make practical use of their astronomical knowledge. It would seem from the *Bhavishyattakaha*²⁷ that the sailors studied texts on medicine or chemistry.

But it seems that, as compared with the sailors of other countries, the technical skill of Indian sailors was not of a high order. John of Montesorvino speaks of Indian sailors thus: "Moreover their mariners are few and far from good. Hence they run a multitude of risks, in so much so that they are bound to say, when any ship achieves her voyage safely and soundly, 'this by god's guidance, and man's skill hath little availed.''

Before setting sail, the sailors collected abundant food material, filled up all the water jars with sweet water and also stored fuel. The *Tilakamanjari*²⁸ says that ghee, oil, blankets, medicine and other items essential for nourishing the body were also taken. The sailors gave attention to preservative ointment, necessary for moving in the sea water, and also blocking the holes in the flanks of the reservoir of sweet water. The Navadhamma Kaha²⁹ adds that sailors took with them molasses, rice, oil, ghee, milk products, water in water-jars, medicinal drug, grass, fuel, coverings for the body, wearing apparels, besides many other necessary things required during voyage. The Jātakas give some indication of the crew and passengers facing shipwreck taking as much sugar and ghee as they could digest and covering their bodies and garments with oil to sustain them.

The story books relate that the survivors of a shipwreck on reaching an island, hoisted a flag on a high place, so that the passing ships may notice it and come to their rescue. The Samaraiccakaha³⁰ uses a technical expression for such a flag (bhinnapoyaddhao=bhinnapotadhvaja). The Brhatkathāsloka-sangraha²⁹ refers to the custom of sailors of wrecked ships (bhijnnapatavanijavrtta)to place a flag on the top of a tree and burn fuel, so that passing ships may see it and come to their rescue. The use of the special term shows that sea-voyage and consequent shipwrecks were not uncommon. It was probably professional etiquette (compare the highway ethics of modern automobile drivers) to go to the rescue of such people.

Interpretation of Data

The analysis of historical data available from literary and epigraphical sources is done by experts to ascertain the condition under which the ship sank - whether it struck a reef in the storm, or whether the loss is due to a technical defect resulting in heavy leakage, or because of over-loading. The sea condition when the ship sank is noted. The marine environment also deserves attention. The analysis of the data and study of the environment are done by Hydrographic Surveyors, Oceanographers, and archaeologists, with the assistance of people



Fig. 9: Bet Dwarka ; structures faintly visible in the cliff section of the eastern shore with the thickly wooded hills in the rear and the sea in the foreground

having knowledge of the local condition. In the case of the ship Byramgore, which wrecked on the reef, the then condition of the sea, the direction of wind, the nature of swells, waves and currents, the precious cargo carried and the attempts made to save the ship are all found in the correspondence of the Master Attendant. The court martial Enquiry proceedings in the case of the ships lost throw welcome light on the location of the site, and whether anything worthwhile could have survived. The Mahadev Pal of the Maratha Navy is said to have struck a rock while coming out of the Vijaydurg Harbour. The type of vessel lost and the events of the wreck incident are all important. The extent of damage can be assessed only after studying the ship's exposure to swells and currents.

Site: For locating the site given in the text, archival records and inscriptions, or oral information, the topographical and geological features, the fauna, port-installations, if any, the condition at rivers mouth, swells and current and sand bars need to be taken note of. For instance, the ship which wrecked in the Grande Island in Goa waters seems to have lost anchor in a storm, struck against a rock and drifted near shore. The Minicoy shipwrecks too seem to have suffered the same fate, but in the latter case, one ship broke into two with one part lying on the reef and the other in a place more than 30 m deep. Some wrecks in Minicoy and Androth islands of Lakshadveep are scattered over a very large area. The lighter objects of submerged ports are carried away by currents and buried in channels and cavities of rocks. This was the

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case with a couple of wrecks in Dwarka (fig. 9). The material used in the construction of the vessel often determines its seaworthiness and ability to withstand the impact when battered by waves or against rocks. Teak-hulled ships with stitched planks could last longer than cedarbuilt ones having nailed planks.

Methodology

The various systems available for underwater target search, survey and position-fixing of archaeological objects available in the world are dealt with here.

The actual systems used and methodology adopted for survey in Indian water are referred to in chapters relating to exploration of Dwarka (Ch.III), Poompuhar (Ch. VI) and Shipwrecks (Ch. VII).



Fig. 10 : Diver probing with





Fig. 12 : Side scan sonar survey

Marine Archaeology is a multi-disciplinary study, which demands close cooperation among various branches of science and humanities, besides the help of technicians who can operate sophisticated tools for survey and recording. The services of various laboratories for analysis of samples and interpretation of data are indispensable.

Preliminary Survey

The data collected from archival and literary sources and oral tradition forms the basis for determining the location of submerged sites and wrecks. This data needs to be supplemented by the results of ancient and modern shoreline maps. Aerial photographs are also useful in identifying submerged

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Fig. 13 : Airlifting operation in the Caisson

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Fig. 15 : Diver examining antiquities exposed in a trench excavated in sea-bed near buoy 35. Here a copper vessel was *in situ* near the submerged building


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Fig. 16 : Diver measures a bastion of submerged Dwarka Fig. 14 : Dwarka prominent surface features like temple towers make position fixing of underwater objects comparatively simpler

Fig. 17 Surveying the submerged Dwarka deploying underwater scooter Aquazcipp structures. But the sweep survey and probing with iron or stainless steel rods (Fig. 10) guide divers to know more precisely the site and its extent. A few potsherds, brick or stone building blocks, metal objects and other remains collected by them may provide a clue to the existence of buildings or wrecks underwater. For determining the nature and extent of these remains, a carefully planned preliminary survey is necessary.

Pre-disturbance Survey

The surveyor may, if necessary, prepare a large-scale map, based on topographical maps and hydrographic charts of the area, and mark the location of the site showing the position of marker buoys on the map. The sextant and compass location of the site should be shown on the topographical and enlarged maps. To be accurate, a series of horizontal sextant angle measurements should be made with reference to land features. The sextant angles can be read to an accuracy of 1.0' of arc. Position of the ship or marker buoy can be determined, using an overlay racing. Overlapping photopictures of shoreline are helpful in producing a panoramic view of the shore, as is done in the case of Dwarka, Bet Dwarka and Tranquebar. Angle measurements and a series of satellite navigation fixes are used for arriving at the latitude and longitude of the site where 1:10,000 scale maps are not available.

If the structure or wreck is buried deep in the sediment and cannot be traced by probing, the sonar systems should be pressed into service for preliminary survey, but a word of caution is necessary here. These systems show the anomalies only (Fig.12). Unless the diver is able to expose and photograph them, it is difficult to identify the anomaly as of a wreck or structure or an anchor of archaeological significance. The sonar equipment is quite expensive and the deployment of the technical and other supporting staff involves considerable expenditure. The Institute of Nautical Archaeology, Texas, which has discovered a large number of wrecks off the Turkish coast and in the Caribbean and Aegean seas, rarely resorts to sonar and magnetometer survey. George Bass says, "Information gathered from sponge divers and local fishermen whose nets get caught in the wreck is much more useful than that obtained from sonar survey." However, where sponge diving is not practised and fishermen are not able to give useful information, the location of the site/wreck may be possible with the aid of sonar system.

Aerial Survey

Although the serial photographs of coastlines show more of the land and less of the sea, they may still provide important clues to the location of the site, as in the case of Dwarka. The aerial photographs taken by the Aerial Survey Division of the Survey of India, at the request of the Marine Archaeology Centre of the National Institute of Oceanography, have revealed two submerged terraces near Rupen and a few features submerged off Samudranarayana temple at Dwarka. The black and white, colour, and infra-red photographs on 10000 and 4,000 scale are taken from such a great height that details of buildings underwater cannot be seen. Underwater photogrammetry, with overlapping pictures taken at close quarters by diver-photographers, are the best, but the cost, when a large city-site like Dwarka is involved, is very high. The Marine Archaeology Centre resorts to detailed manual drawings, photographic record being limited to important features, more so in shallow waters, where visibility is poor and clear pictures cannot be obtained as in Poompuhar.

Sextant Survey

All objects of archaeological significance must be plotted as accurately as possible, so that the plan of the submerged port or wreck can be had. The best instrument for surveying at sea level the buoyed underwater structures and wrecks is the sextant, if used along with a prepared circle chart. At Dwarka, where prominent surface features such as Light House, temple towers (fig. 14), and Radio and TV Towers are available, position-fixing of underwater objects was comparatively simpler. The sextant consists of a metal frame supporting two mirrors. One of these, called the "Horizon Glass," is fixed. Its upper part is plain, and lower part is silvered. The second glass fixed to the arm is called the "Index Glass". The arm, which revolves about a pivot, has on one end of it, a small scale called the "Vernier", which slides along the bigger scale called the "Arc". It may be clamped to the arc by the "Clamping screw" underneath, and may be moved very gradually by the "Tangent screw". Some sextants are fitted with a micrometer screw instead of a vernier. There are various methods of fixing a vessel's position when in sight of land.

Two conspicuous objects on shore are picked out, and by getting both the objects in transit (or in line with each other), and then taking a bearing of a third object, as nearly at right angles of the line of transit as possible, the position of the ship can be fixed.

The application of magnetics to identify wreck-location is possible, if a suitable shallow draft vessel is available. It should be able to navigate in shallow water, and its draft should be 2 m or even less. From a shore station a fishing trawler can also work out easily. For great accuracy, other position-fixing instruments like miniranger II, to charter the target within two metres accuracy should be available. Thirdly, a magnetometer (fig. 8) with a towing mechanism of 1 gamma sensitivity for the actual wreck detection, will be useful.

Navigational System and Postiton Fixing

The Navigational equipment must provide routine ship positioning ship course information for laying down straight survey tracks, and a closely spaced and an accurate fix of the ship, when a wreck site is located. There are different types of navigational systems that provide these features for purposes of shippositioning in shallow waters close to the shore. Small shore-based transponders can be positioned, as was done while surveying off Kaveripatnam. Electronic navigational aids are available for position-fixing of the ship. The Tri-sponder, manufactured by Del Narete Technology, is easily portable and "has the advantage of accuracy although with a relatively shorter maximum range."

The Tri-sponder uses three stations, one in the survey vessel (the mobile unit), and two remote stations, which are positioned at known ground points such as the temple tower or the terrace of a tall building. In this pulsed type system, the mobile unit sends coded pulses to the remote stations at a standard carrier frequency. The transmitters of the remote stations return the specifically coded pulses back to the mobile unit at their standard carrier frequency. The distance is measured by the mobile units digital counter, such that the leaving pulse starts the counter and the returning pulse stops it. All transmitters use a tunable magnetron within frequencies of 9.30 and 9.48 KHz, having the pulse power of 1 Kw, and all receivers are super-hetrodynes with frequency ranges of 9.30 to 9.50 KHz. The data output can be automatically recorded to feed the range data to standard BCD outputs, peripheral equipment and plotted, paper tape or magnetic tape recorders. The maximum measurable distance being 100 km, with an accuracy of \pm 3 metres, this system is well suited to navigational requirements for coastal survey of wrecks and submerged cities.

A navigational system known as the Hi - Fix - 6 comprises 6 stations all employing the same single radiated frequency or the same pair of frequencies (frequency band between 1.700 and 2.000 MHz). The chain consists of one primary and five secondary stations. The maximum measurable distance over sea in daylight is 300 Km with an accuracy of ± 1 metre on the base line.

Magnetometer

The Total field proton precesion magnetometer is used mostly for marine application. Considering the variability in ship orientation, the motion of towed sensor in its underwater fish container and other variables, a performance better than a l gamma envelope is unnecessary. While high accuracy systems are used for marine geo-physical surveys, magnetic charting and other special applications such as sensitivity are not important for location of wreck/site. The magnetometer is useful in wreck/site location, if the target contains ferrous material such as iron hulls, engines, boilers and anchor chains, of modern ships, which came into use after 1830 A.D. Wrecks of wooden ships of earlier days may contain iron cannons and cannon balls. Large



Fig. 18 : Magnetometer sensor

dumps of amphoras containing ferrogenous material can also be located with the help of magnetometer. The larger the ferrous content, the greater its magnetic signature. But wooden boats, without large iron objects in them, cannot be located by the magnetometer.

The survey procedure comprised the sailing of a set grid pattern, with the magnetometer sensor being towed close to the sea bottom. Barringer SM 123 system is useful for shallow water operation with cable deployment of 70 m. Non-ferrous weighted depressions are used to sink the sensor to a towing position close to the bottom. An appropriate ship course should be selected while towing the fish at a suitable depth in the sciected survey area. The length of the cable to be laid out and the towing speed of the fish depend on the average water depth. Care must be taken to adjust towing speeds with cable and magnetometer fish resistance. Sufficient headway for the surface vessel against winds, tides and currents, should be provided. The ship track should be maintained accurately along the survey lines. For economy, the ship's speed may be kept at 5 knots. The magnetic anomalies are proportional to a third power, lower fall off in distance between the sensor and target. To achieve the greatest signal-to-noise ratio for target detection, the sensors should be as close to suspected targets as possible. The ferrous material in the survey ship itself provides a constant anomaly. It is, therefore, necessary to have the sensor at a reasonable distance. At 40 m distance, 5 ton ferrous material in ship gives a constant 3 or 4 gamma offset.

In continental shelf areas, igneous or volcanic rocks lying beneath the bottom sediments, eg. on Konkan coast, introduce geo-magnetic anomalies. Such rocks are generally large in aerial extent and, being deep-seated, their anomalies are broader than the sharp features of the wrecks. Even if wrecks are covered by silt, sand or sediment, they provide large magnetic anomalies.

Shallow marine magnetometer systems and portable hydrographic survey systems can be integrated for speedy installation into small boats, eg. 10 m craft capable of surveying coastal areas and harbours³³.

The Columbus Caravels Project of the Institute of Nautical Archaeology, Texas A & M University at College Station³⁰, was able to locate buried shipwrecks and anchorage middens in 1948 in St. Ann's Bay. When the team recorded a "mysterious magnetic anomaly under a shallow

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sand bar near the mouth of the Churely River", Roger Smith remarks, "Armed with a computergenerated contour map, produced from our field data by James Baker of Texas A & M, we began pinpoint coring on the area of highest intensity. A three-dimensional projection of the anomaly showed that its size and characteristics were tantalizingly similar to what we might expect from two buried caravels. The turbulence and turbidity of the water at this location had made visual examination difficult, but from the cores we knew that the anomalous layer did The INA team suspected that the wharf might have been built on top of an earlier spanish structure, which originally might have been constructed from the ballast of the beached columbus ships. Piers and wharfs were often built on top of abandoned ships, since their ballast represented a convenient accumulation of foundation rocks. A caisson was inserted next to the wharf, and excavation was carried out in arbitrary levels, with artefacts sorted and bagged in lots, according to depths. Gradually the worm-eaten tops of two wooden pilings



Fig. 19 : Towvane

not extend very deep into the sediments. Core samples contained fragments of brick, ceramic and ballast, but not wood. Early one morning, before the tradewinds started, the water was unusally calm and clear. As we swam over the anomaly, we noticed that it had been uncovered, revealing a small pile of rocks, bricks and modern trash, including metal objects that had been detected by our instruments. It looked like another anchorage hidden, where small boats had anchored over the years, discarding debris, ballast and trash overboard. The computer enhanced colour sonar instrument displayed various densities of buried sediment layers on a monitor in multi-coloured images. began to emerge from the sediments".

Towvane

The Towvane invented by Macleay is a steel observation capsule (Fig. 19) used by the University Museum of Pennsylvania in 1965 in search operations on Turkish coast. The Towvane "holds one man along with an airpurifying system and additional oxygen. A plexiglass window provides the pilot with a 360degree view around him. The Towvane is pulled behind a trawler on a 300m long nylon line. The wing-like vanes on either side of the capsule can be tilted by the pilot by turning the wheel inside for placing the system outward or



GRID OF IO cm x IO cm SIZE BY USING THREADLINE

downward. The buoyant Towvane surfaces, if the pilot loses consciousness and releases controls.

The fathometer is used by the crew on the surface to warn the pilot by telephone about any obstacle in the path. Towvane is a simple device to search upto 100 m depth in clear water over a flat sea bed. Almost the same principle is adopted in devising an underwater scooter (fig. 17), but there is no capsule, The diver can operate it freely.³¹

Underwater Survey Plan

Working from the known to unknown, namely from known features such as TV or Radio towers, factory chimneys, temple towers and hill tops position of marker buoys is what is aimed at in manual survey. The position of land features should be marked, and a base line onshore, with its terminal points firmly fixed, should be established between two points, from which the marked features can be measured. To fix the terminal points, iron stakes may be driven into outcrops of rock. In a sandy beach or muddy bottom, steel rods should be driven into the sediment and further secured by ballast. The length of the base line may be between 10 and 30 metres. The relative positions of other points in survey plan can be fixed by triangulation, using 30 m fibre tapes. If longer tapes are used accuracy cannot be ensured, owing to excessive bending of the tape in currents despite the care taken to see that the tapes run straight from the basepoint to fix. It is advisable to carry out triangulation in a series of "jump" in an area where there are obstructions such as rockoutcrops and protruding structural remains. Measurements taken underwater should be transferred to a measurement book, and invariably the diver should plot the outlines of the wreck/site and main parts of the wreck, or submerged structure in the underwater slate, noting always the magnetic north. Besides noting the coordinates, actual measurement in metres should be marked in the divers slate and in field note book. Tapes of different colours may be used for measuring distances from different base points. A grid system (Fig. 20 & 21) should

be established for easy plotting and measurement of the site or wreck. A graduated drawing frame of stainless steel may be used within the grid for taking detailed measurements in smaller squares of 2 x 1 m. Right angles can be obtained from the principle of 3-4-5, the right angle being between the sides measuring 3 and 4. Threedimensional measurements (First two horizontal measurements and one vertical) should be taken and recorded, as in the case of excavation on land. Levels must be introduced in survey when there are undulations. A sensitive depth gauge calibrated against a suitably measured shot line can be used for obtaining levels from the arms of the grid.

Side Scan Sonar and Sub-bottom Profiler Survey

Side Scan Sonar (Fig. 25) is a very useful tool for mapping the topography of the seabed. It covers hundreds of meters on both sides of a moving ship and facilitates a rapid survey of a selected area. The side Scan Sonar Towfish contains transmitting circuitry to energise transducers, which project high intensity, high frequency bursts of acoustic energy in fan-shaped beams which are narrow in the horizontal plane, and wide in the vertical plane. These sound beams project along the sea-bed on both sides of the moving vessel. Objects or topographic features on the sea-bed produce echoes which are received by the transducers. These echoes are received and amplified, and sent up the Tow Cable to the Graphic Recorder. (Fig. 27) The Graphic Recorder processes the incoming echoes and prints them on a special multi-channel writing mechanism. This creates a permanent, continuous graphic record of the surface topography and "objects" lying there. A Side Scan Sonar which transmits short pulses of high frequency (50 to 500 kilo hertz) can produce an image of the sea-floor more than 500 m out on both sides of the tow path.

The Sub-bottom Profiler is a high resolution unit for profiling the shallow bottom sediment layers. It works on the same principle as the side-scan sonar, but it penetrates into sediment

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Fig. 21 : Plotting with drawing grid



Fig. 22 : Aqua pressure air tank strapped to the diver's back for scuba diving



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Fig. 24 : Diver scientist Manavi Thakkar riding aquazepp surveying submerged site of Dwarka

Fig. 23 : The expedition party working off Bet Dwarka island in the Gulf of Kutch





Fig. 25 : Towfish of side scan sonar

Fig. 26 : Metal detector





ISOLATED OBJECTS AND SUSFECTED SHIP WRECK (A) SOUTH OFF SINNARPETE AT 9 M DEPTH

layers and gives a profile in which wrecks and sediment-covered structures can be detected.

Hydroscan

Klein Associates Inc., Salem, New Hampshire, USA, have produced a system known as Hydroscan, which combines the side scan sonar and sub-bottom profiler in one unit. The system consists of a side scan sonar towfish with subbottom profiler attachment (Trifish), a towing cable and Graphic Recorder, This system is useful in Geological studies, Bathymetry and Hydrography, general searching and Underwater Archaeology. Wooden sailing barges and sailing vessels, which sank 1800 m. the Greet Lakes, have been detected by this system.

The sub-bottom profiler uses lower frequency sound (3.5 to 12 Kilohertz) to penetrate bottom sediments. Pulses of sound are directed vertically down into the bottom rather than out to the side as in the Side Scan Sonar. At each interface between different types of sediment layers, some part of the sound energy continues and some part is reflected. As the device is towed along, a cross-sectional view of the seafloor is generated, showing the different layers and the underlying bedrock. If there are buried shipwreck remains, they appear as a localized reflection below the bottom.

Metal Detector Survey

After the initial survey and mapping of the visible features and characteristics of the site, the location and extent of the wreck are determined, a metal detector survey (fig. 26) of the area conducted systematically will help in determining precisely the extent of the wreck. But this presupposes a knowledge on the part of the director and surveyor of the metallic fastenings and fittings of a ship. Sometimes, metallic deposits may lie in masses such as ballast or cargo. The spot and area targets should be clearly distinguished on the predisturbance plan. Digging out individual targets after locating with the metal detector should never be attempted, since it destroys the context in which it lies.

Surveys with probe (5 mm mild-steel rod with

T handle at one end and the other pointed) should be carried out carefully and systematically. Damage to fragile objects should be avoided. Large objects such as the hull or a buried structure can be easily ascertained by probing. Deeper soundings may be taken with a jet probe.

Recently, battery powered underwater scooters (Aquazep) have been found very useful for surveying large areas of the submerged city of Dwaraka (Fig. 24).

Submersibles

Highly advanced search systems, such as submersibles, are available for marine archaeological exploration, provided the cost of the system is not a major consideration when important shipwrecks in deep waters are involved. Both manned and unmanned submersibles can be chartered for underwater search.

Manned Submersibles

The diver lock-out (DLO) manned submersible is very useful in surveying large areas in specified locations off the whole length of the Indian coast of 6000 km. The DLO has two separate crew compartments, one, for the divers, can be pressurised like a diving bell and the other at atmospheric pressure for the pilot, observer and diving supervisor. With provision a marine archaeologist can go down to work-site a warm, dry, atmospheric pressure in environment to direct the underwater excavation and documentation by diver archaeologists. The DLO helps the director of the underwater archaeological exploration to take on-the-spot decisions. A drawback with the manned submersible is that it lacks the power required to support the divers for long periods against Hypothermia. The bulky size of DLO's another disadvantage is in handling and transporting it. A special type of mother ship is needed for handling and operating a DLO manned submersible.

Unmanned Submersibles

The Unmanned submersible is a remote operated vehicle (ROV), relying on close circuit TV (CCTV) system for underwater inspection



Fig. 28 : Diver wearing wet suit and mask

works. A survey on inspection is recorded on video tapes for subsequent viewing, which, however, results in a delay in taking a decision at work. The ROV is easily transportable and can be operated from a medium size vessel, or from a fixed platform. The recently developed ROVs are of two types. (i) A small light - weight, low-cost vehicle for observational and documentary purpose, which is highly useful to a marine archaeologist. (ii) A larger and heavier one which is a more powerful work vehicle, equipped with manipulators. A low-cost ROV weighs less than 550 kg. The tethered ROV runs on surface supplied AC power from the ship, or a diesel generator. The umbilical cable, which carries power and communication links are single units with one or three co-axial conductors. They normally have electric or hydraulic thrusters, and are invariably equipped with Black and white System, with a television monitor on the surface boat.

Diving System (SCUBA and SDDE)

Underwater archaeological survey, excavation, documentation and retrieval demand prolonged diving on shipwrecks and submerged ports at specific locations. The support facility, by way of an anchored barge or boat with adequate space for diving and equipment, is a prime necessity for long-schedule diving in shallow waters. It is convenient to use a low-pressure SDDE (Surface Demand Diving Equipment) in preference to the SCUBA (Selfcontained Underwater Breathing Apparatus) diving system, which involves the use of highpressure air cylinders/tanks strapped to the diver's back (Fig. 22). In the case of SDDE, an HP compressor on the surface supplies air to the diver continuously, so that he may be spared the inconvenience of changing tanks half-way, or of running short of air. He is also relieved of the unwieldy burden of the cylinders on his back. The diving operations in Dwarka, Poompuhar and Goa waters are mostly done under surface and demand diving systems. Preliminary surveys under the SCUBA system enable the diver to move freely, covering large areas; but the time may be limited to one hour. A number of factors namely weight-loss caused by buoyancy effect, the added weight of breathing apparatus, a wet or dry diving suit, a mask to

Fig. 29 : Sediment-mixed water delivered into a sieve by airlifting in Dwarka waters for collecting antiquities from the overburden





Fig. 30 : The airlift is operated by the diver to remove overburden near a submerged structure in Dwarka waters.

allow clear vision (Fig. 28) for propulsion, weight to ballast him, a life-jacket and a buoyany compensating jacket to bring him safely to the surface, render man less efficient under water than on surface. He may feel the effect of heat loss (Hypothermia) and at depths below 20 m, he may feel the effect of nitrogen absorption in his tissues which necessitates limiting working time. It is because of these disadvantages that a simple diving system such as SDDE is preferred to SCUBA in shallow water where a long divingschedule is needed. In more than 20 m water depth, the time limit and stoppages at required depths while surfacing are imposed to avoid decompression (see p. 39) In addition to the air cylinders, which a SCUBA diver carries on his person, he has to operate airlifts, carry excavation tools, still and video cameras, drawing slates and grids. The equipment must therefore be as simple and as light as possible.



Fig. 31 : Lowering the steel caisson in Dwarka waters for controlled digging

Excavation Tools

Water dredge: A water dredge (Fig. 30) provides light suction at the excavation end and carries the spoil, covering the archaeological objects to the required spot through an exhaust pipe. It works only in the horizontal position owing to its limited suction power.

Airlift: Airlifts are of two types, and both provide powerful suction. Both were used in Poompuhar, Dwarka and Bet Dwarka waters for removing the overburden of sediment and vegetation covering the submerged structures. They were useful in exposing the shipwrecks in Grande Island (Goa) and Poompuhar. Airlift of Type A (Fig. 13 and 29) has a stainless steel suction of 10 cm diameter, and Type B has a mild steel suction. Soil-water mixture is lifted through a hose to the surface (Fig. 29). The sediment-mixed water is let in a sieve on top of a mild steel tank, and significant archaeological finds such as pottery, shell bangles, beads, etc. are collected, cleaned and labelled. For controlled digging an open-ended collapsible caisson (Fig. 31) is placed on the sea-bed to support the sides of the pit under excavation using compressed air. The artefacts collected from successive deposits of 15 to 20 cms are separated in order to arrive at a rough stratigraphic sequence.

Methods of Mensuration

The site is griddled with reference to a baseline on shore and related baseline underwater. The protruding structural remains make gridding an entire site difficult. Hence the transit line of Dwarkadhish and Samudranarayana Temple Towers was extended seaward to serve as a baseline and a large steel grid, 6 x 6 m and a small one, 2x2 m, (Fig. 20) were used for plotting structural remains and antiquities by trilateration using measuring tapes. The positions of structures and major antiquities were fixed with the aid of the sextant, and the plotted positions were rechecked by deploying Mini Ranger III which gives an accuracy of ± 2 m. The major datum points were the base of the temple of Samudranarayana and the submerged in situ Structures 4, 7 and 10, which are bastions built over boulder foundation. At the western end, the base line runs along the scars.

It is also possible to take three dimensional angle and distance measurement using an underwater theodolite or laserbeam and sonic ranging devices in deeper waters. The measurements and coordinates can be fed through a computer to get a three-dimensional plan.

Stereo Photogrammetry

This method is similar to aerial photography. The photographs taken, after processing to correct tilt, height, etc., can be trimmed and mounted to form a photogrammetric plan. A three-dimensional image can be obtained using a photogrammetric viewer and threedimensional measurements can be taken from photographs. The details of monuments at Mahabalipuram near Madras, have been reconstructed by Dr. S.M.Ramasamy, Professor and Head, School of Earth Sciences, Bharatidasan University, Trichy, through Photogrammetric technique; it can be adopted for reconstruction of the plan and elevation of underwater archaeological remains. The scale and accuracy of the plan of underwater objects are controlled by reference to datum points around the site, which appear on the photomosaic plan. The structures, wrecks, anchors and other artefacts are stereophotographed and drawn in situ, and again on recovery. The log book entries and field notes supplement the data of objects and environ, based on the observations of the diverarchaeologists.

Archaeological data recorded daily, and the drawings and photographs before and during excavation, and after recovery, shall form the basis for discussion and conclusions.

Remote Sensing

The use of aerial photographs for archaeological mapping is, in a sense, the first archaeological application of Remote Sensing. Problems relating to the types of sites, mapping and preliminary reconnaissance, especially in the case of buried sites on land and, to some extent, in water, can be dealt with by Remote Sensing.

New sites of archaeological importance in India are being located using soil marks, vegetation marks and anomalous landforms in Rajasthan, Kuchch, Saurashtra and North Gujarat from satellite data. Narendranath of Indian Remote Sensing Agency is of the view that sites submerged in 10-15 m water depth can also be located from satellite imagery data. It is hoped that soon devices will be found for penetration to greater water depths for locating shipwrecks and submerged ports in the Indian Ocean.

An attempt has been made by the Space Application Centre, Ahmedabad, to ascertain whether sites of archaeological interest can be located in the Rann of Kuchch using soil marks, vegetation marks and anomalous land forms. One report says that the river Saraswati flowed along the bank of Little Rann of Kuchch and poured its water in the Gulf of Khambhat, another report says that Saraswati flowed in Kachcha upto 325 B.C. The location of Dhola Vira, a Harappan town in Kutch, is also indicative of a riverine access for the Harappans to the hinterland in Rajasthan via Saraswati. The satellite imagery of the Great Rann of Kachcha, which is dry with encrusted salt in summer and covered with water in monsoon, shows signs of a mighty river flowing northsouth between 70° 15' and 70° 30'E (Fig. 32). It also shows that the river is divided. A branch of the great Saraswati must have been flowing near Patan, Modhera, Sidhpur, in north Gujarat before joining the Gulf of Kuchch. A few Harappan sites are also found here. A Few villages seem to have existed in the area between 24º 09'N and 70º 28'E. Agricultural areas are seen between 24°11'-24°15'N and 70°20E and 70° 30'E in Thakkar's report which gives the interpreted IRS data of the Great Rann of Kachcha showing soil marks, palaeo-channels, probable location of settlements and agricultural area. These areas need to be explored by land and marine archaeologists.

Diving and Seamanship

History gives no clue as to when the art of diving was discovered, or who the first divers may have been, but there are profuse accounts of man's effort to breathe and operate underwater. In naval warfare, as early as 400 B.C., diving was common. It is recorded that Alexander the great descended in some form of diving bell in 333 B.C. Most of this diving was carried out without special equipment. A breathing tube was held in the diver's mouth, with the other end attached to a float. Not until the Middle ages was any attempt made to supply air to man under water. It began with the appearance, in 1837, of the 'Closed' Diving Dress and Helmet, invented by Augustus Siebe. This was the greatest single advance made in the development of diving equipment. This dress, essentially unchanged, is still in use worldwide. It is known to us as the Standard Diving Dress. However, it was Jacques Cousteau who popularised the use of self-contained airbreathing by the introduction of the Cousteau demand valve. Deep diving, employing mixture of oxygen and helium, is a comparatively recent innovation. But it has been proved that man can live and work in depths considerably in excess of 400 metres for days at a stretch.

Diving is basically a seamanship evolution helped by the fields of science, engineering and medicine in our efforts to go deep into the water, for longer periods. However, we should be wrong if we do not consider the most important factor, the diver himself. Without his courage, dedication and determination, we would all be wasting our time.

The human body under water is operating in a completely different environment, in which it is exposed to much greater pressures compared to normal surface pressures. It is necessary, therefore, to consider carefully the meanings of the terms force, pressure and density as applied to liquids and gases. Some of the factors affecting divers are listed below:

(a) Oxygen Poisoning: This is brought on by breathing oxygen at too high a pressure. The exact cause is still not known, but is believed to be the intoxication of the breathing centres of the brain. The symptoms are unreliable and the onset varies both from individual to individual and from day to day. It generally occurs at any depth where oxygen has a partial pressure greater than two bars abs and so diving is limited in depth to the point at which this occurs (depending upon the mixture being breathed).

The most frequent order of appearance of symptom is as follows: Twitching of the lips, vertigo, dizziness, nausea (feeling of sickness), drowsiness, convulsion, unconsciousness. sometimes, convulsion may be the one and only symptom.

Treatment is to reduce the pressure, place the diver in fresh air, restrain him during convulsions, prevent self-injury and gag him to prevent him biting his tongue. Loss of memory occurs frequently, so he should be kept under observation for at least 12 hours.

(b) Hypozia (Lack of Oxygen). This will occur if the partial pressure of the oxygen being breathed falls below 0.2 bars abs and is almost always caused by an excess of nitrogen. It is then known as Dilution Hypoxia.

(c) Carbon Dioxide is a poisonous gas. It is

a waste product of combustion in the production of energy, and its presence in the body stimulates breathing. A diver will produce, approximately, one litre of the gas per minute, while swimming, and under normal conditions the body is well able to get rid of this. Thus, if it is present in excess, it is because of some failure of the diver or his equipment.

At atmospheric pressure, upto about 3% carbon dioxide can be breathed with no effect on the body. As the percentage is increased, the stimulation of the respiratory centre of the brain increases, resulting in an increased pulse rate and heavier breathing. At about 0-1 bars abs the pulse rate slows down and the blood pressure drops. Resulting in unconsciousness and, in extreme cases, death. Thus, the onset of carbon dioxide poisoning can be recognised by the increased breathing rate followed by breathlessness and exhaustion. On return to

Fig. 32 : Anomalous structure on the bank of a palaeochannel seen on IRS data of the Great Rann of Kutch.



fresh air, the symptoms soon disappear. However, the person may experience head aches; may also vomit for a while.

(d) Carbon Monoxide: Under normal conditions, this gas will not be present in any breathing apparatus. It is produced mainly in the internal combustion engines, and forms part of the exhaust gas. Its two most likely sources that concern the diver are a ship's engine and the air compressor. Thus, care must be taken on the siting of the compressor's fresh air inlet with regard to the exhaust outlet. Again although the inlet may not actually be near the exhaust fumes, the wind may blow some carbon monoxide into it. Thus 0-00001 bars abs is taken as the upper safety limit.

Diving Equipment

For two thousand years divers in the Levant have been bringing valuable cargo from shipwrecks and receiving a percentage of the value of the finds depending on the water depth, but they could not stay in water more than a few minutes.

A legendary breed of Korean women divers who plunge to depth of 18 metres without the aid of oxygen has reached the end of the line (Hindustan Times, New Delhi, March-1995)

In 1531, Lorena invented a portable diving bell to retrieve Emperor Caligula's pleasure galleys from the bottom of Lake Nemi in Italy where they lay for more than a thousand years. An improved version of the diving bell was used in 1583 to bring up cannon off Gothenberg from a depth of 35 m. The attempt to retrieve the Swedish Ship, however, failed. William Phipps, a treasure hunter, used a larger Diving Bell in 1689 to recover the treasure from a ship that had sunk off Cuba.

It is Edmund Halley, the astronomer, who recognised the necessity of supplying pure air in diving bells. He designed a bell in which air was repurified in barrels sent down from the surface. The divers could also work outside the barrel by breathing air through tubes, in which he could lie protected from water pressure. He could work with hands upto 20 m depth through insulated holes in the bottom.

The first helmet designed by John Deane had two windows and could be fixed to a watertight dress, but later he improved it so much that it became the standard. It was used for diving on *Mary Rose*. William Jones and Charles Condert produced a design wherein compressed air was held in a metal reservoir fixed to the diver's waist. A variant, subsequently made consisted of a metal cannister containing air at 40 atmosphere pressure.

For adjusting the pressure of air by the diver to the pressure of surrounding water, a "Demand Valve" was produced by Nouguayrol and Denayrouze. By 1900, Louis Bouton introduced a compressed air breathing set of two cylinders holding 200 atmospheres pressure.

In SCUBA (Self Contained Underwater Breathing Apparatus), the air-containing cylinders attached to the back of the diver supply air to the full face mask. An automatic aqualung with a demand valve mounted between diver's shoulders was produced by George Commeinhes in 1939. Its final version was the contribution of George Cousteau and Engineer Gagman. It is used by divers throughout the world (Fig. 22).

There are four dive patterns in target search. One may dive clockwise or anti-clockwise, along the sides of a square or rectangle, in a predetermined area. A triangular form of diving and diving in a circle are also useful. The diver must acquaint himself with the dive site determined by the director. The location itself understand the nature of is important to seabed, sediment cover, structure of the seabed and the nature of reefs and shoals. Safety must be the first consideration in diving laws. The diver must read the Diving Manual under the direction of the Instructor and must have firsthand information of weather, tides, currents and sea state. He should be able, as far as possible, to predict the swell, etc., from the wind. The diving rules and laws of the state regarding protected sites, condition of licence procured for diving and retrieval of objects,

the material of which the object is made and techniques of retrieval should be known to him.

Underwater Photographs

Water being many times heavier than air, pressure increases as the diver goes deeper and the pressure inside him equals at 30 or 40 m depth to the pressure in a fully inflated car tyre. This pressure in itself is not dangerous, but it is the change in gas volume that accompanies it that is dangerous. If the pressure inside and outside the diver is free to equalize itself, there is no change in the volume and no damage is done. However, if the pressure relief route is blocked, the isolated gas space will contract as the diver swims down, or expands as he swims up, causing the body's tissues to rupture. For underwater photographs, diving is a necessity. Fortunately, if the techniques and schedules prescribed for making diving safe are observed, there can be no problem for a diver-photographer. Still, underwater photography is a demanding skill and in depths exceeding 30-40 metres, and almost certainly below 60 metres depth, a dangerous situation

may build up suddenly, for nitrogen narcosis begins to appear at 30-40 m depth and a definite effort of will is needed to concentrate on a particular task like photographing details of wreck or site or antiquity.

The visibility of the object is greatly hampered in turbid water. Even otherwise, in clear water, the torch beam is reduced to 10% of its original value when it penetrates one metre. In the next metre, the remaining 10% will itself be reduced to 10% so that after 2 metres only 1% of the original light will remain. Flash guns, however, have solved this problem.

The Nikonos Kalypso Nikkon Camera with metal-housing or plastic housing is regarded as the standard general purpose underwater camera. It has a 28m,f. 3.5 Nikkon lens. An ultra wide-angle lens (15 mm f 2.5 UW Nikkon) with dome port-hole well corrected for underwater photography and special view finder clamping to the top of the camera, is necessary in some cases.

Video Filming : Osprey underwater Video camera with monitor and strobe were found useful in producing videofilms of underwater operations.

CHAPTER III

DISCOVERY OF SUBMERGED DVĀRAKĀ

he importance of the legendary city of Dvārakā, believed to have been founded by Lord Krishna, and subsequently swallowed by the sea about 5,000 years ago according to some scholars, and 3,500 years ago according to others, has been realised of late by historians, archaeologists and oceanographers. The epic *Mahābhārata* and its epilogue, *Harivamśa*, give a graphic description of the city and its environs. The *Mahābhārata* treats Krishna both as a man and God. In fact, Krishna himself says in the *Bhagavad* Gītā that people do not understand my supernatural being because of my human body.¹

अवजानन्ति मां मूढ़ाः मानुषीं तनुमाश्रितम्। परं भावमजानन्तो मम भूतमहेश्वरम्॥

Avajānanti mām mūdhāh mānushīm tanum āśrītam. Param bhāvam ajānanto mama bhūta maheśvaram ii¹

(Bhagavad Gita-9.11)

The boyhood adventures of Krishna described by the Sage Vyasa in the *Bhāgavata Purāņa* clearly suggest that even as a teenaged lad Krishna exhibited extraordinary qualities of leadership in rescuing the flood-stricken residents of Gokula by leading them to a safer place on the hills of Govardhana. The rock-shelters in low lying hills of Fatehpur Sikri - Bharatpur series contain some prehistoric rock paintings, and it is no wonder if the Govardhan hillock, now dwarfed by the accumulation of flood deposits at the foot, was high enough to provide shelter to the men and animals of Gokula. Another quality of this young leader was righteous indignation against injustice and cruelty.

Krishna could not withstand the cruelty of his maternal uncle Kamsa, the ruler of Mathura (in UP), who had not only imprisoned his parents Vasudev and Devaki but also killed their first six new-born offsprings. To put an end to the harassment of the innocent subjects and to uphold dharma Krishna had to slay Kamsa. By this single act and to uphold dharma Krishna incurred the wrath of Jarasandha, the powerful ruler of the large kingdom of Magadha (modern Bihar) Jarasandha's army attacked Mathura and devastated the land. According to Jaina text Jarasandha's wrath stemmed from Krishna's refusal to acknowledge the suzerainty of Jarasandha. It is at the suggestion of the elders of Mathura that Krishna agreed to leave Mathura along with his Yadava followers, so that the subjects of Vraja (Mathura region) could live in peace (Fig.33). As a shrewd and practical statesman, Krishna acted in an exemplary manner and left Mathura in the larger interest of the people. This concern for the welfare of his people earned him their gratitude. He chose to go to a distant place, which was not only inaccessible to Jarasandha's forces, but at the same time, held out promise for a comfortable living for the Yadavas. This is one of the reasons for selecting Kusasthali on the northwestern coast of Surashtra (modern Saurashtra in Gujarat State), which was well protected by a hill on one side and the sea on the other sides. It is identified with Bet Dwarka or Sankhodhara (Fig.35). The Sabha-Parva of Mahābhārata states that the



Yadavas migrated from Mathura to Kusasthali to avoid harassment from Jarasandha.

वयं च महाराज जरासन्ध भयात्तदा। मथुरां संपरित्यञ्य गता द्वारावती पुरीम्॥ ²

Vayamcā mahārāja Jarāsandha bhayāt tadā Mathurām samparityajya gatā dvārāvati purīm.

The colourful personality of Krishna, as epic hero and divine lover, has endeared him for generations in India. The Bhagavad Gita, which embodies his teachings, has exerted a powerful influence on the daily life of an Indian in general, and Hindu in particular. It has inspired literary works such as the Kirātārjunīyam of Bharavi and Siśupālavadha of Māgha in Sanskrit, and Naladaman of Babullah in Persian (1657 A. D.) written in Nastaiq style with illustrations in Deccani style. The Krishna Cult influenced foreigners also. For instance the Indo-Greek ruler Agathacles issued coins depicting Vāsudeva's symbol, wheel (chakra), on the obverse, and Balarama's Plough (hala) on the reverse. At Chulas, in Pakistan, two figures engraved on rock with inscriptions below them, reading Baladeva and Vasudeva in Brahmi characters, are similar to those on the coins of Agathacles. The Mathura figure of Balarama is dated 2nd century B.C. The most interesting depiction of Krishna is, however, a terracotta figure from Sugh in Haryana, wherein he is shown learning the Brahmi alphabets at the hermitage of his preceptor Sandipini. B.C.Chhabra has assigned it to 2nd century B.C.

As a strategist, Krishna could dispose of the enemies one by one and restore the kingdom to its rightful heirs, namely the Pandava princes. The very fact that he met his end like an ordinary mortal at the hands of the hunter, named Jara, may suggest that he was, in fact a, human being.

Deification of Krishna

It is because of his extraordinary qualities of leadership, love and sympathy for the poor and the helpless that Krishna has been deified. In one sense, he was a "man extraordinary", because he could destroy the mighty forces of the Kauravas and restore the kingdom of the Pandavas to the rightful heirs. As a great social reformer, he rescued and rehabilitated the damsels held by Naraka in captivity and gave them respectability by symbolically marrying them. His response to the cry of the helpless was instantaneous, as in the case of Draupadi, who suffered indignity before an assembly of men.

Krishna was a great philosopher, and at the same time practical to the core. He laid emphasis in his teachings on bhakti (devotion to the Supreme Being) and *nishkāma Karma* (desirefree action) in his famous message known as the *Bhagavad Gītā*.

The Krishna cult which became very popular in a short time, was incorporated in the Vishnu cult. The Taittirīya Āraņyka (X, 1.6) developed the Nara-Narayana (man and superman) concept, wherein Arjuna stood for man and Krishna for the superman. On Panini's sutra "Vāsudevārjunābhyām Vuņ" Patanjali comments that the use of the suffix vun and the precedence of Vāsudeva contrary to the grammatical rules, are justified because of the devata viśesha (divinity) of Vāsudeva (Krishna). By the 5th century B.C. the divinity of Krishna was well established. The appeal of Krishna's teachings through the Bhagavad Gītā was so great that even foreigners embraced Bhāgavatism, which is recorded in the inscription of Heliodorus, the Greek Ambassador at the court of Bhagabhadra at Avanti (Ujjain). He erected a Garuda column to the Samkarshana-Vāsudeva temple at Bedsa (Vidisa), near Bhopal, and in the inscription he has called Vasudeva (Krishna) devadevā, 'God of Gods'. The excavations at Vidisa have brought to light the remains of a 3rd century B.C. temple in which Vāsudeva, Balarama his elder brother, Pradyumna his son, Aniruddha grandson and Satyaki were also worshipped. If, in a remote place like Vidisa, a temple for Vāsudeva was built in the 3rd century B.C. it is reasonable to conclude that in Dvārakā and other places of Krishna cult, also temples must have been built in honour of Vāsudeva.

Date of the Mahābhārata War

The opening verse of the *Mahābhārata* refers to a historical poem called *Jaya* (Victory) composed by Vyasa, a contemporary of the heroes of the Bharata War. The early Vedic literature (RV.X. 98 and Kāthaka Samhitā X.6) refers to a number of rulers, namely Santanu, Vichitravirya and Dhritarashtra, who are later referred to as ancestors of the epic hero Devakiputra Krishna (Chāndogya Upanishad III, 17.6) and Sikhandin Yajnasena (Kaushītaki Brāhmaņa VII.4). V. N. Datta³ cites Sānkhayana as mentioning a sacrificial lapse which had brought misfortune to the Kurus by depriving them of Kurukshetra. Panini (500 B.C.) mentions Vāsudeva, Arjuna, Bhima, Yudhishthira, Kunti and the Kurus. Kautilya (400 B. C.), in his famous work Arthaśāstra4, attributes the destruction of Duryodhana to his coveting another's kingdom. The earliest Puranas, Matsya and Vāyu (5th-4th century B.C.), consider the war as a dividing line between the two great epochs, namely Dvāpara and Kali. There is much controversy about the date of the Mahābhārata war which, according to Aihole inscription⁵ is assignable to 3102 B.C., while archaeological, dynastic and other evidences suggest 16th-15th century B.C. date⁶ . A crucial element on which dating the war depends, is the acknowledged use of iron weapons in the Bharata war⁷. The earliest date of iron in India is 1520 B.C., as attested to by the excavations at Gufkral in Kashmir⁸. It occurs at Kumaranahalli in Karnataka in 1380 B.C.⁹

So far as the date 3102 B. C., based on astronomical calculations and Aihole inscription is concerned, N. Mahadevan¹⁰ has discussed the human errors that crept in the Puranas in copying or due to lapse of concentration. Another scholar, Rai Gyan Narain Prasad¹¹, observes, "Because the first Saptarishi cycle began in 8508 B. C. when Vernal Equinox was a Māgha 0^{0} , therefore, it was often traditionally believed that the beginning of Saptarishi cycle should always coincide with the Māgha 0^0 in a fixed Zodiac system. Due to this tradition, the beginning of the epoch of the third cycle of Saptarishi in 2448 B. C. is often confused with the Māgha century of Saptarishi Cycle (1438-1326 B.C. in the Varahamihira's Narayana Zodiac

system) during Parikshit's time, when Vernal Equinox in backward precession coincided with the Rohini 0° or Krittika 13° 20, i.e. the last point of Krittika". He adds, "we are in the fourth Saptarishi Cycle" and the Māgha (Mahābhārata War) century should be in 1438-1326 B.C. One cannot, therefore, rely solely on Puranic date of 3102 B.C. for Mahābhārata.

Excavations at Hastinapur

If the historicity of the events and personages mentioned in the epic is to be verified, it is necessary to identify the ancient sites of Mahābhārata tradition such as Hastinapura, Indraprastha, Mathura and Dvaraka, and conduct large scale archaeological excavations, which alone can yeild reliable evidence for checking the date and cultural attainments of the people. The excavations conducted by B.B. Lal¹² at Hastinapur had brought to light a first millennium B.C. settlement, where a distinct pottery known as Painted Grey Ware (PGW) was found. He, however, ignored the earlier Ochre Coloured Pottery (OCP). M.C. Joshi's excavation at Mathura also did not yeild satisfactory result, because certain mounds were not excavated.

The excavations at the ancient site of Purana Qila, Delhi, which is traditionally known as Indraprastha, were extremely limited in the lowest levels. Although the Ochre Coloured Pottery of mid-second millennium B.C. was found here, a large-scale excavation was hindered by deposits of medieval and early historical periods. The Hastinapur evidence in the form of structures and ceramics did not indicate a developed urban civilization of the kind described in the Mahābhārata. This lacuna prompted H.D. Sankalia to say that the Hastinapur evidence does not reflect an urban civilization of the Mahabharata Age. In view of the inconclusive evidence obtained from Mathura, Indraprastha and Hastinapura, the author was looking for a site where conclusive evidence could be had. Dvārakā, which Krishna himself is said to have founded, was the obvious choice for a large-scale excavation, but here too a difficulty arose. All ancient texts, including



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the *Mahābhārata*, are unanimous about the submergence of Dvārakā by the sea immediately after Krishna left his mortal frame.

Original Dvārakā

To complicate the issue further, there are four claimants to the honour of being Krishna's Dvārakā¹³. They are, (1) present Dwārkā town on mainland and Bet Dwarka island, both in Jamnagar District of Saurashtra; (2) Visawada, about 30 km from Porbandar on Porbandar-Dwarka highway, where there are only early medieval Saivite temples and no traces of any port of 2nd or 3rd millennium B.C.; (3) Madhapur, near Kodinār in Junāgadh district, where a solitary shrine of early historical period stands on the sea-shore; (4) Girnar, where the hill renamed as Raivataka, referred to in the *Mahābhārata* stands.

Both Sankalia and the author have explored Visawada and Madhapur (Mul Dwarka) and found no protohistoric settlement. As there is no sea at Girnar, it could not have been the sea port of Dvārakā of the Mahābhārata period.

Dwārkā

The only site recognized as Krishna's Dvārakā by all great saints since the 8th-9th century A.D., is the Dwārkā in Jamnagar District. The excavation in 1963 at Dwārkā by the Deccan College, Poona, was inconclusive, because the excavators could not get evidence of a town

Fig. 37: Ground plan of Dwarkadhish Temple



earlier than the 1st century A.D./B.C. **Onshore Excavations**

The Deccan College, Poona, had excavated outside Dwarkadhish Temple Complex in 1963 and concluded that this was the Dvārakā of the Mahābhārata Age. The excavators recognized 5 periods. The earliest period, namely Period 1, has been dated 1st to 2nd century B. C.14, on the basis of a distinct datable pottery known as the Red Polished Ware, found along with terracotta balls, a piece of iron and shell bangles in layer 7 comprising sea sand. Period II, noted for the presence of Roman amphora and Red Polished Ware, is assigned to lst-4th century A.D. The first habitation of Dvārkā is said to belong to this Period. Next comes Period III, noted for structures and moulded courses of a temple. Period IV yielded coins of Gujarat Sultans, polychrome glass bangles and glazed pottery, the last mentioned item being dated to 10th century A.D. Three structural phases noticed in

this period extend almost upto modern times represented by Period V. The excavators concluded "From our observation of the various places in and around Dwarka, as also from the evidence of excavation, one can definitely say that this is the Dvārakā mentioned in the Musala Parva of the Mahābhārata, the Dvārakā Mahatmya of Skanda Purana, other Puranas and the Ghata Jātaka. In particular, one can say that the Dvārakā described in such great detail as a sacred tirtha by the Harivamśa, probably came into existence after the second submergence in the sea of two earlier Dvārakās¹⁵, The excavation by A.S.I. under present authors guidance in Dwārkādhish Temple Complex at Dwārkā in 1980 gave unmistakable evidence of the destruction by sea of a township of 1500-B.C. (Rao S.R.1988). The consensus date of the Mahābhārata War being 1424 B.C., although earlier dates were not to be rejected straight away; it was possible to infer that the



Fig. 38 : Excavation of Dwarka and (inset) site plan of Dwarkadhish Temple Complex



habitation debris of the town, which could be assigned to 1500 B.C., may be of submerged Dvārāka of the Mahābhārata tradition; and it would be necessary to explore seaward to trace the structural remains and other relics of this ancient town in order to prove or disprove that this was the original Dvārāka. There was, however, one problem regarding the exact location of Dvārāka. According to the Vishnu Parva of Harivamśa (57-5), Dvāraka was a Varidurga¹⁶ (a water fort; and is said to be Udadhimadhyasthām, surrounded by the sea, may be an island.¹⁷ The island of Bet Dwārkā (22° 25' 10"N 69° 6' E), situated 30 km north of Dwārkā on the mainland, is also a holy place and is

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identified by Umashankar Joshi with Antardvipa and Kusasthali mentioned in the Mahābhārata (Fig 28). It may be recalled that Matsya Puraņa (Anandasram Edn 12.22) refers to Kusasthali, which was named Dvārakā after Yadavas occupied the town. Vāyu Purāņa Purvabhaga adds that Kusasthali was a city or Capital (?) in Ānarta.

Onshore Exploration of Bet Dwarka

The Marine Archaeology Unit (later designated as Marine Archaeology Centre) was established in the National Institute of Oceanography in Goa in 1981 for offshore excavation.

The institute undertook in 1982-83, the



Township	Date	Archaeological Evidence 1980
First Dwārkā	15th-14th Century BC	Lustrous Red Ware eroded by sea
Second Dwārkā	900-500 BC(?)	House floors, thin black-on-red
		painted pottery
Third Dwārkā	2nd Century BC to 6th	Temple I (1st Century BC-2nd century)
	Century AD	(AD) and Red Polished Ware
Fourth Dwārkā	7th-8th Century AD	Temple II (3rd-7th century AD)
Fifth Dwārkā	7th-8th Century AD	Temple III (8th-12th century AD)
Sixth Dwārkā	12th-13th Century AD	Temple IV
Seventh Dwārkā	13th-15th Century AD	Inner and outer portions of Temple
		V(Dwarkadish)
Eighth Dwārkā	Post - 16th Century AD	Late Medieval and Modern Townships

onshore survey of the island of Bet Dwarka, which is also known as Sankhodhara (Fig 35). The island was connected with the mainland in 1500 B.C. as the contour reveals (Fig 28-A). The wooded hills in the island corroborate its discription in Mahābhārata (Fig 42). The southern sector of the eastern shore shows traces of rubble walls (Fig.43), extending over 500m, noticed in several places northward of the tomb of Siddi Bawa Pir. The intertidal zone at the foot of the cliff is strewn with building blocks of stone structures (Fig.44,47) which are continuosly eroded by spring tides, thereby damaging a large portion of the once continuous wall of 500m length. The exploration of the intertidal zone yielded wave-rolled pottery, namely convex-sided bowls, dishes with carination, stand parts of dish-on-stand, troughs, storage jars and basins of sturdy red ware which, both in fabric and shape, were found to be of the late Harappan type (Fig.45) comparable to those from Rangpur Period IIB. There were also a few sherds of the carinated bowls of Lustrous Red Ware of Rangpur IIC type. Further onshore excavation was undertaken for determining the date of the wall in the eastern cliff section of BDK I - BDK II in Bet Dwarka.

The crenulated bay near the tomb of Siddi Bawa (Fig.46) is well sheltered against wind because of 30 to 40 m high wooded hills rising above the intertidal zone. The outcrops of rock on the southern and northern flanks of the bay served in the past as natural breakwaters. Some boulders dumped on them can still be seen. The excavation of the cliff section, where rubble walls stand, was undertaken by laying a trench across the walls, and nine courses of masonry were exposed. An interesting feature of construction of the structure is that there are cross walls at regular intervals of 2m projecting from the long wall (Fig.50). The box technique is found to have been adopted by filling the compartments formed by long and cross walls with earth capped by rubble in order to increase its thickness to serve as landward gravity wall (Fig.49). The foundation of the long wall is laid in layer 4 and that of the later srtuctures in layer 3. The local residents of Balapur have dug below the walls for clay and thereby caused further damage to structures. Another wall, (Period II) abutting west of the gravity wall of Period I, was found to have been built long after the gravity wall was abandoned and partly destroyed. Pottery from the layers contemporary with the gravity wall was unmistakably of the Proto-historic period assignable to Late or post-Harappan phase (Fig.51) while the pottery of the abutting wall was of the Early Historical phase. Both the categories of pottery were sent to Dr. A.K. Singhvi, Scientist in the Physical

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Fig. 42 : Medieval town of Bet Dwarka island (Sankhodhara) General view



DISCOVERY OF SUBMERGED DVÄRAKÄ

Fig. 44 : Building blocks of ancient township destroyed by the sea

Fig. 43 : Rubble walls in the eastern cliff section before excavation





Fig. 45 : Late Harappan and Lustrous Red ware pottery from BDK

Fig. 46 : Crenulated bay of Bet Dwarka



Fig. 47 : Bet Dwaraka island with sea on one side and hill on the other. Ancient habitation is partly submerged at the foot of the hill

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Fig. 48 : Ancient Dvārakā



Fig. 49 : Plan and section of structures in BDK I & II

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Fig. 50 : Long and cross walls in BDK I and II after excavation suggest box technique of construction

Research Laboratory for ascertaining their age by Thermoluminescence dating method. The dates¹⁸ assigned by this scientific method are:

- 1. 3528 years Before Present for pottery (Lustrous Red Ware) of Period I.
- 2. 1800-2000 years Before Present for the pottery of Period II.

These dates corroborate the dates assigned to Period 1(1500 B.C.) and Period II (800-1000 B.C.) on other archaeological evidences.

First Marine Archaeological Expedition 1983. Offshore exploration of Bet Dwārkā.

Before undertaking underwater exploration of Bet Dwārkā, the relevant data regarding the nature of the seabed, coastal geology and bathymetry, were obtained from the scientists of the NIO whose study in the past was found very useful for planning offshore search for archaeogical remains. According to R.R. Nair, N.H. Hashimi and R.H. Kidwai, the presence of calcareous sandstones at a depth of 60 m originating in intertidal zone indicates shallow water conditions between 9,000 and 11,000 years Before Present (BP), and the subsequent rise in sea level would have resulted in the transport of sediments from the shelf to the Gulf and then redistributed by currents.¹⁹ The floor of the Gulf consists of numerous topographical irregularities like pinnacles, as much as 10 m high, separated by flat topped features. A number of shoals such as the Ranwara, Lushington and others are present in the Gulf.



Fig. 51 : Proto-historic pottery from Bet Dwarka

The maximum depth in the Gulf of Kutch being 60 m, the lowering of the sea level as much as 60 m would mean almost a dry land or Rann. The calcareous sandstone of intertidal zone found at 25 m depth in the Gulf is dated 4000 BP. The bathymetric map of the Gulf of Kutch (Fig.38), where Bet Dwarka island is situated, shows 3 m to 6 m depths with mud flats over large areas exposed during ebb tides near Balapur and southern parts of the island. There is little doubt that Bet Dwarka was connected with the mainland near Okha and Kui about 3,500 years ago. There was more open land at the foot of the hills for constructing houses and building boats. The wooded hills provided fuel and timber. From the good quality conch shells available in the Gulf. It may be infered that shell working was a major industry. Pearl-fishing and pottery making were other industries which sustained the economy of Kusasthali. The overseas trade opened up new avenues for export to Bahrain and other countries. The main objective of the First Marine Archaeological Expedition was to locate ancient structural remains seaward of the walls in the cliff section of the eastern shore. A preliminary survey in ebb tide (0.04 m OCD) revealed a dwarf wall of dressed stone blocks, built on the wavecut bench, which extends 220 m seaward of BDK I. Although a major part of this wall has been destroyed, an array of blocks, measuring on an average 1 x 0.6 x 0.5m, is seen lying in a straight line (Fig.43), indicating a wall 180 m seaward of the beach. B.U. Nayak, Head of the Ocean Engineer



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Division of the National Institute of Oceanography, is of the view that "the massiveness of the stones rules out any possibility of being transported by waves and currents. They also do not appear to be derived from the disintegration of the local outcrops. Their prismatic shape and alignment suggest that they form building blocks of a wall-like structure, extending over a length of 20 m. Seaward of this line lie heaps of rubble of the same size as that of the stones used in the construction of two structures namely Str1 and Str2 in the cliff. The smaller fraction rubble, extending all along and lying almost parallel to the shore line seems to be the result of onshore-offshore movement of water due to the action of tides and waves"20 Four trenches dug seaward of the wavecut bench provided useful data regarding have sedimentation, and also yielded pottery and other artefacts. Below the overburden of silt and sand accounting for 0.5 to 2 m there lies the rocky bed. In some locations the underlying sediment deposit was so hard and compact that even probing with iron rod was difficult. A couple of parallel-sided chert blades were, however, recovered while airlifting in the trenches. The sherds of Lustrous Red Ware bowl and dish recovered in excavation corroborate the TL date of 1500 B.C. for pottery associated with the structure of Period I.

Second Expedition 1984

In the course of the Second Marine Archaeological Expedition, the seaward extension of the midsecond millennium B.C. township was ascertained by excavating under controlled conditions within a box-like steel caisson placed on sea bed. Airlifting of the overburden yielded some artefacts. Two caissons of MS sheets 2 x 1.5 x 1.5 m and two airlifts of 10 cm diameter, fabricated at Bombay, were pressed into service. An air-compressor was procured from M/s. Orient Underwater Engineers Pvt. Ltd., New Delhi. A drawing grid of MS angles with graduation marked on it was found useful for plotting antiquities *in situ*. Initially, commercial divers had to be engaged but later on marine archeologists P. Gudigar and K.Rajan joined the Marine Archaeology Centre for underwater exploration. Two motorboats, Raghuvira and Fateh Savoy were chartered for diving purposes. The sediment mixed water was sucked by the airlift and delivered into a sieve placed on the MS Tank. The sediment was examined and pottery and other objects of archaeological significance were collected, cleaned, given first aid wherever necessary, and entered in the Antiquity Register. Every dive is recorded in the log book wherein the time of diving and surfacing, location, buoy number, work done, and findings of the diver regarding the conditions of the objects are noted. The condition of the sea bottom, swell, current, tide and depth are also recorded. Before disturbance photographs are taken in colour, or black-and white, or both, and again photographs are taken after clearance, fully exposing important objects. Their in situ position is plotted on a slate using Garware Polythene film. The site is gridded by a steel frame to facilitate plotting each structure or any other object. Aithough controlled digging is done in seabed, it is difficult to arrive at precise stratigraphy of the sediment. If the composition of sediment at varying depths differs, objects from each such deposit are separated and the layer numbers are marked. The analysis of the sediment is done in the laboratory of NIO to ascertain the components as well as other factors.

The poor visibility in Bet Dwarka waters owing to swells, currents and clay composition of the sediment has rendered underwater photography difficult, while in Dwarka waters the visibility is good and photographic documentation is satisfactory. The runoff from the shore in Bet Dwarka has buried structures in more than 3 m depth, but a few in lesser depth become exposed to view in lowest ebb tide as in the case of the walls in BDK I, BDK VI (Balapur) and BDK VIII (Central sector).

Eleven cruises to Bet Dwaraka were made during the second expedition. Two trenches UWI and UW2 were sunk in Bet Dwarka 500 m seaward of BDK base line. Layer 1 of UWI consisting of compact clay and lot of molluscan shells, is about 0.5 m thick. Layer 2 of Trench UW2 yielded rejected columella of conch shells and rolled potsherds of sturdy red ware, confirming, thereby, that the habitation area extended at least 200 m seaward. In Trench UW3, which is 300 m seaward of BDK II, a few building blocks and potsherds were found. Trench UW4 was laid 500 m seaward of BDK I and UW5 about 400m seaward. Two samples from layer 2 in 0.75m depth in sediment were collected for analysis. A trench dug 1 x 1 x 0.75 m in the intertidal zone (fig. 53) yielded in layer 2 a large potsherd comparable to Kassite Ware of Bahrain. Layer 3 is composed of fine sand capping weathered rock. Diving 600m seaward revealed fine sandy clay covering the

peripheral region of the toe wall built on wavecut bench recorded in the first expedition. About 200 m seaward of BDK I, large sherds of sturdy red ware of protohistoric age were found in the clay sediment. In the absence of artefacts in the sediment 600 m seaward, diving was confined to the 300-400 m seaward zone of BDK II. On 27th December, 1984, a trial trench UW 6, measuring lm square on plan, was dug and a Late Indus type seal of conch shell 18 x 20 cm with a perforated button on the back and engraved with a 3-headed animal on the face was found in layer 2.

Slipways

Two rock-cut slipways were noticed north of BDK II (Fig 54). According to B.U. Nayak they seem to be mostly natural features, but the



Fig. 53 : Trenches laid on BDK I and II slope of the bed of the slipway was created by artificial means by cutting the rock flanking the ramps. Some weathering effect and denudation, including erosion, which are natural phenomena in the intertidal zone are noticeable here. The beds are partly buried in sediment. The varying width of the slipways could have been created for launching boats of different sizes. The Black-and-Red Ware sherd found in the crevice of one of the ramps suggests the use of the ramp in the protohistoric period.

Dwārkā

Exploration of ancient Dwārkā (1983-84) commenced on 23rd December, 1983, and was continued in the fair weather seasons upto 1990, again in 1992 and 1994. The constraint of budget, personnel and equipment limited the duration of exploration to about 30 days in a year. The disadvantage of such extremely limited operation is that at the beginning of every field season (December), the buildings exposed in the earlier seasons had to be cleared of vegetation and sediment cover. Sometimes, collapsed parts of the structures could not be restored even on the basis of drawings and photographs prepared earlier when they were *in situ*.

The base line for plotting submerged structures was laid on the shore south of the temple of Samudranarayana. From this base line, another line 200 m seaward was marked for the purpose of plotting underwater buildings and anchors. The construction of a wall on the shore, south of the right bank of Gomati river, about one hundred years ago, has narrowed



Fig. 54 : Slipways in BDK VI

down its mouth, which in turn resulted in the formation of a sand bar. Its present channel is dredged once in three or four years. The sand heaped up on shore after dredging is transported into the nearshore zone by the shovelling action of the sea, and the submerged structures of ancient Dvārāka, exposed by the Marine Archaeology Centre, are again buried under the transported material.

About 200 m seaward of the temple of Samudranarayana (SN), a structure of large blocks of stone was traced after removing the overburden of sand and vegetation growing on it. The transit line of Dwarkadhish and SN temples when, extended seaward, touches this structure. The dressed blocks of sandstone used in construction measure, on an average, 1.5 m in length 0.75 to 1 m in width and 0.3m in thickness. A few are larger in size. Two courses of two arms of a wall 200 m seaward were photographed by Srinivas Bandodkar when the visibility was good (Fig 55). Some blocks of a structure destroyed by the sea are also lying at different locations, which are numbered 1 to 11.

Third Expedition (1985)

Underwater exploration in Dwarka waters was resumed in December, 1985, and seventeen cruises in FMV *Raghuvira* and *Fateh Savoy* were made between 28th November and 14th December, 1985, from Rupen to Dwarka (Fig. 56), as there was no landing facility in Dwarka. The primary purpose of this expedition was to survey a larger area than was hitherto possible so as to ascertain whether any significant structures had survived the fury of the sea and, if so, whether a plan of the town could be made out. During this expedition young

Fig. 55 : A structure of large building blocks raised over boulders in ancient Dvārakā now submerged part of structure A.



professional archaeologists were trained in diving and underwater excavation by Bandodkar. Often, heavy swell and current (Fig. 57,58) prevented the divers from gaining stability for cleaning the structures, anchors and other antiquities. Documentation was also delayed owing to poor visibility caused by the suspended sediments. Onshore survey was done on days when the sea was too choppy and boats were rolling heavily. Position-fixing of objects found in the seabed is a very important part of underwater exploration. This is done with the help of a sextant with reference to at least three prominent features on shore, such as the sikharas (towers) of Dwarkadhish and Samudranarayana temples (Fig. 59) and the Light Houses nearby. C. Chandola, former Hydrographic Surveyor, was engaged for position-fixing of underwater objects. The airjet was deployed for exposing the submerged structures. A preliminary survey of offshore region did not yeild significant results (Fig .60). Hence further seaward search for structural remains of the ancient city was undertaken from 36th November to 4th December, 1985. It revealed three groups of structures, designated as structures A,B and C. The inner group (structure A) was perhaps, a rectangular building with two arms, one running NE from buoy 12 and another NW-SE between buoys 10 and 13, but only one is intact. The large heaps of building blocks between buoys 11 and 7 indicate that the houses built of smaller fraction blocks within the enclosure were totally destroyed while the protection walls constructed from larger blocks were partly saved. In some cases, 3 or 4 courses of masonry upto 1.5 m height are in situ. In the

Fig. 56 : Rupen port wherefrom the Marine Archaeology had to cruise daily to Dwārakā water for underwater exploration





Fig. 58 : Smmudranarayna temple in calm sea

Fig. 60 : Preliminary survey offshore of Dwaraka town



intermediate Group (Structure B), a partial plan of a building, the two arms of which are visible, has been traced at buoy 16 (Fig. 48) One of the arms running between buoys 3 and 6 almost joins Strucutre A. Structure C in the outer group lies about 600 m seaward of the Samudranarayana temple. Only one arm of the building (Fig. 49) was traced between buoys 17 and 19, while other arms are greatly disturbed and buried in sediment. Further south of buoy 19, a few building blocks are visible. The massiveness of dressed building blocks and other architectural members such as the beam and pillar suggests that a public building stood here. Some blocks measure as much as $2 \ge 0.75$ x 0.3 m. The beam is 1.5 x 0.8 x 0.2 m. Most of the walls are just 0.75 m wide and a few are 1.5 m wide.

Fourth Marine Archaeological Expedition (1986)

The main objective of the Fourth Expedition lasting only a week from 7th to 14th April, 1986, was to provide the necessary facilities to the Government of India to produce a video film on the history of sciences wherein Marine Archaeology played a significant role. At the same time the structures exposed partially in the Third Expedition had to be fully exposed.

An important discovery made in Balapur Bay of Bet Dwarka in ebb flow is a wall of dressed stones, four courses of which are exposed over a length of 6 m (Fig.63).

Survey Method



Fig. 61: Structure B between buoys 13 and 16 at Dwarka



Fig. : 62A and B below partially exposed boulder foundation of structure C



The Swimline technique was followed in diving without using the jackstay. Buoys were placed at the starting point and end of the line. The land transits for surveying are the Dwarkadhish and Samudranarayana temples (Fig.59). The marker buoys are fixed at stations where structures or anchors and other antiquities have been found, and their position is fixed with the help of the sextant. For underwater survey, the trilateration method was adopted by taking measurements from three buoys whose position was fixed in the Third Expedition. The land transits are fairly accurate on Dwārkā coast, and there are back features which can be sighted. Relation of buoys, marked earlier on charts, was easily done. During this season most of the underwater exploration was done by young archaeologists and technicians trained in diving (Fig.36). Several rectangular stone objects with 3-holes (Fig. 64) which also served as anchors in addition to the triangular 3-holed anchors (Fig. 65) were located and plotted.

On the 9th April, even though the sea was rough, the boats Al Razaki sailed with the COMET team from Rupen to Dwarka. After reaching the site, the loose building blocks of a structure lying in a row near buoy 27 were photographed. It was noticed that L-shaped stones are used in the masonry for ensuring proper grip between various building blocks. Before documenting the structure, the profuse growth of sea weeds, identified as Coelanthrum mullerii and Bobycladia leptopoda, were removed, and the structure was cleaned. One of the three-holed triangular anchors from here measures 80 cm at base, 40 cm at the apex and 83 cm on either side. A rectangular bastion like a structure found here was photographed by Manavi (Fig.66). In ebb flow a rock-cut channel was found near SN (Fig.67)

Fifth Expedition (27th November to 27th December 1986).

During the expedition, it was possible to study the plan of the submerged town from the buildings discovered so far and to explore further seaward. For plotting of structures, anchors and scattered blocks, the different sectors of the site were gridded, for which a steel grid was prepared. The usual difficulties of swell, current and poor visibility had to be faced while documenting the objects. Turbidity due to swell hindered photography on several days. After preparing site drawings, two triangular anchors and one prismatic anchor, which was mistaken earlier for a railing post, and 14 dressed stone blocks used in building walls, etc., were retrieved with the help of chain and pulley. Mud flats of Balapur were explored (Fig.67) during the season.

The 3-holed triangular stone anchors (Fig. 65) range from 120 to 150 kg in weight. The wooden stakes are fixed in the two square holes above the base for holding the anchor in the sea bed. The stake fixed in the round hole at the apex enabled the boatman to haul the anchor with a rope tied to the stake (Fig. 22-A). Honor



Fig. 63 : A massive fortification stonewall BDK VI

Frost²¹ who has studied 3-holed anchors of Kition in Cyprus and at the Biblical site of Ugarit in Syria has assigned them to the l4th-12th century B.C. The comparable anchor of Dwarka also belong to the midsecond millennium B.C. Frost adds that "anchor stones that are too heavy for one man to handle in 50 to 70 kg range will, however, certainly antedate the introduction of metal and wooden anchor during the Iron Age". One of the architectural members recovered from the seabed is a lunateshaped stone, which resembles the candraśilā (moonstone) used at the entrance to temples. A stone pillar was also found in the vicinity of the lunate shaped block. Perhaps, both belong to a temple.

The research vessel *Vedhavati*, fully equipped with winch, generator, compressor etc., arrived at Okha on 29th November and reached Dwārkā on the 30th November. Bandodkar, Sharma and Brahmanand were fully engaged in diving and clearing vegetation, covering the submerged buildings and anchors at 6 m water depth 500 to 600 m seaward of Sumudranarayana temple. Some of the architectural members were also retrieved (Fig. 69) and plotted (Fig. 70).

A seaward base line was fixed on 1st December in Dwārkā waters by Surveyor Nanyasi and Scientist Saran, on the basis of an onshore base line marked on shore by Rathod of the



Fig. 64 : A prismatic 3-holed stone anchor, Dwarka

of India. The Archaeological Survey archaeological site was gridded. Two plain aluminium buoys marked the seaward base line, while buoys painted red and numbered were used for marking structural remains and anchors. Between buoys 28 and 30 a building of 15 to 20 blocks (Fig. 71,72) was cleared of vegetation and sediments by divers Nandu and Sharma in 5 to 7 m depth. A few agate and chert flakes were found in the course of airlifting the overburden on 1st December. As the sea became rough at 2.30 pm, further excavation was stopped for the day. Fortunately, the sea became calm on 3rd December and visibility was fairly good. Exploration resulted in tracing a 3.3 m long wall (Str 1) upto 3 courses of masonry. A new grid of aluminium pipe, with 10 cm graduations

Fig. 65 : A tiiangular 3-holed stone anchor, Dwarka





Fig. 66 : A complete bastion *in situ* at buoy 33, Dwarka built on boulder foundation



Fig 67: A rock-cut channel near Samudranarayana

marked on it, was fixed at the site for plotting the wall and stray blocks on drawing slate. Two arms of a building were traced near buoy 28 on the 4th December in 6m depth. Another structure (Str 2) of 3 courses of masonry was also exposed (Fig. 73, 74) and a marker buoy 33 was fixed. A triangular stone anchor and a few potsherds of Red Ware were found while airlifting in the gulley between Str 1 and Str.2. A third structure (Str 3) running parallel to Transit Line and a prismatic anchor found there were also recorded. The importance of Str 2 lies in the fact that it is built on basal rock and there is no evidence of subsidence of land. There is a greater probability of the submergence of structures of ancient Dvārakā owing to sea level rise than subsidence of land; this, however, needed further verification not only in Dvārakā waters but also at another port site namely

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Somnath, which was contemporary with protohistoric Dvārakā. A part of a wooden boat which must have sunk not in the distant past was found near buoy 31. It was documented and retrieved. A columella of conch shell with rounded edges and patination is a significant find because of the light it throws on the technique of working shell bangles in the early days of Dvārakā. Another wooden part of a wrecked boat damaged by wood borers (Fig.75) was given first aid and sent to NIO for conservation measures. An iron anchor found near buoy 33 (Fig.76) confirms that a boat had wrecked here. The *Vedhavati* (Fig. 77) was put to maximum use for retrieving stray objects.

Fig 68 : Preliminary survey at Balapur Bay, trench floated in high tide



Fig. 69 Retrieving an architectural member, Dwarka





Fig 70 : Diver plots a structure in Dwaraka

In all, 7 trenches were laid in the sea bed to expose structures, anchors and parts of a wooden boat. The following objects were found in the trenches:

Trench 1	-	Buoy 28 :
		triangular stone anchor (Fig.61)
Trench 2	-	Buoy 29 :
		Protohistoric pottery
Trench 3	-	Buoy 31 :
		Wooden object - Hull (Fig.78)
Trench 5	-	near Buoy 35 :
		Str 3 and wooden object
Trench 6	-	near Buoy 35 :
		A crescentic dressed stone

Diving undertaken on the 7th December, seaward of the TV Tower to locate structures, as suspected earlier, did not yield any fruitful result. The negative evidence was useful in concluding

Fig. 71: Structure 1 between buoys 28 and 30







that there was no extension of the town north of the Light House.

At a distance of 20 m southeast of buoy 33, a bastion built on boulder foundation but covered by concretions, was located (Fig. 79,80). An axelike wooden object was recovered near buoy 35, where another semicircular bastion was found *in situ*. Three courses of dressed blocks of the



Fig. 73 and 74 : Structure 2 at buoy 33



superstructure raised over a boulder foundation and capped by slabs laid flat (Fig. 81, 82) were exposed. Its outer arc is 142 cm and the stones used in construction are 1.09 m to 0.62 m in length. This structure *in situ* became a reference point for all future exploration, survey and position-fixing. The water depth over the extant top of the bastion was 5.5 m at 12.45 hrs. Elsewhere, it is explained that when this bastion and others were built at least 1 to 1.5 m above the Highest High Water (HHW) Line 3500



Fig. 75 : Part of wood; boat damaged by wood borers, Dwārakā

years ago, the sea level must have been 5.5 + 1.3 + 1.5 = 8.3 m lower than the present High Water Line (HWL).

By lowering a search-light at the anchorage of *Vedhavati* at night a few dressed stone blocks spread over 10 x 12 m area were noticed and a buoy marked 36 was fixed at the spot.

A prismatic anchor with 3-holes was traced at 6.8 m depth on the 8th December. A Trench (No.6) divided into 4 squares, A1-A2 and B1-B2, was laid near the bastion at buoy 35. It yielded wooden members of a wrecked boat. The hull must have been destroyed by wood-borers, except for a small part traced in a channel southeast of buoys 35 and 36. The wooden object has two holes and chamfered ends.

Trench 8 was dug upto 1.5 m depth in the channel and 3 layers were distinguished. Below occur layer 1, shingle and sand of layer 2, while layer 3 is sandy silt, in which a few potsherds were found. Trench 9 dug near buoy 33 yielded, in layer 2 sherds of a thin red ware, and in layer 3



Fig. 76 : Iron anchor, Dwarka

Fig. 77 : Boat Vedhavati, retrieving objects



well-fired sturdy pottery of red fabric and part of a bowl with flat base similar to that of the Lustrous RedWare (LRW) bowl were found. Layer 3 of Trench 10 laid near buoy 39 yielded two sherds of a concavo-convex bowl of LRW and two chert blades. Two other trenches yielded LRW sherds, which are heavily rolled.

The Unpredictable Sea

The sea became so rough in the afternoon on 12th December that the small boat(hodi) capsized while beaching. The boatman however,



Fig. 78 : Part of a wooden hull of a wrecked boat



Fig. 79 : A complete bastion in situ at buoy 33, built on boulder foundation Dwārakā





Fig. 80 : A complete bastion *in situ* at buoy 33, Dwārakā, built on boulder foundation (sketch)

was not injured, although the boat itself was damaged. On the 13th, too, the sea was very rough and with great difficulty the author could land 500 m south of SN on the rocky shore. Soundings taken on the 17th after the sea became calm, indicated a seaward channel of Gomati (buoy-29). Structures were traced on its right bank, as already noted, at buoys 28, 32 to 36. An iron anchor big enough to hold Fig. 82 : Part of a bastion at buoy 35 (sketch)



a 40 ton boat was recovered after airlifting in the channel near buoy 37. A smaller anchor retrieved from the same zone could hold a 25 tonner.

The Vedhavati, on its way to Okha on the 20th December, hit a sand bank in 2.5 m water depth and was about to capsize, but soon it regained stability after emptying the sediment filled tank on board. The trench No.14 was laid near buoy 38 on the 24th December when visibility improved, and a structure was traced near buoy 36.

Sixth Expedition (1987-1988)

The twofold objective of the sixth expedition was to prepare, at least, a partial plan of the submerged city of Dvārakā seaward of the temple of Samudranarayana (SN) after correlating disjointed structures, and excavate in the intertidal zone of Bet Dwarka to trace the remains of the ancient town of Kusasthali. The boat Ghelano Madad was engaged for offshore survey of Bet Dwärkā-. After exploring the eastern shore and cliff section near Balapur Bay of Bet Dwarka on the 3rd December, two small trenches were laid in the intertidal zone at the foot of the mound designated as BDK VI. Excavation was very difficult because of the low tide and the sticky clay in the seabed. The tidal range was not adequate for diving or airlifting in the mudflats even in low tide. With great difficulty, the excavation could be carried upto 0.5 m depth in the sediment and two layers were recognized. A small part of a floor and wall of what might have been a shell-worker's workshop was exposed. Pottery and worked columella were found on the floor of the house. The ebb tide in the afternoon exposed the mudflats, where walking is difficult on loose and sticky clay. At great risk, the expedition party crossed the mudflats and extricated the grounded hodi and then left for Okha on the evening of 3rd December. Further excavation in trench Al revealed a wall in the shell-worker's workshop where the Late Harappan Red Ware and a fragment of the Lustrous Red Ware bowl were also found. The alignment of stones and the presence of worked and unworked conch shells and pottery, indicate that once a wall running NE-SE existed here. Excavation in Layer 1 in Al revealed that it consisted of brownish sand, and layer 2 blackish clay upto a depth of 12 cm.

There was no pottery in trench A6 laid in the Intertidal Zone of BDK VI. Exploration of the Custom House Mound (site BDK VIA) in Balapur Bay indicated Early Historical and Medieval settlements. A trench sunk in the mound gave a continuous sequence from the Early Historical Period upto layer 10, where a potsherd inscribed *Sya* in Brahmi character of the 1st century BC/ AD was found.

On 11th December, a massive rubble wall, almost hexagonal in plan, was noticed in ebb tide by Rajan on the eastern shore (Fig. 83). During low tide this wall remains submerged. The site has been designated as BDK VIII. After photographing the wall, which measures 558 m in peripheral length, excavation to reach the foundation of the wall was undertaken in ebb tide (Fig. 84). Eight courses of dressed and undressed blocks of stone were found used in the masonry (Fig. 85,86) which is now heavily encrusted with barnacles and other sea organisms. To expose even a few courses much chiseling of barnacles had to be done. A trench measuring, 1 x 1.2m, was dug on either face of the wall, which is built on a wavecut bench. The builders have adopted the box technique by filling the core between inner and outer courses with rubble. Trapezoid stones were used for proper joints (Fig. 87). The wall is 2.5 m thick. A few sherds of Lustrous Red Ware and grey ware have been recovered. The extant height of the wall exposed (Fig. 88) all along the length (Fig. 89) is 1.2 but it must have been higher originally.

Seventh Expedition (1988-89)

The Expedition was planned with the two fold objective of imparting practical training in diving and underwater exploration to young archaeologists and technicians and, at the same time, to explore further seaward of buoys 35-39 to reach the nick point of Gomati, where it must

f



Fig. 83 : A massive enclosure wall of 558m in peripheral length exposed in ebb flow at site BDK VIII (Central Sector), Bet Dwarka







Fig. 85 : Successive courses of stone masonry of the submerged city wall in the intertidal zone of Bet Dwarka island. (Mid second millenium B.C.) exposed after recovering inscrustation of barnacles





Fig. 87: Interior of wall in BDK VIII filled with rubble

have joined the sea in the second millennium B.C. It was also proposed to search for other structures on its banks so as to ascertain the plan of the port town of ancient Dvārakā.

The vessel Vedhavati was not available for exploration during this season. Hence the boat Vijaya was chartered. On 28th December, 1988 underwater exploration of the zone 500m seaward of TV Tower was undertaken to trace the northward extension of Dvārakā. Misra and Setty dived in 5 to 17 m but no substantial structural evidence was forthcoming. In a way, the negative evidence was useful in concentrating on the southern and western zones. A few building blocks, perhaps dislodged from the structures on the left bank of submerged Gomati channel, were reported by divers at buoy 61 and an anchor was found 300m north of buoy 61 where buoy 63 was

Fig. 88 : Extant height of the massive enclosure wall in BDK VIII





Fig. 89 : Elevation of a corner of the enclosure wall in BDK VIII

fixed. At buoy 64 also some of the dislodged architectural members of a protection wall were noticed.

A search by divers Pinto, Bandodkar and Misra for buildings and portable antiquities on January 1st yielded two anchors, one of stone and another of iron, near buoy 67, also a fragmentary earthen bowl of Rangpur IIC- III type. The sea became choppy in the afternoon and heavy swell on the 2nd January prevented underwater search and documentation. A few photographs were, however, taken on the 3rd January. A search on the 4th for the bastion at buoy 35 recorded in earlier expeditions went in vain, as the shovelling action of sea had transported huge quantities of sand dredged in the present Gomati channel and dumped on shore by the Irrigation Department. The sea was choppy, and the boats Indira and Vijaya were rolling heavily on the 6th and 7th January. Offshore survey was, therefore, suspended. Exploration of ancient site in Harshad perhaps stands for Darukavana or Dvaravati which city MARINE ARCHAEOLOGY IN INDIA

state was found necessary.

Harshad-Miyani

This port, situated at the mouth of river Vasu, 70 km south of Dwārkā, was explored as part of a training programme on the 6th January. According to local tradition, Sri Krishna is said to have been helped by the Goddess Harshadmata in putting an end to the piracy of the earlier inhabitants of Sankhodhara (Kusasthali). Miyani was a very prosperous port in early medieval times, but its trade declined owing to piracy. The fortification on Harshad hill suggests that it must have been an observation or weather warning station, and the post-Gupta temple at the foot of the hill overlooking the estuary is indicative of the importance of the town in the 7th-8th century A.D. A sand bar prevents large boats from entering the river. Only fishing vessels can.

On the 7th January, the Expedition team made an attempt to resume exploration of Dwārkā by reaching *Vijaya* in midsea, but failed because of rough weather. The *hodi* capsized while beaching, and the boatman, who was thrown out, was rescued by the divers.

Diving operation was resumed off Dwārkā on 8th January and a rocky ridge was traced at 12 m depth, 1 km seaward of SN. The distances from various buoys to SN were measured manually to make sure that the margin of error was least. A rope was held in boats at both ends, and measurements were taken every 50 ft., parallel to the base line on the shore.

The lowest ebb tide at 1700 hrs on the 8th January exposed not only the wave cut bench in front of SN but also 3 iron rings fixed on the bench at the foot of SN. A sculpture of black stone, heavily damaged in the upper part, was found in the Intertidal Zone near the Light House (Fig. 90). The sculpture is of a deity with ornaments on legs and waist flanked by pot-like oijects. Its identification is not possible in the absence of the Vāahana (vehicle) and Lānchanas (insignia). A wall was exposed in a trench near buoy 70 at 5.5 m water depth, at

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4.30 pm, where a few potsherds were also recovered from layer 2, below which is natural rock. The visibility improved on the 11th, and the structures exposed near buoys 64, 66, 69 and 70 were documented. A wall between buoys 68 and 70 zone was plotted after gridding the area. All structures plotted from 1983 to 1989 were re-checked between 13th and 18th January. Exploration beyond 1km seaward in 13 to 19 m depth did not indicate any structural remains.

Ninth Expedition (1989-90)

Two well equipped boats, namely Sharda Devi and Sea Master (Fig. 91), owned by Bernard D'souza, arrived at Okha from Goa on the 1st December, 1989. The main objectives of exploration during this season were to carry out Seismic and Geophysical survey by NIO scientists for obtaining a plan view of the seabed and its bathymetry, besides highlighting anomalies which may give a clue to man-made features as distinct from natural ones.

While K.H. Vora and his team carried out geophysical survey in Dwarka waters, the marine archaeological team explored Bet Dwārkā and Dwārkā waters and finally the findings of the two teams were corelated.

Bet Dwārkā

Offshore and onshore survey in BDK was limited to 500 m south of Kekri Dhar Pir - a tomb with Green Flag known earlier as Siddi Bawa Pir and an Early Historical site was discovered. Rubble walls exposed in BDK I and BDK II during earlier expeditions were found completely destroyed by local residents, who had removed the stones and mud for building houses. However, 500 m north of BDK II, another patch of the rubble wall was found in the cliff section (Fig. 92). It appears to be the continuation of the gravity wall of BDK I-II, which also extends southward towards the Pir. It is now fairly clear that houses and protection walls were built in terraces following the contour of the hill. It may be recalled that fragments of cylindrical perforated jar (Fig. 92) and straight- sided bowls found in BDK I-II underlie the gravity wall in the cliff



Fig. 90 : An image of a deity in black stone, Dwaraka

section of BDK III, while the Lustrous Red Ware and Black and Red Ware are found in layers contemporary with this wall of Period 1. Secondly, the coarse grey and red wares occurring in the layer sealing the wall in BDK, II are of the Early Historical Period (II), which is confirmed by TL dating.

Dwārkā

The submerged buildings, which were buried under the sediment transported from the shore by the shovelling action of the sea, had to be located and ceared of vegetation and sediment, to identify the bastions with reference to which new finds such as walls, could be plotted. The marine archaeologist P. Gudigar, diverphotographer Srinivas Bandodkar and the Diver Scientist Ms. Manavi Thakkar and trainee

Fig. 91 : Northern extension of wall in cliff BDK II



archaeologists Sila Tripathi, Sundaresh and A.S. Gaur were engaged in extensive underwater exploration. The structures discovered during this field season were numbered S1 to S12 and anchors as A1 to A10 to distinguish them from earlier finds. On 9th December, airlifting in S1 area yielded pottery. An anchor was photographed on the 10th December near buoy Al in 1.50 m depth, and a disturbed wall was discovered in 4 m depth at 4 pm near buoy S2. The trainees could locate on 11th December a wall and some architectural members in 3.5 m. depth at 3.20 pm, near S5. Other important findings south of the Transit Line about 500 m seaward of SN were a damaged stone anchor and a stone pillar at S6 in 6.5 m water depth at 11.15 am. A large number of building blocks and two walls (Fig. 93) were exposed after airlifting in and around S7-S8.

Fig. : 92 : Wave-rolled fragments of perforated cylindrical jar are found in BDK



A bastion was exposed near S9 on the 13th December, and a few loose blocks and an anchor found at A3 were photographed on the 14th. About 700 m seaward of SN, a prismatic stone anchor was located at A8 in 6m depth. Three anchors were cleared of over burden at A8, A10 and A11 and the structure S3 was photographed in 8 m depth. A few more structures were plotted by Gudigar, Gaur and Manavi. On 19th December sediment samples from excavated trenches were collected by Chopdekar and Dabholkar. From the trench near S12, a highly encrusted iron anchor and the base of a red ware bowl were found in layer 2 below which were rocks. Here the total sediment is 1 m thick. After gridding the area of A12-S12, drawings of L-shaped blocks of a disturbed bastion and an isometric view of another bastion were prepared. Apart from the anchors marked AI-AI1 and structures numbered SI-S13, several other buildings were exposed at buoys 41, 60, 63, 68, 69, 70 and Dl to D19. A stone built drain (Fig. 94) and a wall (Fig. 95, 96, 97) were exposed near buoy 60.

The use of a spheroid stone with truncated top and bottom having a hole of 20 cm diameter found near a fallen wall is not yet clear. It might have served as a base for a flag post. Photographs of structures partly cleared of vegetation growth were taken for showing the differences between the cleared and uncleared parts. A massive wall at S15-S16 and a huge bastion which has collapsed near buoy D4 were also plotted. Near the ridge at A7 there is a very large triangular stone anchor which suggests that large ships were anchored here. The following finds of this season are significant.

Buoy 60 : wall (Fig. 101); Buoy 63 : walls etc. Buoy 68-70 wall etc; Buoy 69 : wall

At Buoy Nos A1, A5, A7, A12 : Triangular anchors

At Buoy Nos A2, A3, A6, A8, A9, A10, A11: Prismatic anchors

At Buoy No. A13 : Iron anchor

At Buoy Nos. S10, S11 : wall and prismatic anchor

At Buoy No. S2 : Fallen bastion

DISCOVERY OF SUBMERGED DVĀRAKĀ



Fig. 93 : Some building blocks on a wall near buoy 57-58, Dwarka (inset, left above) Fig. 94 : Stone built drain near buoy 60, Dwarka Fig. 97 : Stone wall near buoy 60, Dwarka (inset, right above)

At Buoy No. S3 : Fallen wall of a house At Buoy Nos. S4, S5, S7, S8, S12 : Stone blocks, slabs, etc.

At Buoy Nos. S2, S9 : Bastion At Buoy No. S13 : Prismatic anchor and

Fig. 96 : Another view of stone built drain



Fig. 95 Sketch of stonebuilt drain



84

P: 2 pillars and 2 bastions

(S15-S16 are the base line points)

Some of the stone walls (S8) are almost 1 m thick and others 0.75 to 0.5 m thick. A sawedged lunate shaped stone is found at S10 and nearby are two arms of a large building traced upto 7m length, between S12 and A12.

Geophysical and Seismic Survey of Submerged Dvārakā

For the first time in India, sonar and magnetic surveys of the sea bed for marine archaeological studies were carried out by K.H. Vora and L.V Subba Raju²², Scientists of the National Institute of Oceanography in the Bay of Bengal, in 1981. However, for want of diving archaeologists who could identify anomalies shown by the Side Scan Sonar and Magnetometer, it was not possible to come to any conclusion as to the nature of anomalies. On the contrary, the

geophysical survey carried out by K.H Vora and his colleagues in Dwarka in 198923 was followed by archaeological investigations and the results were very encouraging. Similarly, the geophysical survey off Tranquebar and Poompuhar by T.C.S. Rao²⁴ and his colleagues in 1988 and 1990 have yielded fruitful results. The Echo-sounding system records the water depth and also composition of the sediment upto a certain depth. The Side Scan Sonar System gives a plan view of the sea floor, besides recording the topographical and lithological variations on the seabed on the sonograph in the form of tonal variations. The system consists of an image processing side scan recorder (model 260), the tow fish (model 272) and interconnecting cable. The transducer fixed on either side of the tow fish and interconnecting cable can scan upto a range of 25 to 500 m on both sides of the survey track, depending upon the water depth and range used. The system is

Fig. 98 : A massive wall of 3 courses of large dressed sandstone blocks in Dwarka waters (Period I)





Fig. 99 : Wall (structure 4D) at buoy 41, Dwarka

Fig. 100 : Submerged bastion of fort wall near buoy 68-69





Fig. 101 : Fortwall near which a stone door socket was found at buoy 63 (same size)

Fig. 102 : Structure of fortwall near buoy 63





DISCOVERY OF SUBMERGED DVÅRAKÅ



Fig. 103 : Wall at D13, Dwarka

Fig. 104 : Structure at D13





Fig. 105 : Long wall of which some parts are missing, buoy A12, S12. Dwarka

Fig. 106 : Fallen bastion near D4



Fig. 107 : Part of a wall of large dressed blocks





Fig. 108 : Part of a wall of large dressed blocks

Fig. 109 : Structure wall of large dressed blocks





Fig. 110 : A wall of dislodged stone blocks found in excavation at S5 in Dwarka



Fig. 111 : A wall near D3, Dwarka

Fig. 112 : A wall near D3, Dwarka





Fig. 113 : Fallen wall, Dwarka

Fig. 114 : Damaged bastion at D19, Dwarka



Fig. 115 : Bastion with L-shaped architectural members at S8, Dwarka



Fig. 116 : Lunate shaped stone of a bastion in Dwarka waters





Fig. 117 : Structure of Lunate shaped stone

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Fig. 120 : Structure between S15 and S16, Dwarka

Fig. 121 : Drawing of structure between S15 and S16



DISCOVERY OF SUBMERGED DVĀRAKĀ







Fig. 124 : Clusters of damaged walls at D19, Dwarka





Fig. 125 : Long wall of which some parts are missing, buoy A12, S12, Dwarka
DISCOVERY OF SUBMERGED DVĀRAKĀ



Fig. 126 : Disturbed bastion at buoy D8, Dwarka



wall at buoy 13, S12 Dwarka

____100 cm

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Fig. 129 : A massive sunken structure of collapsed bastion at buoy S2, Dwarka

Fig. 130 : Sketch of collapsed bastion at buoy S2, Dwarka



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Fig. 131 : A submerged bastion built of large blocks with L-shaped edge for proper grip in the masonry near buov S9, Dwarka



Fig. 133 : Sketch of wall near buoy S10, Dwarka

Fig. 132 : A sketch of submerged bastion at buoy S9, Dwarka



Fig. 134 : Submerged structure at buoy S10, Dwarka



100

Fig. 135 : Wall structure 10 near buoy 63, Dwarka

therefore micro - processorised and, automatically corrects for speed and range. Position fixing was done by a Motorola Miniranger III system consisting of Range Console, Data Processor, Complot Track Plotter, Track Indicator and Omni-directional Antennaall installed on board. The base stations were installed on the sikhara of Dwarkadhish Temple and the Lighthouses of Dwarka and Kacchigadh on shore, for which coordinates were available from Survey of India pamphlets and notices to the mariners. The electronic position-fixing system works on C-band on line of sight principle. When the system is in operation, the mobile station transmits microwave signals at 5570 MHz; the base stations receive these sinals and retransmit at 5480 MHz; these are in turn recieved by the mobile station. The time elapsed



Fig. 136 : Sketch of structure 10 near buoy 63, Dwarka

is converted by range console into distances that are displayed. The survey data were recorded on a 1:5000 scale.

The boat MFV Shardadevi was deployed for Geophysical survey. It is 14.5 m long, 4.7 m broad, and has 2 m draught. The surveys conducted off Dwarka include 130 lines of 1km echo sounding, side scan sonar survey and shallow seismic profiling. The map scale adopted for survey was 1:1500 and the area was divided into a northern part from Rupen port to Dwārkā Lighthouse, and a southern part from Dwārkā Lighthouse to Gaekwad wall south of Gomati built about 100 years ago. In the northern part 45 lines perpendicular to the shoreline and in the southern part 22 lines parallel to the shoreline were surveyed. The main purpose of the survey in the southern part was to find out the offshore extension of the Gomati river and this was fulfilled. The survey in 2 m to 22 m water depth indicated extension of the Gomati Channel in NE-SW direction upto 1.5 km seaward of SN. The maximum width of the channel is 400 m. Submerged drainage systems and geomorphic features, such as scarps, terraces and pinnacles in seabed were also noted. The large tonal variations shown in the sonographs all over the area suggest furrows of various sizes and directions and even ripples and boulders. Five locations of anomalous features recorded were inspected by diving archaeologists. In only one location an iron anchor was found. The quantum of work done by the Geophysical survey team is as follows:

Echo-sounding :1331 lines of 1km length Side Scan profiling:125 lines of 1km length Sub-Bottom Profiling : 130 lines of 1 km length Corrections applied to underwater data:

- 1. Transducer Correction : The echo sounder was calibrated with bar check carried out regularly and the necessary adjustment was made in the instruments. The depths of the records were, therefore, corrected for transducer depth.
- 2. Tidal Correction : The bathymetric maps were prepared after applying necessary tidal corrections with references to the chart datum of Okha Port (OCD). Tidal observations were taken every 15 minutes at the Tide Pole installed by the Okha Port

Fig. 137 : Walls of a building excavated between buoy 68 and 70 in Dwaraka waters



Fig. 138 : Sketch of walls excavated between buoys 68 & 70, Dwarka



authority and the data was used to correct sounding values.

The Side Scan Sonar of EG and G model 259 are corrected for speed and height. The only correction needed is the distance lag due to the difference between Miniranger at base and the Side Scan Sonar about 10 m behind.

Shallow seismic records were interpreted, considering the velocity of sound at 1500 m/ sec. No actual velocity of sound through different strata was carried out. The actual depth shown is on the lower side as checked by the manual sounding of depths recorded at different hours in the log book.

Position Maps

The position maps/base maps have been prepared in two parts, northern and southern. Twentytwo tracks parallel to shoreline were surveyed in the area south of Dwarka Lighthouse to record the offshore extension of the Gomati Channel. The northern part upto Rupen was surveyed by 45 tracks perpendicular to the coast. The area very close to the Lighthouse could not be surveyed owing to lack of good position fixes.

Southern Area

In this area the minimum depth recorded is 2 m and the maximum 22 m, the depth increasing offshore. Almost the entire area is of rugged topography, but the western lines surveyed show an increasingly even seabed. "A well defined channel which seems to be a part of the extension of Gomati is more than 1.5 km long and 400 m wide. It is identifiable throughout the survey area. The section is Vshaped towards the shore with more than 5 m high flanks. At the offshore end, the channel is wider and shallower, though, surprisingly, in the middle three tracks there is no indication of the channel. The southern bank in the offshore region is less discernible (Fig.94). The present onshore mouth of river Gomati and its offshore extension deciphered during the optical survey are in the same alignment as the inland river bank (Gomati Valley) that is 200-300 m northwards of the second channel found in

sonar survey. This is perhaps due to the retaining wall constructed by the erstwhile Maharaja of Baroda a century ago²⁵.

The alignment of the first channel, which is a continuation of the Gomatighat channel, has been confirmed again by checking the position of the submerged in situ bastions. The present day contour indicates a second channel, recorded by sonograph, which may be attributed, to the scouring effect of the sea some time after the ancient Dvārakā port town was submerged. This explains the collapse of a couple of bastions and the absence of the channel in the middle 3 tracks. Most of the bastions are in the alignment of the first channel, which takes a southwardly bend after 500 m and joins the sea near the ridge, where large anchors are found. On the Gomati Ghat, there is a 7th century temple, which confirms that the original channel is what is shown as continuation seaward of SN. No doubt, the channel must have been wider. The middle part of the second channel, which is shown as rugged in sonograph, may be partly due to the collapse of the ancient structural remains and partly to the movement of the river mouth.

An important geomorphological feature is a channel marked by the visual identification of echograms running 4 km long nearly parallel to the shore at a distance of 1.5 km. Man-made holes are found in the scarp recorded by echogram. Whether the scarp and channel parallel to the shore mark the ancient shoreline or not needs to be verified. As the Gomati channel meets the sea channel near the scarp, it may be considered as the nick point.

A small channel cut into the wavecut bench seaward of SN is exposed in ebb tide. It seems to be an artificial one, provided for smaller boats ferrying between the sea and warehouse on land, while larger vessels were anchored in 12 to 15 m depth near the scarp.

The scarp plotted shows a linear NW-SE direction, almost parallel to the shoreline. Besides this scarp and terraces, there are several V-shaped valleys and a few pinnacles which, in a few places, form linearment feature. The seabed in the southern part is smooth, the central part rugged, and the western part even.

The sonographs of side scan sonar show large tonal variations which are distinguished by Vora, as under:

- 1. Uniform light tone with occasional dark patches representing fine silt/sand and boulders.
- 2. Alternate light and dark furrows parallel to survey tracks.
- 3. Light and dark furrows perpendicular or oblique to survey tracks.
- 4. Dark small patches of regular/irregular shape and size.

Vora adds, "It is difficult to comment what causes the remaining signatures (2 to 4). It must be realized that marine geological/geophysical surveys are only indicative in nature, and not confirmatory". In fact, they only help in suggesting some locations for inspection by diving teams. There is no other way to confirm suspected features of their archaeological significance except by manual inspection by experienced marine archaeologists. Geophysical survey is, however, helpful in bringing to light geomorphic features, which provide a clue for studying sea level rise and, perhaps, palaeo climate. If the Gomati was able to cut through rocky terrace, it must have carried a large volume of water and the rainfall must have been considerably heavier than at present. That it was a much larger river than what the present Gomati channel indicates is confirmed by its upper courses near Jagannath temple, about 2 km from Dwarka, on the highway to Khambhalia. This larger flow channel of Gomati has been turned into a salt water creek owing to the encroachment by the sea.

Offshore Exploration of Dwārkā, Bet Dwārkā and Somnath (1991-92)

It was found necessary to recheck the position of all structures hitherto found in Dwārkā and also fix the position of those which were likely to be discovered in the fifteenth expedition. Secondly, the extent and nature of a ridge-like feature noticed in Side Scan Sonar survey had to be determined in order to ascertain whether it served as an anchorage for sea-going vessels. It was also essential to ascertain whether, from this anchorage, an access to Gomati was available for smaller vessels. Thirdly, the cause of submergence of Dwārkā needed to be investigated. If the primary cause was sea level rise, Somnath-Prabhas, a contemporary port, must have also been submerged. To prove or disprove a sea level rise, an offshore survey from Verawal to Prabhas was planned. Both SDDE (Surface Demand Diving Equipment) and SCUBA (Selfcontained Underwater Breathing Accessories) were deployed, as in the previous expeditions for diving purpose.

MFV Penta a steel-hulled vessel was chartered from 27th December 1991 to 27th January 1992. Heavy Compressor and Underwater Scooter (Aquazepp) were deployed for air-lifting and survey, respectively. The GPS Satellite Position-Fixing System and an Echo-sounder capable of recording depth upto 180 m were available on the boat. The Underwater scooter Aquazepp enables the diver to survey quickly a large area with much less effort than under manual survey. The system can be deployed from a small dinghy, if the larger vessel is engaged for other works. The Aquazepp, which runs on battery, is driven 1.5 m above the sea-bed! The "furano colour sounder" which is an echosounder, was fitted on the boat. Although it was not possible to get a hard copy, a display on the screen temporarily was possible.

The deploying of Global Position-fixing System (GPS) enabled the surveyor to fix the position of buoys more accurately than was possible with Mini Ranger III.

The offshore exploration at Dwarka started with an earlier known site, namely the bastion at buoy 35, and gradually extended towards deeper waters, north of the Transit Line. Diving was conducted in a circular search pattern in which, at a given time, two drivers went together and explored the area within 50 m radius. On finding any objects of archaeological significance such as a building or architectural member or anchor or earthen, metal and wooden artefact, a buoy was fixed at the spot. All buoys were numbered serially, and finally, their position was fixed. For convenience the search area was divided into eight zones. All significant objects were calibrated to actual depth in Dwarka waters. The following structures and anchors were identified by divers of the station indicated partly in geophysical survey.

Zone 1

Water depth 4 to 5 m, Area 250 x 250 m Buoys l, 3, 5, 8, 9, 16-17, 21-23

A wall of 2 courses of masonry, 3 m long and 1 m wide was found near buoy 3 (Fig .139, 140). Several dressed stone blocks measuring, on an average, 1.25x0.6x0.15 m were lying nearby. Nine semi- circular stones belonging to a bastion at buoy 9 and two bastions *in situ* at buoy No. 8 (Fig. 141,142) were found. A stone anchor and blocks were also recorded. At Buoys 21 to 23 stone blocks of a bastion and triangular and prismatic anchors were found. There are thus six bastions, three *in situ* and three fallen ones in Zone 1, that is within an area of 250x250 m.

Zone 2

Water Depth 3-5 m, 165x90 m Buoy 25-27

TABLE 1: STRUCTURES AND FEATURES OFARCHAEOLOGICALIMPORTANCEOBSERVEDUNDERWATEROFFDWĀRKĀDURINGJANUARY1992EXPEDITION

Bation

S.No. Buoy	No.	Description
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- 1. SS 5 Bastion in situ and fallen wall
- 2. SS 7 Bastion measuring 1.55m x 0.5m x 0.45 m
- 3. SS 8 L-shaped semi-circular stone block of a bastion half buried under sediment. 1.98 m x .50 m

Fig. 139 : Fallen wall near buoy 3, Zone 1, Dwarka



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Fig. 140 : Sketch showing position of fallen wall near buoy 3, Zone 1, Dwarka

Fig. 142 : Fallen bastion, Zone 1, Dwarka

- 4. SS 9 Bastion
- 5. SS 14 Three semicircular blocks of a fallen bastion
- SS 16 Big semi-circular stone blocks of bastion 1.25 m x .35 upto .75 m x .50 m and .3m thick



Fig. 141 : Sketch of fallen wall near buoy 3, Zone 1 Dwarka



0

lm.



Fig. 143 : Two blocks of a fallen bastion in Zone 1, Dwarka

- 8. SS 22 Bastion in situ .90m x .50m x .34m
- 9. SS 23 2 Bastions in situ
- 10. SS 26 Fallen bastions. One has L-shaped joints in masonry

Wall

- 1. SS 1 Rubble wall in situ
- 2. SS 2 Fallen wall
- 3. SS 3 Wall 3 m x 1m x 2 courses, A block measures 1.25 m x .60 m x .15 m
- 4. SS 4 Scattered blocks of a wall. One block measures 1m x .50 m
- 5. SS 5 Fallen wall
- 6. SS 6 Fallen wall. One block of this wall measures 1.08 m x 1 m
- 7. SS 7 Scatterd stone blocks (1) 1.25 m x
 .50 m x .40m(2) 1.20 m x .50 m x
 .45 and (3) .85m x .55m x .30m
- 8. SS 8 Fallen wall. The block measures

1 m 14.5m

- 9. SS 9 This wall *in situ* is in continuation of structure at buoy 8
- 10. SS 10 Big stone blocks of a wall
- 11. SS 11 Stone blocks of a wall
- 12. SS 15 Big stone blocks with 2-3 holes
- 13. SS 17 Big stone blocks of a wall
- 14. SS 18 Big stone blocks with a square hole
- 15. SS 23 Stone block of a wall
- 16. SS 24 A rectangular block of a wall with a length .92 m and width .31 m
- 17. SS 25 A wall *in situ* (height about 1 m) A rectangular block of this wall measures 1.67 m x .36 m x .21 m
- 18. SS 26 A portion of a wall in *in situ* measuring 1.9 m in three courses
- 19. SS 27 Extension of the scattered blocks at buoys 25-26 wall



Fig. 144 : Part of a wall of three courses exposed in Zone 2, Dwarka. A large number of dislodged blocks are buried in sediment.



Fig. 145 : Sketch of dislodged blocks

- 20. SS 27 Extension of scattered blocks of a wall at buoys 25-26
- 20. SS 28 Big stone block of a wall with four holes

Pillar

- 1. SS 24 A broken pillar octagonal section Single Holed Stone Artefact
- 1. SS 12 Part of a pillar with diameter about .50 m and height about .40 m

Anchors

1. SS 4 A triangular stone anchor

- 2. SS 8 A rectangular prismatic anchor 1.67 m x.48 m
- 3. SS 9 A three-holed triangular anchor
- 4. SS 11 A prismatic three-holed stone anchor
- 5. SS 19 Rectangular stone anchor
- 6. SS 20 Rectangular stone anchor
- 7. SS 22 A prismatic stone anchor
- 8. SS 23 Triangular stone anchor
- 9. SS 25 A prismatic stone anchor-(length 1.75 m.)



Fig. 146 : Temple of Somnath

- 10. SS 29 Three-holed prismatic stone anchor
- 11. A1Triangular stone anchor, measures1.23 m x .62 m 30 m x .15 m

12. A4 Triangular stone anchor

. Within this zone a large number of stray architectural members were found lying buried in sediment. Some were exposed by airlifting. A long wall of 3 courses of masonry built on rubble foundation (Fig. 113A) was partly *in situ*, the rest of it was disturbed and the top courses had fallen. A long wall of three courses of masonry was exposed in zone 2 (Fig 144, 145) **Zone 3**

Water Depth 3-4 m, Area 175 x 85 m Buoy 18, 19 and AA4

The area is covered by sediment and vegetation. As a result of manual survey, two prismatic anchors and one triangular anchor were found.

Zone 4

Water Depth 8 to 12 m, Area 90 x 90 m Buoys 13 and 15

A single-holed spheroid stone object was an

important find in Zone 4. Near buoy 15, natural rock 1.5 to 2 m in height was traced. This seems to be a ridge, where large vessels might have been anchored. One anchor was found here. Airlifting exposed bedrock at 10 cm depth in sediment.

Zone 5

Water Depth 5 to 6 m, Area 125 x 90 m Buoy 28

A large stone block with 4 holes was exposed and the surrounding area was found to be full of sand.

Zone 6 (located 175 m south of Zone 5)

Water depth 10 m, Area 90 x 85 m Buoy 12

The circular stone with a hole, found near what seems to be an entrance or gateway, must have been used as a door socket for the massive wooden door.

Zone 7

Water depth 8 to 9 m, Area 90 x 90m

The purpose of diving was to locate a ridge traced in the previous expedition, but it could



Fig. 147 : Explored area with inter-zonal markings in Somnath-Veraval waters

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Fig. 148 : Rockcut channel, the ridge with man-made holes for docking boats, buoy 15, Zone 4

> Fig. 149 : Sketch showing rock-cut channel

not be traced in this expedition because of sediment cover.

Zone 8

Water Depth 5 to 7 m, Area 95 x 90 m A channel 2 m deep was traced.

Results

A large number of walls and bastions are disturbed but a few structures are *in situ*. For ascertaining the town plan, the only guide is the enclosures and protection walls built of large dressed stone blocks serve as a guide. The houses built of smaller fraction blocks are destroyed. Since the blocks are quite heavy, most of the walls are single block-wide. In a few instances, however, they are two blocks-wide. A 3 m long wall near buoy No.3 gives an idea of the masonry of the foundation and superstructure.

Prabhasa

Offshore survey of Prabhasa-Somnath was found necessary to determine whether it was submerged. The *Māhābhārata* refers to it as Prabhasatirtha. According to *Bhāgavata Purāņa* Prabhasa was a sacred place where the river Sarasvati flows to the east. The ancient site of Prabhasa situated on the right bank of the river Hiranya in Junagadh district of Gujarat was a prosperous port contemporary with Dwārkā. Krishna is said to have sailed from Bhrugukaccha



(Bharuch) to Prabhasa. Excavations at Prabhasa by the Archaeological Department of Saurashtra and M.S. University Baroda (1956), Gujarat State Archaeology Department (1965) and Deccan College Poona (1975) yielded, among others, a seal of west Asian origin. The Lustrous Red Ware pottery of Prabhasa is dated 1500-1200 B.C., and another distinct fabric, known as the Prabhas Ware, was also in use here. Somnath, which is famous for its Siva temple (Fig. 145) is situated close to Prabhasa, on the one hand, and the modern port of Verawal, on the other. The purpose of undertaking offshore exploration of Prabbas-Verawal zone (Fig.147) was to ascertain whether any ancient port was submerged here during the second millennium B.C. Three zones were selected for diving.

Initially, four buoys were dropped to form a square in zone opposite Somnath Temple, and within this area of 4 buoys, diving in a circular form with 50 m, radius was undertaken in order to search for ancient relics. The search was gradually extended towards deeper waters. Diving operations were also undertaken opposite the mouth of Hiranya. In all the three zones selected for diving, buoys were numbered serially and, their position was fixed by using the sextant.

Zone 1: water depth 4 to 9 m Buoys 8 to 12, 18, 21

A large spheroid stone with a hole in the centre was found buried in sediment near buoy 8. The diameter at the top of the object is 50 cm. Not far from it, about 75m, seaward, another single holed stone object with a diameter of 42 cm was found at buoy 9. Between buoys 9 and 10, a 2 m deep channel cut into the rock was noticed (Fig. 148, 149). A prismatic anchor and a triangular one were found in the channel. A third single-holed spheroid stone was recorded at buoy 11.

Zone 2 : Water depth 4 to 8 m Buoys 1 to 7

No artefact was found here.

Zone 3 : Water depth 6 to 9 m Buoys I3 to 16

Near buoy 15, the area is rocky where soft corals of pink and grey colour grow. The area near buoys 13 and 14 is sandy.

One of the intriguing objects found at Somnath and Dwarka is the single-holed massive spheroid stone. It could neither have been used as mortar nor as an oil mill. Captain Gupchup suggests that it may be a mooring stone. Possibly it might have been used as a stone base of a flagpost on the shore or of the mast on the boat. The material of which it is made is sandstone in three instances and basalt in another. Larger basalt objects with wide mouth, regarded as *ulukhalas*, are preserved in Dwarka.

XVI Expedition to Dwārkā and Bet Dwārkā. March - April. 1994

Owing to late receipt of funds, it was not possible to start offshore exploration in December 1993 or in January-February , 1994, as planned earlier.

Dr. Kamalakar, Director of the Birla Archaeological Research Institute, Hyderabad, and his colleagues joined the expedition to undergo practical training in diving and underwater exploration after attending lectures on marine archaeology in the Marine Archaeology Centre at Goa. In the course of onshore exploration of the site BDK VIII, a small potsherd inscribed in the late Indus script with two signs, was discovered by Dr. Kamalakar. The inscription deciphered by the author on the same principle on which the Indus script has been deciphered reads \underline{b} - \underline{g} = *baga* meaning 'God' in Avestan and Old Indo Aryan.

Airlifting in two trenches 300 m seaward of BDK I-II was undertaken, but the work had to be suspended as the sea was very rough and the visibility zero. Attempts were made by diving archaeologists to explore in Dwarka waters, but here too the choppy sea and swell prevented underwater search. The expedition team had to postpone offshore surveys to a more favourable season.

XVIII Marine Archaeological Expedition, 1994-1995

Early planning and preparations for this expedition enabled the team to start onshore excavation of Bet Dwarka on 28th November, 1994. One of the objectives was to trace the southward as well as northward extension of the rubble walls in BDK I-II and to ascertain whether in the midsecond millennium B.C. the landward gravity wall was built in box-technique in other parts also. Three trenches were laid in the cliff. A trench 8 x 2 m was laid in BDK I-II. Its southern part, designated as BDK II (S), was excavated by A.S. Gaur, and the northern part, designated as BDK II, by Sila Tripathi. Another trench 2 x I m laid south of BDK I and designated



Fig. 150 : Ridge with vertical face and man-made hole at E2

BDK I(S) was excavated by Sundaresh.

In BDK II South, layer 1 is surface humus, and layer 2 is compact brownish earth which strikes against the exposed rubble wall. Layer 3 is brownish gravelly earth in which the foundation of an upper wall (Str 2), projecting from the North-South long wall, is laid in Layer, scaling the lower structure. (Str 1), two courses of which are projecting from the long wall. Layer 4 is compact light yellowish clay in which a few potsherds occur. It is contemporary with Structure 1. Layer 5 consists of compact yellow clay which is also natural soil. Two lower courses of Str 1 consits of large blocks with sharp edges and in the upper courses roughly dressed stones are used.

In BDK II North, the cross wall in the trench consists of 6 courses of stone masonry. Some building blocks are large and others small. Adjoining this cross wall is part of the long wall which is noticeable further north of the robber's trench. Here, layer 1 is surface humus. In layer 2 are long and cross walls, and layer 3 is reddish kankar in which the foundation of the wall is

Fig. 151 : Wall 2 at E2 in Dwarka harbour area





Fig. 152 : Dwarka harbour area gridded by E2 site where a large anchor was also found

laid. Layer 4 is yellowish clay with a few potsherds and layer 5 is again yellow clay but without any human artefact and is, therefore, treated as natural soil. The total thickness habitation deposit is 1.25 m above the talus.

In BDK 1 (s), there are 7 courses of a long wall. Some building blocks are large and others small. Layer 1 is surface humus. Layer 2 consisting of light brown earth is contemporary with the wall. Layer 3 is reddish gravelly loose earth in which the foundation of the wall is laid. Layer 4 is yellow clay. Layer 5 is natural soil.

Airlifting in off shore trenches opposite BDK I-II and BDK VI was done from 25th to 27th and samples were collected for sedimentation studies.

Dwārkā

Offshore excavations in this season aimed at deciding the harbour area and ascertaining extent and nature of manmade features for berthing ships. Another objective was to explore the nick point where the Gomati channel met the sea. Thirdly, the extent of the southward extension of the submerged city had to be determined. Excavation continued from 1st December to 27th December, 1994. The base line for survey purpose was Dwarkadhish Temple Tower and Samudranarayana Temple Tower.

The underwater search covered an area of 1500 x 400 m which has been divided into six zones numbered A through F. Zones A,B,E and F are southeast or south of the Transit Line, and Zone C is across the line. Zone D is to the north. All the structures and anchors of stone and iron have been plotted and photographed and recorded on VHS film.

Zone A

Four walls and a bastion have been found near EI-E2-E3. Several stone blocks dislodged from walls and bastions are lying here. The wall at El (Fig 151,152) is clearly visible from the boat itself. Another wall and a prismatic anchor have been found near E2. Dressed stone blocks measuring 1 to 1.5 m in length are noticed at buoy E3.

Zone B

In this zone, buoys E4, E5, E6, E7 and E8 indicate the location of a ridge and anchors.



Fig. 153 : Wooden log, buried in the channel gap of rocky ridge, buoy E10

Fig. 154 : Prismatic anchor at buoy E10, Dwarka



Fig. 157 : A log of wood perhaps part of a timber construction at buoy E16 near the ridge



DISCOVERY OF SUBMERGED DVĀRAKĀ





Fig. 156 : Triangular stone anchor at the foot of the ridge buoy E9

Fig. 159 : Diver points out the part of timber construction in the rocky ridge

Fig. 158 : Single holed mooring stone at buoy E12, Dwarka



There is a single-holed block near the ridge at E4. The same ridge continues upto and beyond E5 where 3 man-made holes are noticed. Ships must have been anchored here. Near E6 is a wooden part of a wrecked boat, and another part of perhaps the same boat lies 7 m away from a prismatic stone anchor at buoy E7. Near Buoy 8 are two anchors, one of which is triangular and the other prismatic. A wooden part of a boat lies stuck in the ridge. A big log of wood near the dressed blocks and ridge seems to be part of a palisade or timber casing of harbour installation.

Zone C

An iron anchor and a prismatic stone anchor (Fig. 154,155) were found lying near a poollike depression at buoy 9. A copper lota was also recovered from this zone. A semi-spheroid stone object, 65 cm in diameter at the top and 35 cm hole right through the section, lying at buoy E10, (Fig. 153) seems to be the stone base of a mast, but with a roundish bottom it is difficult to fix the object. Since similar objects, but spheroid in shape, are found in Somnath and Dwarka, it is worthwhile finding out the real use to which they were put. They could be mooring stones also (Fig. 158). A triangular anchor (Fig. 156) and a prismatic one are found along with a log of wood. Near buoy E12, there is a triangular anchor, and, near E13 (Fig. 159), there is a prismatic anchor. Along the ridge running from E14 to E16 (Fig. 157), there are two prismatic anchors.

The Harbour of Ancient Dvārakā

The Arthaśāstra and Brihatkatha Kalpa Sutra laid down that a sea port must be built preferably at the point where a river joins the sea. This statement was made after long experience of the mariners, merchant, captains and nautical engineers, who built the Harappan port of Lothal, at the mouth of the rivers Bhogawo and Sabarmati. The ancient port of Bhrugukaccha (Barygaza or modern Bharuch) was situated at the mouth of the river Narmada in South Gujarat. The Early Chola port of Poompuhar on the East coast was located at the mouth of the river Kaveri. Such sea ports at the mouths of rivers are known as Dronimukha in Brihatkathakalpasutra. Dvārakā was also a

Dronimukha, as it is situated at the point where the river Gomati joins the western sea. The advantage of a Dronimukha is that the river provides easy access to the hinterland and an abundant supply of potable water is assured. Thus, the city-state of Dwārakā, with a good sea port serving as a Gateway (dvāra) to the western world was well protected by nature. The Gomati channel landward of Jagannath temple which is, 2 km from Dwārkā on Dwārkā-Jamnagar highway, is now practically a creek. It is connected to the Rupen creek owing to the transgression of the sea during the last 3,000 years. Further south there is a very large creek known as Okhamadhi which must have also been a river.

The first settlement of the Yadavas under Krishna's leadership was made in Kusasthali, identified with Bet Dwarka, which was anciently connected with Gopi Talao on mainland through a land-bridge between the southwestern tip of Bet Dwarka and the islet of Kui. Perhaps, another link lay near Okha. The contour map of the Gulf around Bet Dwarka, showing as low as 0.3 m depth of the sea, confirms this point. The Yadavas, fleeing from the attacks of Jarasandha on Mathura, must have preferred this distant ancestral town of Kusasthali, which is also referred to as antardvipa in the Mahābhārata, and as Vāridurga in Harivamsa because it was well defended by nature with a hill on one side and the sea on almost all other sides. It was far from the enemy's reach. Its crenulated bay gave shelter to ships in bad weather. The western shore had no significant human settlement, while the major constructions such as the fortification wall, large fortified enclosures and the slipway for launching boats, were built on the eastern shore, mainly because the crenulated bay was protected by hills against the southwesterly wind. Hence boatbuilding activity, which is even now surviving, was possible in the second millennium B.C. Underwater exploration and airlifting in the Gulf have yielded a seal, shell artefacts, pottery and metal objects, besides stone anchors of the proto historic or early historical periods has come to light in the nearshore zones of Bet Dwarka, while in Dwarka waters more than 50 stone anchors and a few iron anchors have been found. It appears that Bet Dwarka was an administrative



Fig. 160 : Fourth Marine Archaeological Expedition, Dwarka, marine archaeologists, scientists of NIO and crew of the research vessel Vedhavati in Dwarka waters with Dr. S.R. Rao (seated second from left)

capital of the city state of Kusasthli- Dvārakā but not a major seaport, the role of which was assumed by Dvārakā situated at the mouth of Gomati overlooking the Arabian Sea. Āranda, Pindara and Nageswar must have been smaller ports. known for its pearl-fishing and the latter for shell-working.

The extensive underwater exploration, 1 to 1.5 km seaward of Samudranarayana Temple in Dwarka in 1992 and 1994, has brought to light the ancient harbour of Dvārakā. Before going into details of the harbour facilities and installation in Dvaraka, it is necessary to note that building a structure, or modifying natural scarp, or ridge at the interface of land and sea, is more difficult, as it demands greater forethought, planning and engineering skill. By and large, the nautical engineers of ancient India preferred the interface of land and sea, as is amply borne out by the location of ancient ports such as Dwārakā Prabhas-Somnath, Sopara, Bhrugukaccha (Broach), Surat, Chaul, Honnavar, Kaveripatnam, Konark and Tamralipti, all of which were in use for several centuries, except perhaps ancient Dvārakā which served as a major port for a hundred years only. After a long gap, it once again became an important port. The sea frets at the barrier of land or any artificial obstruction, and reveals its enormous energy. This is all the more in the Gulfs of Kutch and Cambay, where the tidal range is high. Being located in a high energy zone, a great deal of effort must have been put in for designing an effective harbour in the open sea at Dvārakā. As an alternative to large scale construction, the engineers of Dvārakā preferred availing of the rocky ridge running along the then coastline at the nick point of Gomati river. This fact has been established by the discovery of a 2 m high ridge, with a flat top



Fig. 161 : Marine archaeologists risking a choppy sea in Dwarka

and a vertical seaward face (Fig. 117) over a length of nearly 500 m almost parallel to the present shore, but 1.2 to 1.3 km seaward of the temple of Samudranarayana. The top of the ridge is 39.4 m wide (between buoys E6 and E14) and its height above the seabed is 2 m near buoy E14. The water depth here is 8 m above the top of the ridge. Running almost N-S for about 150 m from E14 towards the Dwarkadhish-Samudranarayana Transit Line, it dips to less than a metre from E14 to E16 over a length of 84 m, thus forming a bay and then protrudes westwards, forming a promontory 52 m in length. After a small bay formation there is protrusion of 26 m westwards until it dips. There is a channel at its eastern end. Seaward of the ridge, there is sand upto 50 m, water depth. Between E14 and E16, there is a gap of 12.5 m in the ridge where some dressed stone blocks are lying. Large ships docking here were secured to the ridge in which there were man made holes

(Fig 116). A thick rope can pass through them. Near E18 and E19, there are a few dislodged building blocks, indicating that some construction was made here. The wavecut bench, with a flat top served as a wharf and the dressed outer face of the ridge facilitated hauling cargo from boats. A series of walls near El (Fig 150) E2 (Fig. 151,152) and stone anchors at E9 (Fig. 154, 155) and E12 (Fig.156), wooden logs at buoys E10, E16 (Fig.157) and a mooring stone at buoy E12 (Fig.158) have been recorded.

The channel near the eastern end of the ridge was wide enough to enable smaller vessels to ferry between the warehouses and the main harbour. To protect the embankment of the Gomati channel from scouring through currents and beating of the waves in spring tide and stormy conditions, heavy stone walls and circular or semi circular bastions were built all along both the banks for more than one km length. These protection walls and bastions were built on boulder foundation in the river bed, and the construction at the nick point confirms that they were in the nearshore region of the sea. There is a wall at E19, and some more remains of it in situ or disturbed, near the channels may come to light. There are 5 fortified enclosures within which warehouses and other harbour installations stood. The spheroid single-holed stone objects found in the sea seem to have been mooring stones, or bases of wooden flag posts, to indicate the entrance to the harbour. They could also serve as warning signals in a storm. Further exploration is, however, necessary at both ends of the ridge, which served the purpose of an anchorage. An intensive search in the channel and 'gap' is likely to yield more antiquities. The discovery of wooden parts of a couple of shipwrecks recovered from the seabed, at buoys E6 and E11 and anchors at E11, E12, E13 and E14, goes to confirm that Dvārakā was a busy port. So far, more than 50 anchors have been reported and many more may be lying buried in the sediment. The harbour of Dvārakā provides the earliest evidence of modifying natural rock to serve the needs of a harbour. Later in the 9th-8th centuries B.C., the Phoenicians too were modifying the reefs for the same purpose.²⁶ The manmade anchorage at Dvārakā provided shelter to large sea-going vessels of more than 2 in draught. The artificial quay and channel offered a convenient shelter. The prismatic structure at Dvaraka received the ships and protected them on thier voyage from Broach and Prabhas to the ports of the Red Sea, Bahrain and other Persian Gulf countries.

Another great contribution of the nautical engineers of Dvārakā was the construction of 0.75 to 1.5 in thick stone walls interspersed with bastions. They served not only as protection walls of warehouses but also as breakwaters. The massive dressed stone blocks of the bastions are held to one another firmly by a series of L-shaped joints.

R.R. Nair's analysis of the present beach sand and the sample from the excavated trench in Dwarkadhish Temple Complex, "comprising predominantly shell material suggests that the surf zone was around an island with fringing reefs". The present beach sand of Dwārkā is made up of siliceous material. It is, however, not known if an offshore island existed here 3,500 years ago. The sample consisting of fine-grained sand from layer 3 at 1.5 m depth in the sediment at -19 in MSL about 1750 m seaward of SN indicates that the effect of waves and currents was anciently (Period 1) limited here, when compared with the later (Period II) sample from the trench at buoy 64 in-5m MSL landward. The large corals, gastropods and rock fragments in the sediment sample of layer 1 suggest a surf zone". It is reasonable to infer that the nick point of Gomati was somewhere near the ridge which extends southwards.

End of Dvārakā

How the "golden city of Dvārakā" met its end is graphically described in the Mahābhārata. Particular mention of Sankhodhara is also made in the Bhāgavata Purāna. Hirananda Sastri's remarks in this context are most relevant. He says, "The temples of Bet Dwarka do not possess any special architectural value. They are all living sanctuaries, and are of late origin. The older ones must have been destroyed by the Muhammadan invaders. The site has undergone such vicissitudes that even the place where Mirabai, the well-known devotee of Krishna, used to stay is forgotten. Bet was originally known as Sankhodhara. This can be inferred from the description given in the Bhāgavata Purāna²⁷. The name occurs in a fragmentary stone inscription which was found into the wall of a tank called Sankhanarayana talao. The Bhāgavata Purāna Skandha XI, Adhyaya 30. V. 5-6 says:

एते घोरा महोत्पाता द्वार्वत्यां यमकेतवः। मुहूर्तमति न स्थेयमत्र नो यदुपुङ्गवा॥ स्त्रियो बालाश्च वृद्धाश्च शङ्खोद्धारं व्रजन्वितः। वयं प्रभासं यास्यामो यत्र प्रत्यक् सरस्वती॥

ete ghorā mahotpātā dvārvatyām yamaketavah. muhūrtamapi na stheyamatra no yadupuṅgavā striyo bālāśca vridhāśca śankhoddhāram vrajanvitah vayam prabhāsam yāsyāmo yatra pratyak sarasvatī (Bhāgvata XI. 30. 5-6)

The Lord said: O great Yadavas, these mighty and fearful portents are seen over Dvārakā like the flag of Yama, God of Death. We should not stay here even for a moment. Let women, children and old men leave this and go to



Fig. 162 : Preliminary offshore survey of submerged Dvārakā in the Gulf of Kutch, Bet Dwarka

Sankhodhara, and we shall go to Prabhasa, where the Sarasvati flows towards the west'.

The hills in Bet Dwārkā (Shankhodhara) might have provided temporary shelter against the raging cyclone or some other calamity resulting in the submergence of mainland Dvārakā. A large part of the city built on the lower terrace of Bet Dwārkā, too, was swallowed by the sea, which is attested to by the submerged walls. The buildings standing on higher terraces of BDK I II, VI and VII were partly saved. This explains the presence of stone walls in the cliff section and upper terraces, wherefrom the pottery is dated 1528 B.C. by TL dating method.

The *Bhāgavata Purāņa* Skandha 11, Adhyaya 31, Sts. 15-18, 22-23 says:

15-22. "Daruka, separated from Krishna, returned to Dvārakā, fell at the feet of Vasudeva and Ugrasena, bathed their feet with his tears and related the whole story of Krishna's death. 23. The sea instantly flooded Dvārakā left by Hari.... except the Lord's mansion."

Speaking of Mul Dwarka, (See P.49) Hirananda Sastri says, "the solitary building under notice is a temple not a mansion, neither is it very old. It cannot be anterior even to the tenth century A.D. Still, we might find under it the remains of much earlier periods. This agreement makes the matter rather tantalizing. Here by the sea side, one trench was laid, and a coping stone with bitumen colours was found. Other stones of the kind still lying hidden in the debris unless they have all been removed by this time. Similar coloured stones are seen in structures of about the seventh century and it is not impossible that the piece under notice belonged to some contemporary building". The explorations by Sankalia and the author have confirmed that there are no antiquarian remains earlier than 1st century A.D. at Mul Dwarka.

Identification of Ancient Dvārakā

The archaeological evidence so far made available from the onshore and offshore excavations at Bet Dwārkā during the years 1983 to 1995 is adequate enough to suggest the identify of the excavated site in Bet Dwārakā island with Kusasthaliī where a town was built and named as Dvārakā. Similarly, the port town of Dvārakā on the mainland can be identified with the town built after reclaiming land from the sea when it was found that the narrow strip of land at the foot of the hill in Kusasthali-Dvārakā was not sufficient for the Yadavas.

The topography of Bet Dwarka reveals that there is a hill 30 to 40 m high, at the foot of which a stretch of 0.5 to 1 km wide flat land was available for human settlement all along the 5 km length of the eastern flank of Bet Dwarka 3,500 years ago. Bet Dwarka was then not a complete island. It was connected with the mainland near Gopi talao via Kui in the southeast and with Okha on the west, where the sea is very shallow even now. The ancient texts including the Mahābhārata and Harivamsa repeatedly mention that the Yadavas came to Kusasthali, which was well protected by nature itself with a hill on one side and the sea on the other (Fig.120A). It was further fortified by building impregnable walls, so much so that this place standing in the sea was like a fortress in water. The increasing population found the narrow strip of land at the foot of the densely wooded hill was insufficient and reclamation of land on the mainland became a necessity as vouchsafed by the statement in Harivamsa.

The 2 m thick gravity wall about 0.5 km in length in BDK I-II and further north exposed in the cliff section is a positive evidence for the existences of fort walls. It is a landward wall at the foot of the hill, while the seaward wall is visible in the central sector (BDK VIII) and to a limited extent in BDK VI. The one kilometre wide mud flats of Balapur (BDK VI) and 300 m wide wave cut bench, etc. in BDK I-II, besides an equally wide stretch of land in BDK VII, were occupied during the mid-second millennium B.C. and rendered impregnable by the hill on the east and sea on almost all sides, except near one or two narrow land bridges. This was the Dwārakā founded on the ruins of the earlier town of Kusasthlii. The Late Harappan pottery of Balapur (BDK VI) and BDK I-II underlying the post-Harappan occupation represents the pre-Dvārakā Kusasthaliī. Reference has been made earlier to the fact that the Yadava ancestor Kakudmin Raivata had built Kusasthalii, and due to his neglect during long absence, or an attack by the Punyajana people, it was in a dilapidated condition. Krishna must have found this ancestral town a safe place for Yadavas to live in. The new town in Bet Dwārakā built by him had all the facilities for developing it into prosperous town-namely potable water, access to mainland and natural harbour. After a few years and a new port town was built on the mainland at the mouth of Gomati. This was a well-planned town with six distinct fortified sectors, two on the northern bank of Gomati and four on its southern bank. The massive stone walls, interspersed with a large number of bastions could withstand the battering of waves and scouring of currents. The engineering skill of the builders of the city walls is remarkable for the age. Besides using large and well dressed blocks of stone which were too heavy to be moved by waves, tides and currents, they adopted a new technique of providing L-shaped joints in masonry and evolved a new type of 3holed triangular anchors. There were some public buildings as suggested by large beams, pillars and other architectural members. The inner enclosures were well guarded as the first entry lay through an outer fortification wall. The town is said to have been planned as an ashtapada, comprising 8 sector. Six sector of which town have been identified and 2 more sectors may be traced near the second channel. The city walls were pierced by gateways and the buildings are said to be white in colour. In fact, sandstone used is itself white.

The prosperity of Dvārakā on the mainland was due to its overseas trade. The natural ridge modified into an anchorage and wharf provided the necessary shelter for ships and also facilities for handling cargo. The ancient river mouth, identified by the channel to the south of the rocky ridge, served as an entry point for small boats. Another rocky promontory seaward of the ridge must have served as a breakwater. There also appears to have been an offshore island fringed by coral reef.



CHAPTER IV

ANTIQUITIES FROM DWARKA AND BET DWARKA

he antiquities found in the sea bed excavations are still highly significant although they are limited in number.

The Seal

A small seal of conch shell 18 x 20 mm was recovered by V.M. Date, from the habitation debris (sediment) brought by airlift into the MS tank in the course of digging Trench UW 3 in Bet Dwarka. It is engraved with a composite animal motif of bull, unicorn and goat seen anti-clockwise (Fig 16). The motif is, no doubt, of Indus origin, but the art style shows considerable Bahrainian influence, which is apparent from the exaggerated eyes and body outline of the animals. The bullunicorn-goat motif on seals from other Harappan sites, like Kalibangan and Mohenjodaro (Fig 164), is distinct from that of Bet Dwarka, which belongs to the Late Indus period. In this connection, mention may be made of the occurrence, in the late levels of Lothal of a Bahrain type seal with the motif of a dragon having exaggerated eyes¹ (Fig 164). Trade connection with Bahrain is indicated by the presence of Lustrous Red Ware in the late tombs of Bahrain. An Indus seal was also recovered by the Indian Expedition to Bahrain in the course of recent excavations². The Kassite Ware occurring in Bet Dwarka can be compared with that of Bahrain with which Bet Dwarka had trade relations. It will be presently shown that Kassite period sites in Bahrain were

submerged when Bet Dwarka also suffered the same fate. The use of seals in Harappan times for commercial purpose is well known. It was used for identifying the citizen in Dwarka in an emergency after the city was attacked by Salva, King of Saubha. The relevant passage says that it is the duty of the guards to see that every citizen entering or leaving the city carries a seal³.

मुद्रयासह गच्छन्तु राज्ञो ये गन्तुमीप्सवः। न च मुद्रप्रवेष्टव्यो द्वारपालस्य पश्यतः॥

The Bet Dwarka seal may be assigned to the 17th-16th century B.C. in view of the occurrence of chert blades and late Harappan pottery which survived in post-Harappan times.

The Inscription

There are seven distinctly inscribed characters (Fig. 165) above the shoulder of this wide-mouthed jar found in IZ of BDK I-II. It has a low flange on the shoulder and perforation also. The letters, one cm in height, are separated from one another. Out of seven letters six are identical with the Late Harappan characters and one, i.e. the fourth from the left, is a combination of two signs, one of which is a Late Harappan sign for ga and the other also non-Harappan sign resembling the Brahmi sign for cha. The inscription runs from left to right as in Brahmi inscriptions. All the signs, except the fourth sign, bear close resemblance to the Semitic (Phoenician) signs, on the one hand⁴, and Late Harappan, on the



JUEA wi

Fig. 164 : A late Harappan type seal of conch shell from trench dug in Gulf of Kutch off BDK-I. Bull, unicorn and goat form a composite motif on the seal

Fig. 165 : Inscription in the evolved Late Harappan script on a votive jar, reads ma.ha.gacha.shah.pa

other. At least, five out of seven signs can be given the phonetic value of analogous signs⁵ in the Semitic script. All the Indus basic linear signs (listed in Fig 166) are identified on the basis of their evolution into a simple alphabetic script⁶. The basic Indus signs are distinguished from the accentuated forms (Figs 170-171). Accenting has been done by attaching slashes or strokes, one to three in number, to basic sign to indicate the vowel value of the consonantal sign as in Brahmi where the same principle of *matra* is adopted (Fig. 169). The Indus phonemes so formed are meaningful (Fig. 172).

The first sign in Bet Dwarka inscription is comparable to the sign for m in the South Arabian Iron Age inscription and it occurs on the Daimabad in post-Harappan period. The same sign is evolved into Brahmi sign for ma, the intermediate stages being indicated by the Rangpur and Megalithic graffitti of Sanur. The second and third signs in the Bet Dwarka inscription are identical with the sign for h in Semitic (Canaanite) inscriptions and the late Harappan and Harappan signs, the phonetic value they are given the same as in Semitic writing. The recurrence of the character in the Bet Dwarka inscription shows the continuance of the Harappan tradition. It occurs in Daimabad and Megalithic graffiti also. Another feature that deserves attention is that the second and third characters in the inscription under consideration face left as is the case in the ivory rod inscriptions of Mohenjo-daro. They are written facing right in Bet Dwarka and this is the normal way of writing it even on Indus Seals. The fourth character is a blend of two signs similar to the characters in Brahmi for ga and cha. The first sign here is identical with the sign for ga in Semitic and Indus writing, but neither had palatals in their phonetic system. The sign for cha represents the intermediate stage when new signs, especially for cerebrals and palatals, were introduced. Thus the compound character is to be read gacha (gachcha) which marks the

PHONETIC VALUE OF							
SEMILICA INDUS SIGNS							
S. NO.	PHONETIC	OLD NORTH SEMITIC SIGNS 16th-13th C.B.C.	HARAPPAN SIGNS	LATE HARAPPAN SIGNS			
l	b	口 9	09	$\square 9$			
2	g	1	$\land \neg$				
3	d	$D \bigtriangleup$	DD	\square			
4	h	えヨ	₹E	E			
5	w	ΥY	У	У			
6	ĥ	日 日 H	曰H爿╡				
7	th	00	\odot	\Diamond			
8	k	VV	$\forall \psi$	\checkmark			
9	Π	45	51	5			
10	S	手	丰	±			
11	c (ay)	00	0	0			
12	p	2 Q•◊•	$(\Diamond \Diamond)$	$0 \diamond$			
13	r	499	Þ	Þ			
14	s.	\lor \lor	\sim	\sim			
15	ŕ	$+ \times \land$	$\times \land \boxtimes$	A			
16	S	┍╧┑●	占个	\uparrow			
17	h.	Ψ•	щ				
18	m	<	X XX	X			
19	٥	x x x	V	V			
20	ŗ		\uparrow	*			
21	s		×	<u>ک</u>			

S.Semitic

Fig. 166 : Phonetic value of Semitic and Indus signs

intermediate stage. Thus the compound character is to be read gacha (gachcha) which is a homophone of Kachcha. (Fig 165). Interchange of k and g was common in Indus inscriptions, e.g. Baka and Baga.

TRANSCRIPTION	MEANING
l) asv-pa "ph-adr-ma-a 2 3 4 5 6 aśvapa" bhadra ma	'Asvapa" most auspicious'
II) vrsha-n-ppāt—ha I 2 3 4 = Vrshan-ppātaha }	(seal)' of powerful protector '
<pre>III) dh (or aty) - ksha tri p a 2 3 4 5 dhaksha-tripa or great - kshatra-pa</pre>	Able Tripa 2 or great protector of the kingdom
IV) sahh-ba-trā I 2 3 sahha batra (badra)	King – auspicious
V) bhag-dra-ha I 2 3 bhaga draha	Bountiful
VI) pāt - pa - ba - rhai I 2 3 4 pātu - pa - barhi 4 2	Let Barhi protecor "protect (us)
VII) t" p Ə — ka 1 2 3 4 ta" paka	Ta "Gaurdian
VIII) da ra I 2 dasa	Dasa
IX <u>ma na</u> mana	Manā (Manu ?)
X k da Əpgamahā 12345678 Kada apaga mahā	Kada (of) great Apaga (river)

Fig. 167 : Transcription of Indus script and meaning of words

ANTIQUITIES FROM DWĀRKĀ AND BET DWĀRKĀ

EVOLUTION OF THE INDUS SCRIPT	Fig. 168 : Evolution of
$[(*) \dashv (((((((((((((((((($	Indus script
(IX) \sum (IX) 18,4 pseudo pictures. Rest	
LATE LEVELS (VIII) # Cursive signs.No.(X) is from Jhajjar	
1900-1600 B.C. (VII) ¥ U 0 "K	
$(VI) \begin{pmatrix} VI \\ 4 \\ 3 \\ 2 \\ 1 \end{pmatrix} \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$	
HARAPPAN HARAPPAN MIDDLE LEVELS 2200-1900 B.C. $(IV)^{\frac{1}{2}}$ $(IV)^$	
3 2 1	
$\begin{bmatrix} (111) \ \hline \\ 5 \ 4 \ 3 \ 2 \ 1 \end{bmatrix} \xrightarrow{A} (111) B 2 \text{ pictures}; 3 \text{ linear sign}$	
HARAPPAN (II) $E \stackrel{1F}{\longrightarrow} 5 \qquad (II)$ I picture ; 3 pseudo picture. EARLY LEVELS 4 3 2 I Rest cursive signs	
$(1) \stackrel{1}{\bigcup} $)
Note : Pseudo pictures are compound signs of bosic cursive signs	B W tł

Fig. 169 : Brahmi writing in the rock edict of Girnar

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						1
S.No.	Seal No	Inscription with Basic Sign	Basic Sign	Accented for of Bosic Sign	m Inscription with Accented fform	Seal No.
L	M. 476	$\Diamond U U$	U	U	V ♦ P	L· 62
				Ŧ	ΨK	
				₹ <i>i</i> F	モノザキロ	
					× ₹"F	
2	L· 70	太む♦闘!₩▲♥	\checkmark	$ \downarrow$	¥Ⅲ″⊗	MK · 130
3	MK-601		. –	2	自众ひり♡	L· 94
4	V·224	₹¥∧I	\wedge	\wedge	瓦火甲含义	L- 138
5	МК∙666	₹77	K	1	do	do
6	M. 179	マイン (1)	\times	$ $ \times	$\times \otimes \diamond$	V. PI.C1 · 8
7	MK·148	EDt	D	Ð	ΒU	V. 23I
			\triangleright	\bowtie	See	L.138 above
					今本を	M. 225
				4	EĄ€	M. 46
				4	$\lor \forall \forall$	M.206
8	M.370	文第11米で	2	X	$\zeta \bowtie$	L. 113
	MK. 200	JF L P	2	P	F15	MK. 200
9	V. 114	YIII UF) P		7, P, 3	そう	M. 272
10	V. 99	15440	0	0	₹₣ ()	M. 236
		·		\odot	EDØ	V. 423
					ÐØ	V.455
11	L. 665	₩ E () " \$	\Diamond	\Diamond	$\bowtie \diamondsuit \land \land$	V. 267
					E D 🐵	V.662
12	L.19	IF D B		占	Ϋ́́ d	L.141
				¢	МĻ	4823
13	MK.183	ひり,父世及も		$ \infty $	₹K	L.136
				$\mid \Sigma \rangle$	自於令令	

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ANTIQUITIES FROM DWĀRKĀ AND BET DWĀRKĀ

S.No.	Seal No.	Inscription with Dest	Danu			
		Sign	Sign	of Basic Sign	Accented form	Seal No.
14	MK. 522	12 PJFA @	Þ	Þ	b f	M. 394
		1		ID	► <br< td=""><td>V. 267</td></br<>	V. 267
				ID.		
15	MK.101	ØY ₺	Y	$ \gamma$	YY	L. 54
16	MK.667	シャイ	\uparrow	· ·	A' + B	HR. 481
				X	ULU XD	
				*		
17	V.37	★ モ ♥ "w)	w	\sim		
18		≢ ↑ ↑	丰	=	◈₽⋕	V. 465
					(2) 11	M. 219
19	M.264	もう)7本し日	۲ (JIE		L. 18
20			E	E		
				E	E大び火	V. 325
			Y	Yuu	Y 1111	M. 25
21				E	$\vDash \times$	MK.652
				百		
			H			
			月,			
22						
				LITT	See . above	
23		E 大1	(入	E 大	
				$ \times$	₩₩기	
24			X	父 &		
			A	犬の		
				X		

S.NO.	1900-1500 B.C. LATE HARAPPAN SIGNS (BASIC)	1500-1000 B.C. NORTH SEMITIC & SOUTH SEMITI SIGNS	PHONETIC VALUE	1300- BET DWK B.C.	1400-800 B C MEGALITHIC SANUR ETC.	3rd CENT B.C. ASOKAN BRAHMI GIRNAR
1 2 3 4 5 6 7 8 9 10 11		1 1 1 1 1 1 1 1 1 1 1 1 1 1	b g d h ~ h th k n s (ay)	G T T T T T T T T T T T T T		□ ba ∧ ga D dha E ja d va O tha + ka ⊥ na ↓ sa
12 13 14 15 16 17 18 19 20 21 22 23 24		XK XKLJXKD XXLJXXAD XXXD	P r s t s h m a r s z y	U s. U m m		Lina Lina Lina Lina Lina Lina Lina Lina

Fig. 172 : Phonetic value of Bet Dvārakā signs in inscription based on the value of analogous signs of Late Harappan and Seimitic signs

The fifth sign is identical with the sign for sh in Semitic Shafatbal, Asdrubal and Canaanite inscriptions⁷ and Indus seals and graffiti. Though it looks more like gha than ya in Brahmi script, its phonetic value is sh in Semitic and Indus scripts. The sixth sign looking like the Brahmi alphabet *ja* is exactly like the basic sign for *h* in Semitic and Indus scripts. The last sign resembles the Semitic sign for *P*, but has two strokes on top as in the Indus script and reads *Pa*. The whole inscription can, therefore, be read *ma-hā-ha-ga-ca-sh-ha-pā* = *mahagacha-shah*- pa = mahakaccha Shah pa conveying the sense
"Sea (or Sea God) King (or Ruler) protect."

If the last three signs resembling Brahmi letters are given the phonetic value of Brahmi signs, the reading *yajama* or *ghajama* (and not *yajasa*) makes no sense, while the phonetic value of the identical signs in Semitic gives the reading *sah-pa* meaning "Ruler protect (or protector)".

From the reading based on Semitic-Indus phonetic value of the seven signs in the inscription it becomes obvious that the language of the inscription is Indo-Aryan and not Semitic as in the case of Indus seal-inscriptions⁷.

The term mahakaccha is used in the Mahābhārata in the sense of "a high Cedrena Toona" (having vast shores). It is also used, according to Lexicographers Amarasimha and others, in the sense of Sea; Sea God (Varuna). The inscription and its contents are most appropriate when we take into account its provenance, development of the script, language and tradition. Offerings used to be made to Varuna Devata in Dvārakā, which included Bet Dvārakā (as both were connected by land), where a temple dedicated to him is situated. In the Rigveda and Mahābhārata, there are references to offerings made and prayers offered to the sea God, Varuna. From Harappan times onwards, down to medieval period, votive jars bearing inscriptions making a reference to the deity to which offering is made have been found. On palaeographical grounds and ceramic evidence the votive vessel of Bet Dwarka belongs to the late-Harappan or post-Harappan period. Taking into account that the Lustrous Red Ware and Chalcolithic black-and-red ware were in use in Bet Dvārakā, the inscription under reference is assignable to the 15th-16th century B.C. Its significance lies in corroborating the evidence from Rangpur, Prabhas (Somnath) and Daimabad besides Mohenjo-daro and Lothal about the evolution of the Indus script and its use in simplified form in the Vedic and Epic periods. It also points to the fact that the Brahmi script was derived from the late Harappan script with some additional signs for cerebrals and palatals. The bulk of the consonantal signs in the late Harappan script were adopted by the Brahmi scribes who wrote rightward. The BDK inscription is the forerunner of Brahmi script providing an important link with the simplified linear script of 24 signs in the late Harappan writing.

V.S. Pathak⁸ suggests that the inscription could be read as *mahaprayajasa*. He observes, "In this context I would like to draw attention to the discovery of an extraordinarily important inscription by S.R. Rao, the former President of the Epigraphical Society of India..... The reading which I tentatively propose is *mahah pra* y(a) *ja sa*. If my decipherment of inscription is correct, the discovery will assume great importance for the religious history of the origin and development of the alphabetic script in India".

"The inscription seems to contain a reference to the mahatsukta of the Rigveda (10.51), which is in the form of a dialogue between Varuna and other gods on the one hand and the fire-god on the other. The three elder brothers of fire-god were slain by Vajra in the form of *Vashatkara*. while they were carrying oblations to gods. The fire-god, was, therefore, mighty scared of the responsibility of carrying oblations and to avoid it, concealed himself in waters. In the absence of the carrier of oblations, gods became famished. Fishes revealed to gods the place of his concealment. Led by Varuna gods came and entreated fire-god to resume the role of the carrier. To assuage his hurt feelings, gods promised that pre-sacrificial offerings as well as post-sacrificial offerings will be made exclusively to fire-god."

"Fire-god eventually relented and accepted the offer of gods. The story is retold in the *Taittiriya Samhita* (2.66) and other Vedic works. The find-spot of the jar and a reference to *prayaja* in inscription (of course if my reading is accepted) will indicate that the content of the jar was pre-sacrificial offering to the fire-



Fig. 173 : Beads of terracotta and shell


0 i 20m.

Fig. 174 : Blades of chert from Bet Dwarka

god in the sea."

"At any rate, the short inscription bears unmistakable testimony to the development of the alphabetic script in India in the post-Harappan period. That a few letters show similarity to the Semitic whereas others to the Harappan ideograms and the Brahmi Kharoshti aksharas admit to little doubt". In tracing the connection of Kharoshti script with Parsian Sakes, Pathak says "Kherosta therefore, connotes the script of the native books, and here the native evidently means the land of the 'Sakas'. He adds, "The two alphabetic scripts known in India, namely Brahmi and Kharoshti, are indicative respectively of the Bharata-Puru and the Dasa-Dahae traditions". It may be recalled here that the Indus seal inscriptions mentioned Pr (Puru), Dasa and Dahae9. Pathak suggests that Brahmi, one of the three dialects of Vedic

speech, "was the speech par excellence of the Vedic people and hence, it was identified with the Brahmi and later with the $\bar{A}rya$ -Bhāsha". Hillebrandt identifies the Panis with the Parnian Sakas of the classical writers. Strabo describes the nomadic Parnians as a branch of the Dahas. Pathak concludes, "Brahmi is thus, associated with the Bharatas and Kharoshti with the Dasa-Dahae Pani-Parnians".

Inscribed Potsherds

Two inscribed potsherds of sturdy red ware have been found in Bet Dwarka. The potsherd No. 1 is a surface find. It bears the legend $b \cdot g$ = baga (Fig 172) in late Harappan cursive writing. The word stands for 'god' in Avestan and is the equivalent of bhaga in Old Indo-Aryan (Vedic and Harappan) language¹⁰. On ceramic and palaeographic evidence the inscription is datable to 16th-15th century B.C.



The second sherd was found in layer 10 of a trench dug at the foot of the old Custom House in BDK VI. The solitary sign in Brahmi character reads sya (Fig 172) and is datable to 4th-5th century A.D. Dwarka had Bet yielded sherd а inscribed Nandasa in the excavation conducted in 1934 by Hirananda Sastri¹¹. He has dated it to 3rd-4th Century A.D. Bet Dwarka is an excellent example for tracing the evolution of the earliest writing of India into Harappan -Brahmi in three stages

Fig. 175 : Stone mould of metal-smith and proto-historic pottery : bowls, dishes etc.



Fig. 176 : Stone mould of metal-smith. Bet Dwarka

0 1 2 3 4 5CM. 0 1 2 INCH. Late Harappan, Post-Harappan (evolved) and Brahmi of 3rd century B.C./A.D.

Chert Blades

The parallel sided blades of chert from Bet Dwarka and the one with serrated edge from Dwarka (Fig. 173,174) are comparable to Harappan blades from Lothal and other sites in Saurashtra¹². It must, however, be remembered that similar blades occur in the post-Harappan chalcolithic levels at Maski in the Deccan. The Dwarka blades may be assigned to the late Harappan or post-Harappan periods in view of the occurrence of the late Indus type seal and carinated bowls and beaker in late Harappan fabric.

Stone Mould

A mould of calcareous sandstone, with 3 grooves for casting pointed spearheads of different sizes (Fig 175,176) was found in the IZ of BDK- I. A similar mould, but with narrower grooves used for casting copper or bronze needles, was found in Lothal¹³.

Stone Seat and Statue

A low-footed stool (Fig 171) of basalt, finely polished, was found along with the brass arches and other parts of a chariot or wagon in the excavation of the seabed. It was perhaps the seat(*pitha*) for a cult image. Within a short distance, the lower part of a marble statue, with only the feet intact, was recovered.

Among other stone artefacts retrieved are a pestle (Fig 178) of granite and a grinder-cumpounder of dolerite

Stone Anchors

The trade winds of the Indian Ocean are so regular that the sailors could frame a timetable in a year to come to India from the western countries, taking advantage of the Southwestern winds, and go back with the Northeastern winds. Sailing against the winds was not possible until the lateen sails were introduced in the 7th century A.D. In earlier times, the square-sailed ship was forced to drop its anchors in unfavourable winds in nearby shallow waters.

It is the experience of the Marine



Fig. 177 : Stone stool from sea-bed trench near buoy 56-57, DWK

Archaeologists working in the Arabian Sea and the Gulf of Kutch that the direction of the wind changes suddenly in a single day during the months from November to March which are considered very favourable for underwater exploration due to very good visibility. Sometimes, swells and currents disrupt underwater search and documentation.

Before the advent of the lateen sails, the Harappans and their successors used rectangular or square sails. Even as late as the 5th century A.D., the ships shown in the murals of Ajanta have rectangular sails ranging from

Fig. 178 : Stone pounder from sea-bed excavation, DWK



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Fig. 179 : Terracotta model of a boat (2500 BC) Lothal

The safety of a vessel depends on its anchors, especially in bad weather. Even those vessels with lateen sails which could sail against the wind in ancient times had to depend on the anchors for the safety of the vessel in a storm.

The stone anchors are of two types, namely weight anchors and armed anchors. Initially, as in Lothal, the sailors depended on the

> Fig. 180 : Prismatic stone anchor lying near the ridge on the sea-bed

one to three in number. The terracotta model of the boat from Lothal (Fig. 179), datable to 2500 B.C., has provision for a single mast. The later ships of the Satavahana rulers (2nd-4th century A.D.) had more than one rectangular sail, as shown in their coins with ship motifs. Similarly, the terracotta sealings from Chandraketugarh depict one or two rectangular sails in ship motifs. As regards the anchors used by the ships of early historical period, no information is available in literature or coins.

Five stone anchors have been found in or near the tidal dock of the Bronze Age at Lothal. Three stone anchors were recovered from the floor of the dock and two from its embankment. Four anchors are round with a single or double holes, and the fifth is a single-holed triangular anchor (Fig 180). An attempt seems to have been made by Lothal sailors as early as 2300 B.C. to have a triangular anchor, (Fig. 181,182) which became popular in the late Harappan and post-Harappan periods. One of the Indus seals depicts hauling of a triangular anchor from the prow of a ship.





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weight of the anchor for the safety of the vessels, hardly realizing that it may not hold properly and may drag.

Triangular Stone Anchors

By sheer experience the sailors of midsecond millennium B.C. must have realized that armed anchors can hold better, and the result was the 3-holed triangular anchor, seen in large numbers in Dwārkā waters. In this connection, it is necessary to mention that the triangular anchor of Lothal had a single hole for the cable, without any provision for wooden stakes. On one of the Mohenjodaro seals, a triangular anchor being lowered with a boom from the prow of the ship has been depicted¹³. It is thus obvious that though triangular anchor was known to the Harappans at Mohenjo-daro and Lothal, it was not armed. The earliest evidence of 3-holed

Fig. 184 : Prismatic anchor, Dwarka





Fig. 183 : Triangular prismatic anchor

triangular anchors found in an archaeological context is from Dvārakā (Fig. 185). Later instances of the use of similar anchors, which are called "pyramidal anchors", come from the Pre-Phoenician levels (14th-12th century B.C.)" of Cyprus and Syria¹⁴, and still later from Zea Liman.

Triangular Three-holed Anchors of Dwārkā

In the course of ten seasons of excavation and underwater exploration of ancient Dvārakā port, more than 60 stone anchors of triangular and "prismatic" shape have been noticed, and 37 of them have been recorded. A dozen anchors have been retrieved.

The technical advantage of 3-holed triangular anchors (Fig. 183), with wooden stakes wedged in the piercing over the unarmed anchors, is that with the bobbing of the vessel

Fig. 185 : Prismatic and triangular stone anchors, Dwarka



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on the surface, the movement is transmitted to the top of the unarmed anchor, resulting in its rocking up and down and thereby loosening its grip. But the 3-holed armed anchor would hold firmly in the sea bed and there would be a much less drag. The role of the anchor in a stormy sea is very crucial, especially near the rocky shore, because the cable may snap and the vessel may be pushed to dangerous reefs.

The wooden stakes, wedged into the bottom holes and protruding at the base, hold the anchor in position by sticking into the seabed and would not drag. Through the third perforation at the top, a wooden stake was tied to the cable for hauling purposes. Thus the evolution from the single-holed spheroid and triangular anchors of Lothal, a great improvement is seen in the 3-holed triangular and prismatic anchors, which could be used on sandy as well as rocky beds, thereby reducing the drag greatly. Secondly, irrespective of how the prismatic anchor fell, the arms would still hold. The scarcity of lead-stock anchors in Indian waters in the early historical period is well known. Stone-stock anchors were also in limited use. However, the abundance of prismatic stone anchors in Dvārakā throws new light on the innovative spirit of Indian sailors. Surprisingly, prismatic anchors are limited to Indian Ocean, and they are not reported from the Pacific Ocean or the Mediterranean Sea.

One of the small triangular anchors has a base of 49 cm, sides of 75 cm and top of 35 cm. Its two square holes above the base are 10 cm on each side, while the round hole on top is also 10 cm in diameter. The largest triangular anchor found near buoy 58B measures (L) 198 x (B) 40 x (T) 34 cms and weighs 572.54 kg (Table II).

The seal from Mohenjo-daro depicts a triangular anchor being lowered from the prow by a boom. Dvārakā sailors too might have followed the same technique in lowering the anchors.

Prismatic Anchors

Dvārakā evolved an entirely new type of

anchors designated here as "prismatic anchors", for want of a better term. They are rectangular in plan and section, but slightly tapering towards the end. The piercing on one side is round and on the other square. The third piercing on an adjoining side is also square. There are, however, exceptions. The average size of the anchor is 70 cm in length, 25 to 30 cm width and thickness. A large anchor of prismatic shape found near buoy 29 measures 1.21 x 0.33 x 0.35 m. Two almost square piercings are 13 x 11.5 cm with a depth of 32 cm, while its round piercing has a diameter of 32 cm. The largest prismatic anchor is 105 cm long/25 cm in width at one end and 18 cm at the tapering end, the average thickness being 18 cm. The smallest prismatic anchor is 60 cm long and 17.5 cm at the base. The material used is sandstone in some cases and basalt in most others. The damage from marine environment is much less in prismatic anchors of basalt than in those of sandstone. In general, the triangular anchors of miliolites have both suffered from wear-and-tear and from the marine environment. The prismatic anchors are more common in the later levels of Period I, and some may belong to the early historic Period II.

The dating of the 3-holed triangular anchors of Dvārakā is done on ceramic evidence, and further cross-checked with the date of similar anchors of Pre-Phoenician Period found at Kition in Cyprus and Ugarit in Syria. The Lustrous Red Ware of Dvaraka, found in layer contemporary with those in which some of these anchors, are found, facilitates dating them to 15th century B.C. - slightly earlier than the date of Kition anchors namely 14th-12th century B.C. Some might have survived upto the Early Historical Period say upto 5th-6th century A.D.

. The ritualistic use of anchors noted by Honor Frost at Kition and other sites is very significant¹⁵. Two round (spheroid) anchors of Lothal are found on the embankment wall of the dock near the warehouse. Till recently, the warehouse mound was associated with the Sea

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Fig. 187 : Spheroid stone with a central hole

Fig. 188 : Rectangular stone block with a large hole (perhaps a door-socket) found near the e n t r a n c e gateway



An important question that deserves attention, the solution for which is possible, is the location of a jetty or wharf. Near the protection walls, anchors have been found in the palaeo-channel of the Gomati. A large prismatic anchor was recovered at the foot of the ridge 183, 184)one km seaward (Fig of Samudranarayana Temple. There are 2 manmade holes in this ridge, which rises to a height of 2 m above the rocky base. It is possible that boats used to be moored here when the sea level was 10 m below the present level as indicated by the water depth of 10 m at the ridge. There is a stone-paved platform nearby, indicating a man-made wharf for hauling cargo.

Single-holed Spheroid Objects

At buoy nos. 12 and 28 in Dwarka two single-holed truncated spheroid stone objects were found at a water depth of 10 m. Buoy 12 of this season is the farthest station which is about 750 m seaward of Samudranarayana temple. The distance between these two objects at buoys 12 and 28 is about 180 m. Both the objects were found partly buried in the sediment (Fig 187 - 188). One of the objects retrieved from Dwarka has a flat bottom and a smooth edge. The hole runs through the section. The profile is convex. The material used is hard black rock, perhaps basalt. The diameter of the object is 65 cm, its height 30 cm and the weight is 108 Kg. They might have been mooring stones or stone bases of masts. A

Goddess Vanuvati Sikotarimata. The ancient anchors of Dwārkā do not appear to have been associated with any temple, or temple ritual, nor are they found built into any structure, although some vestiges of a temple can be inferred from the *candrasila*, brackets, and pillars of stone found in the seabed excavation.

Fig. 189 : A semispherical stone with a hole right near flagpost or door-socket



Fig. 190 : Truncated spheroid stone with a hole, perhaps a Mooring stone

rectangular stone block with a large hole found near buoy 63 seems to be the door socket of a gateway (Fig 189).

Somnath

The Excavation zone in Somnath water extends about 400 m west of the Somnath temple (Fig. 145). It is a very big rocky patch, approximately 250 m x 250 m., and the average height about 1 m. Here, at least three channels cut in the rock are found running from northeast to southwest. Two truncated spheroid stone objects were found buried in the channels, two other lying on rock. The material used for two spheroid objects is basalt. Two others, are made out of locally available sandstone. All the objects were found at a depth of 8 m. The height of the largest object (buoy 9) is 61.5 cm and its maximum diameter is also 65 cm. (Fig 190). Similar objects, but smaller in size, were found at buoy 10. The height of the smallest object at buoy 8 is 25 cm. Two objects at buoys 9 and 10 have a very smooth surface, while other objects have a rough surface. The material used for the spheroid objects is sandstone.

For ascertaining the real use of these objects, one can only look to Dholavira, where well-polished spheroid single- holed stones are found in situ in the habitation area. They were placed one above the other to form a decorative pillar flanking the Gateway (Fig 189). The Somnath and Dvaraka objects too might have served as parts of a stone column. The central hole in Dholavira objects allowed a metal rod to pass through. The hole in Dwarka and Somnath objects is larger for fixing a wooden pole to hold them in position. Their use as pillar parts can be confirmed if some buildings in situ are found at Somnath as in Dwarka. The only other possible use to which they could have been put is to serve as stone base of masts and flagposts. As the mast with the sail was heavy, the stone base too had to be large. This, however, would result in reducing the cargo capacity as the stone base weighs at least 2 tons and occupies much space.

The spheroid stones under discussion can be dated on the basis of associated 3-holed triangular stone anchors of Dwārkā, which are assigned to 1500-1400 B.C., if not earlier.

TABLE IV

Triangular anchors with 3-holes							
	Buoy	S	Size		Weight		
	no	in cen	timet	res	in Kg		
1.	47	81	54	13	122.41		
2.	50	71	65	12	102.90		
3.	52	94	68	13	112.43		
4.	35	95	52	14	163.90		
5.	58	56	46	12	72.01		
Prismatic Anchors							
6.	45	240	30	31	567.66		
7.	46	120	28	24.5	158.53		
8.	51	99.5	22	· 22	106.96		
9.	49	120	27	27	217.50		
10.	58A	137	30	24	232.57		
11.	58B	198	40	43	672.54		
12.	58D	112	32	24	198.24		
13.	58E	56	46	12	72.01		

Other anchors unretrieved are at buoy Nos. 5, 36, 38, 49, 58, S2,S3 and S10.

Fig. 191 : Stone plaque of Vishnu found in the excavation at Dwarka

Table 1 : Showing the dimensions of spheroid stone objects found in Somnath

Spheroid stone Objects

SN.	Location	Height	Diametre of Objects
1.	SMT. 8	63	24
2.	SMT. 9	65	15
3.	SMT. 10	49.5	10.5
4.	SMT. 11	48	

Sculptures

A stone stool, a marble statue in which only two feet of the deity (Fig 191), are visible, and a copper bell were found along with two brass arches, two bars and other parts of what might have been a rudder of the boat. An alternate purpose of these brass objects is discussed elsewhere.

The sculpture of Vishnu, holding gada in the upper right hand and chakra in the upper left hand, found in onshore excavation near Dwarkadhish Temple can be easily identified as the Trivikrama form of Vishnu (Fig 191) although the two lower hands are missing. In all the Trivikrama forms of cult images in Dwarka and Bet Dwarka temples, the lower left, hand holds sankha and the lower right padma. In the sculpture under discussion, Jaya, an attendant, and Satyabhama or Rukmini, a consort of Krshna, are seen near the deity's right leg. Trivikrama wears a Kiritamukuta under a chatra (canopy) in 3 tiers. At the level of gada and cakra are two seated figures. One of them is holding a kalasa. They cannot be identified, nor are they found in other images of Trivikrama. The main cult image of

Fig. 192 : Copper 'lota', Dvaraka





Fig. 193 : Damaged statue of a deity in black basalt from inter-tidal zone near the Light House.

Dwarkadhish Temple is in Trivikrama form. On stylistic grounds and ceramic evidence, the stone plague of Vishnu in Trivikrama form found in the onshore excavation is assignable to 9th century A.D, if not slightly earlier. The

Fig. 194 : Bronze bell from underwater excavation, Dwarka



MARINE ARCHAEÓLOGY IN INDIA



Amreli plaques of Vishnu and other deities are much earlier in date.

An unidentified fragment of sculpture of a deity in black stone (Fig 193) in which the lower half of the legs and an elephant (damaged) to the left are visible was recovered from IZ near the Light House at Dwarka. One possibility is that the sculpture was rejected as a mutilated idol, and was cast into the sea.

Metallurgy

Several copper, bronze and brass objects were recovered in the trenches dug in the seabed off SN Temple at Dvārakā. The more significant ones among them from the point of view of metallurgy and the use to which the objects were put are 3 *lotas*, a bell and parts of what appears to be a votive chariot.

Fig. 196 : Brass arches on horizontal bars of a vehicle frame (below).

Fig. 197 : Lower part (brass) of a vehicle, the axle of which could pass through the hole (bottom).



The copper lota found in the Trench excavated near buoy 35 on the right bank of old Gomati has close similarity to pottery vessels of the same type having a concavoconvex profile, flat base and a projecting rim (Fig 192). Another lota is highly corroded which makes it difficult to date. This type in pottery has been in use in India since Chalcolithic period and in copper during the early historical period. The trench No. 15, sunk near buoy 55 on the left bank of the submerged Gomati channel, yielded a bronze bell (Fig 194,195) and brass arches, bars (Fig 196) and other parts of a miniature chariot or wagon (Fig 197) used in religious ceremonies. The perforated arches might have supported the canopy of a wagon type chariot. As riveting was known to the Harappans at Lothal in 2300 B.C.¹⁶, it is not surprising that the metalsmiths of Dwarka could rivet the bars and drive holes in them.

The *Mahābhārata*¹⁷ refers to weapons of various metals used in the battle. The analysis of the brass objects from Dwarka carried out by Dr. Prabhu¹⁸ of National Information Centre, Hyderabad shows 73% copper, 10.68% zinc, 1.32% Pb, 0.43%Fe, 0.11%N.

Some technicians had suggested that the brass object of U shape with a ring below might have been a part of a rudder used in ancient wooden boats. Although one piece of "U" shape with circular projection below may be part of a rudder of a ship, other associated brass objects, such as bars and arches with holes, do not appear to be parts of any rudder. An alternate explanation is that they form part of a wheeled vehicle resembling the bronze chariot of the Late Harappan site of Daimabad (Fig 197). From the same area in Dvārakā where arches were found and a bronze bell was recovered. The bell is not very much corroded. Alloying as a technique to harden copper with tin and lead was well known to Harappan smiths¹⁹. They also adopted the cold-hammering techni-que to increase the hardness of the object. They knew the sinking and raising technique to mould a metal disc into the required pot form.

Sto. e moulds were used by the Harappan and Dva aka smiths for casting copper/bronze pins and spearheads and closed mould for casting more sophisticated tools²⁰. The metal technology had advanced so much in Harappan and Late Harappan times, especially at Lothal and Daimabad, that the Dvaraka smiths did not find any difficulties in producing vessels by riveting and welding. Both *cireperdue* and open mould castings were known to them. The process of *running* on, that is, pouring molten bronze to join the parts of a vessel, was followed by Harappan smiths. Rivets were used by the Dvārakā smiths besides following running on technique for joining. The dancing girl of Mohenjo-daro, the charioteer of Daimabad and the figures of dog and bird of Lothal were cast in cireperdue. Chariots of different sizes used for different purposes were common in the Māhabhārata Period. The wooden-spoked wheels must have had iron strips, because iron technology was already known. The roads were good, especially in Saurashtra, for the chariots moved fast from Dvaraka to Porbandar, Prabhasa and Girnar. Both hubbed and hubless wheels were known in Harappan times. The painted lines on some Lothal terracota wheels suggest spokes. A miniature stone wheel form Lothal with carved geometric designs is similar to the solid wooden and stone wheels of temple chariots of later days.

Brass Objects (Fig 196,197)

The brass objects from the seabed excavation off Dwārkā are unique for the simple reason that such heavy cast, riveted and perforated bars, arches and frames have not been found in any early historic site in India. The hoard consists of 2 flat strips 1.5 m long and two arches with holes at 20 cms intervals in the bends, for fixing it on the bar, 6 nails and a heavy U-shaped object with a large hole below. All are perfectly cast in mould and the bars and arches must have been drilled after casting. The composition of the alloy is 73% copper and 10% Zinc. If these parts are of a vehicle, (chariot), the wheels too, must have

ANTIQUITIES FROM DWĀRKĀ AND BET DWĀRKĀ



Fig. 198 : Wheeled buffalo (bronze), Daimabad, Gujarat been of brass, but they could not be traced in the sediment. A bronze bell was also found with the brass object. The nearest parallel to Fig. 200 : Elephant (bronze) Daimabad





Fig. 199 : Wheeled rhinoceros (bronze), Daimabad

he brass chariot of Dvārakā is the bronze hariot of Daimabad 2nd millenium B.C. esides the chariot, a wheeled buffalo (Fig 198), a wheeled rhinoceros (Fig 199) and an elephant (Fig 200) of which wheels are missing were found in the Daimabad hoard. The buffalo from Daimabad is welded to a four-wheeled plate which is supported by 2 perforated Ushaped objects, more or less, similar to that of Dvārakā. The axle in the Daimabad buffalo figure passes through the holes in the U-shaped object and the wheels at its far ends. The Daimabad chariot¹⁸ has two solid metal wheels two X-shaped supports and given below the frame. The charioteer standing in this ekkatype chariot is holding a whip. There is a small dog-like animal in the front. A long bar is attached to the cart frame and two bullocks which were wheeled (now missing) were yoked to the cross bar. It is interesting to note that the chariot is lighter than other wheeled animals and has only 2 wheels. The figures of elephant, buffalo and rhinoceros, have 4 wheels each. The terracotta bullock carts of Lothal also have only 2 wheels like the Daimabad and Dvaraka chariot. The Daimabad chariot was drawn by bullocks but the Dvārakā chariot (reconstructed) must have been drawn by horses²¹. The canopy must have been limited to the central part. It was not a model of war chariot, but a miniature one used for ritualistic purposes for taking the deity in procession on festival occasions.

Antiquity of Brass

Prof. Arun Kumar Biswas¹⁹, in his paper "Some Studies on Minerals and Metals in Indian Antiquity" says, "The Indian subcontinent enjoys the unique distinction of being the first to introduce brass and zinc metallurgy to the world". The earliest brass in the world was in the Harappan site of Lothal and then in the early PGW-site of Atranjikhera. The primacy of Zinc metallurgy in India is established by three kinds of evidence :

(a) second millennium B.C. radio-carbon dating of Zinc ore mine in Southern Rajasthan; (b) forth century B.C. brass vase in Taxila as saying 34% zinc; and (c) second century A.D. literature of Nagarjuna describing distillation of Zinc". "The earlier occurrence of Zinc in man-made artefacts is in the form of copper alloy known as brass. Ever since the discovery of copper and the alloying elements of tin, arsenic, lead, etc., different materials, including zinc, were used to alloy and harden copper.

The earliest method of making brass was possibly the cementation process in which finely divided copper fragments were intimately mixed with roasted zinc ore (oxide) and reducing agent, such as charcoal, and heated to 1000°C in a sealed crucible. Zinc vapour formed, dissolved into the copper fragments, yielding a poor quality brass. Zinc percentage could not be easily controlled. Fusion of Zinc with copper increases the strength, hardness and toughness of the latter. When the alloy is composed of 10-18% Zinc, it has a pleasing golden yellow colour. It can also take very high polish and literally glitter like gold. For this property, brass has been widely used for casting statuary and covering temple roofs. Reduction of Zinc Oxide around 1000°C is crucially important; below 950°C no zinc is produced. Zinc is obtained in vapour form at this temperature, since its b.p. is 913°C. The materials of antiquity containing more than 28% Zinc in copper matrix must have been prepared by mixing the two metals, which could have been possible only after the discovery of Zinc as a separate metal and its preparation by a process such as distillation. The antiquity of brass artifacts can, therefore, be divided into two eras, one preceding, and the other following, the discovery of zinc as a separate metal. "We claim that the earliest artefact, noted so far, containing an appreciable amount of zinc anywhere in the world, is from India, Lothal (2200-1500 B.C.) showed one highly oxidized antiquity (No. 4189) which assayed 70.70% copper, 6.04% Zinc, 0.9% Fe and 6.04% acid soluble component probably carbonate, (a product of atmospheric corrosion). The material could have been prepared by smelting Zinc-bearing copper ore or the cementation route described earlier. The raw materials might have come from the Ahar-Zawar area. The Harappan site of Rojdi, also in Gujarat, has yielded a few samples of chisel, celt, rod and bangle, made of brass and assaying upto 1.54% Zinc. One copper-based item of Atranjikhera during the PGW era (1200-600B.C.) contained 11.68% Sn, 9.0% Pb and 6.28% Zn, while another item assayed 20.72% Sn and 16.20% Zn. Both samples contained traces of iron and sulphur, indicating the possibility of Chalcopyrite and sphalerite-galena having been the source materials which could easily come from the Ahar - Zawar area. Most of the brass samples in Ancient India contained variable proportions of Zn, Sn and Pb. "We have drawn attention to the brass items of Lothal and Atranjikhera and their possible link with 1260 ± 160, 1136 ± 160 B.C. and 1050 ± 150 C-14 dates of the timber sample in the



Fig. 201 : Iron anchor

Rajpura-Dariba silver-lead-zinc mine near Udaipur. During the Harappan era copper used to be alloyed with tin and arsenic, since these were scarce commodities and alternative alloying elements had to be looked for. Artisans in the Rajasthan-Gujarat region might have stumbled on to zinc ore deposit as a new source of alloying element Barwas."

Cradilock *et al* surveyed the evidence of early brass artefacts in the west. The earliest brass artefacts known in the West come from excavations at the Gordion Tomb in Phrygia

Fig. 202 : Iron nails after chemical treatment, Bet Dwarka



Fig. 203: Iron nail after chemical treatment, Bet Dwarka

dating from the 8th and 7th century B.C. onwards. These came after the Lothal and Atranjikhera traditions. From the 7th century B.C. the Greeks commented upon brass or oreichalkos but always as an expensive, exotic metal not produced in Greece. There was no zinc in the early Greek bronze, Etruscan bronze of the 5th century B.C. contained 11% zinc.

Zinc Metal and High Zinc Brass

The earliest brass containing more than 28% zinc, which could be made only after the isolation of pure zinc metal came from Taxila. Cradilock pointed out the overriding importance of the Vase (BM 215-284) excavated from the Bhir Mound at Taxila and dated it to the 4th century B.C. This brass sample contains 34.34% zinc, 4.25% Sn, 3.0% pb, 1.77% Fe and 0.4% nickel.

Mining Archaeology and Smelting Related to Indian Zinc Ore.

The recent pioneering work on the Zinclead-silver mining achaeology in the southern part of Rajasthan by Willies *et al* and the relevant C-14 dates have finally established India's primacy in non-ferrous ore-mining in the ancient world.

The ancient workings in the South Lode (100 m depth) of Rajpura-Dariba mine (80 km northeast of Udaipur) have been C-14 dated as 1260 B.C., 1130 B.C., 1050 B.C. and the East Lode workings as 375 B.C., 360 B.C., 120 B.C., 150 A.D. etc.

Iron Objects

Very few iron objects were found in the IZ of Bet Dvārakā. The limited use of iron for tools and weapons was due to its scarcity. However several objects must be lying buried in the seabed. The National Research Laboratory for Conservation of Cultural Property, Lucknow, was requested to make a technical study of iron and other objects (Fig. 201), found in Bet Dvārakā excavation. A summary of the report by of O.P. Agrawal and others is given here. The objects included three iron nails, four potsherds and one olpin (small bottle with handle). Results of the scientific examination of these objects are presented below by O.P. Agrawal and others²⁰:

A. Iron nails (Lab Nos. Fe 179, Fe 180 and Fe 181) (Figs 202,203). These three nails were metallographically examined with the following objectives. (Appendix. Table 1)

- i) To know their fabrication techniques.
- ii) To know whether meteoric iron was used for their fabrication or not.

Metallographic Examination

Two nails having lab nos Fe 179 and Fe 180 were more or less complete in shape and were having less deposition but the nail with lab No. Fe 181 was almost completely covered with siliceous material, small shells, etc. As it was difficult to take samples from nails in this condition, all the nails were manually cleaned and the deposit on them scraped with fine chisels and watch maker's tools to the level of the bare mineralized metal. When the complete shape of the nails was visible very small sections were drawn from these nails with a diamond saw and embedded in a Thermoplastic resin and prepared by standard metallographic procedures. Samples from the core and the corrosion products were also taken for analysis by Emission Spectrographic and X-Ray diffraction techniques. After cutting, it was revealed that all the objects were completely mineralized (mainly iron oxide), and the cutsections, after polishing, revealed one or two fragments of metallic crystals. It is difficult to make sound scientific observations on such corroded materials. But a study at a high magnification can help in detecting the carbide structure. This technique was utilized for the study of these corroded objects. Etching was done by 2% Nital solution (a mixture of nitric acid in ethyl alcohol) and an acid mixture (a mixture of 92 ml HCL, 3 ml HNo3, and 5 ml H_sSO₁/was photographed with Leitz Orthopian metallographic microscope Iron Anchor

Interpretation of microstructure

1. Iron nail (Lab No. Fe 179)

Examination of the section at 125X revealed neither a metal core nor any other metal but, a completely mineralized section having stress-strain cracks and corrosion cavities spread all over the surface. The section was more or less free of slag. Etching with the acid mixture revealed (at 500X) a few relic structures of carbide, near the periphery but it was not detected in the area away from periphery of the section.

Conclusion

Investigations show that the nail was fabricated originally from wrought iron which later absorbed some carbon during forging. The presence of very few relic carbide structure in only one portion indicates that this may be only accidental. The absence of slag impurities in the metal confirmed that the smith tried to procure pure metal from the impure wrought iron.

2. Iron nail (Lab No. Fe 180)

The section of this nail was examined at 31.5X after fine polishing. No metal core was seen except one tiny metal crystal. Numerous elongated strings of slag inclusions were seen in the micro section. The metal crystal noticed near the periphery upon etching with 2% Nital for 15-20 seconds shows ferrite with pearlite at the grain boundary at 250X. The direction of the elongated slag inclusion was found to be towards the pointed end of the nail. Further etching of the section with the acid mixture did not reveal any relic carbide, either near the periphery or away from the periphery.

Conclusion

The above studies indicate that this nail was fabricated with impure wrought iron bloom which was heavily forged to remove only some of the slag, imparting the pointed shape. The presence of heavy slag inclusion indicates that much attention was not paid to purifying the metal.



3. Iron nail (Lab No. Fe 181)

Macro study of the section reveals that the object is completely mineralized without any metal core and having stress cracks. Examination at 125X shows plenty of string of slag, spread all over the mineralized section. Examination at higher magnification (250X) revealed only one tiny metal crystal and that too near the periphery, which upon etching with 2% Nital and on examination at 315X was found to have ferrite with pearlite at the boundary. Further etching of the section with the acid mixture for 5-10 seconds did not reveal the presence of any relic carbide either near the periphery or away from the periphery.

Conclusion

This object was also fabricated in the same manner as the nail lab No. Fe 180.

Spectrographic Examination

Samples from the above nails were also analysed for their chemical composition with Emission Spectrograph. It was found that the main constituent of the nails was iron with silica, manganese and magnesium as minor elements. Nickel and cobalt were not detected in any of them. X-Ray, diffraction of the outer encrustation revealed the presence of Magnetite and Quartz.

Interpretation and Discussion

Examination of the three objects from Dwarka shows that they were fabricated by forging from the impure wrought iron bloom. It appeared from the above studies that these objects absorbed some carbon particles accidently while the smiths were repeatedly forging them for giving the final shape. The presence of more amount of silicate impurities indicates that the smith was not much aware about the harmful effect of its presence. It must, however, be said that the presence of silicate in the metal increases its hardness to some extent, but inclusion beyond that causes brittleness in the metal. Perhaps, the smith unknowingly exploited this property in preparing objects, bigger in size and more durable. (for details see JMA No 1, 1988)

Conclusion

Investigations point out that the Dwarka artisan exploited the available iron ore, extracted metal after roasting it and varied the content of silicate impurities in wrought iron, knowingly, according to the need. Studies also reveal that the iron technology was in the preliminary stage and had not reached the stage of casecarburization or carburization. It is also indicated that the smiths did not use meteoric iron for the nails.

Scientific Study of Potsherds and Olpin (Bottle with handle)

Some pot-sherds and one piece of an olpin (a bottle with handle) were examined by NRLCCP. The pot-sherds were having on them a white deposit and the olpin an over-all white layer.

In order to know the composition of pottery a piece was analysed qualitatively with emission spectrograph. The fabric of the pottery was found to contain silicon, iron, manganese, calcium, magnesium, aluminium and titanium. All these elements are normally found in the earth. This analysis was not likely to give much information and was, therefore, not done quantitatively.

To ascertain the nature of the white deposit on the pottery, a sample was taken from the piece Ant. 10/1983/BDK-I, IZ and analysed chemically. It was found to contain calcium carbonate of organic and inorganic origin as calcite and aragonite, the different crystalline forms of calcium carbonate. Obviously the white deposit was due to long immersion under the sea.

The whitish layer present on the olpin, Ant. 6/1983/BDK - I Beach, was also analysed. It also had an appearance of external deposit and at first we thought it would also be a calcium carbonate deposit. However, analysis, in this case also qualitative, revealed that it contained copper, lead and tin, besides the



Fig. 205 : Columella of worked conch shells (shankha) found on the wavecut bench where structural remains of submerged Dvārkā are *in situ*. Bangles of shell found in Sea-bed near IZ of BDK-1, Bet Dvārkā (inset)

other normal constituents of earth. Proportions of these elements in the whitish layer suggest that the layer could be a glaze, with copper as the colouring matter, which was decayed extensively from corrosive action of sea water.

Fig. 206 : Coin of Kanishka, Bet Dwarka Period-II



It shows that the art of glazing was known in that period. (See JMA No.1, 1988)

Iron anchor

As many as four iron anchors were found of which (Fig 201) only one is intact while the others are highly corroded.

Shell-working

The chank shell occurs in the Gulf of Mannar and Kathiawad-Kutch. The variety of chank found in Bet Dwarka is best suited for making shell artefacts ranging from vessels and ornaments to craftman's, scribes, astronomer's and surgeon's tools and instruments. Among the large variety of artefacts of chank shell found in the Harappan port town of Lothal mention may be made of gamesmen, lids, bowls, ladles, inlays, bangles, beads, hairpins, rings, ear-studs, buttons, engravers used by scribes



Fig. 207 : Pottery from Bet Dwarka Period-I

and seal cutters, scrapers, surgeon's scalpel, needles, points, burnishers, handles, compass for plain table survey and parts of stringed musical instrumets such as the plectrum and bridge²¹. Bet Dwarka is known for rich beds of Gastropods fauna. The common species exploited at Bet Dwarka for making artefacts of shell was X-pyrum. A very large quantity of columella (Fig 204), body portion and bangle pieces has been collected from the surface, intertidal zone and underwater trenches in Bet Dwarka. From the circular cuts on the columella and the chank shell debris, it can be concluded that, besides bangles (Fig 205) other types of art facts such as buttons, ladles and rings were also produced in Bet Dvārakā. X pyrum and Babylonia spirata are two gastropod species used for manufacturing inlay pieces²².

A large number of stony *operculums* with a planoconvex surface, belonging to *Turbinidae* fairly found in Bet Dwarka, were also used for

making buttons. In Bet Dvārakā *M. ramosus* was used to a limited extent for making bangles and inlays, but Nageswar produced artefacts on a large scale from this species.

Seventy two species of Gastropods have been recorded in the Gulf of Kutch, but it is the sacred chank *X pyrum* which is of great commercial value²³. It occurs in the intertidal zone of Okha, Aramda, Poshitra, Ajad, Wadinar, Bhaana, Salaya, Sikka, Pirotan island and Bedi on the southern bank of the Gulf. Hornell has reported chank from 10-20 m water depth with sandy bottom in the proximity of coral reefs on Gujarat coast. They are handpicked in low tide. With increase in demand for sacred chank at the pilgrim centre of Bet Dwarka, new chank beds are being explored.

Technique of Making Shell Bangles

The process of sawing, engraving and giving final shape to chank artefacts was common to

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Lothal (Rao S.R. 1985) and other Indus Valley sites. The same process was followed by the Bet Dwarka shell-workers. The columella of the shell was extracted by swerving off a slice of the lip with the help of a wire-saw and breaking down the septa with a hammer. The apex of the shell was then smashed and the columella freed thereby leaving a hollow tubular piece of shell which could be readily sawn into bracelets. The saw marks on the columella and the valva indicate that the shell was turned slowly while sawing with a saw of bronze wire. Hornell's suggestion that the shells were cut with a flint is not borne out by facts. Although a curved bronze saw with thick teeth on the inner edge was found at Lothal, the saw marks on columella are so thin that such an instrument was not used at Lothal or Bet Dvārakā for cutting the shell. The remnant of the septum between adjacent whorls left after removing the columella was clipped off with great care as it forms the weakest form of the ring. The thick rings produced from the septum were then sawn into thinner pieces for making bangles. The inside of the segment was rubbed down with a wooden spindle coated with river sand embedded. The walls of the chank are also used for making ladles and inlays and the solid part for making gamesmen and seals.

The dimensions of bangles from Bet Dvārakā and Dwarka vary from 5 to 8 cm in inner diameter and 0.4 to 1.6 cm in thickness. They are all plain without any carved design

Fig. 208 : Pottery from Bet Dvārakā Period II





Fig. 209 : Jars with raised neck, flaring mouth etc. from BDK I & II



Fig. 210 : Bet Dwarka more Lustrous Redware, Period I

unlike the shell bangles of the Early Historical Period from Amreli.

Coins

Two copper coins (Fig. 206) of Kanishka were found in the explorations at Bet Dwarka.

Terracotta and bone artefacts

A few beads of terracotta and fish bone have been recovered from Bet Dwarka.

Description of Pottery

The excavation in Bet Dvārakā and Dvārakā has yielded ceramics of the early historic and protohistoric periods as indicated by the Lustrous Red Ware associated with other objects' recovered from stratified deposits. From 1981 to 1991 offshore excavations carried out by the Marine Archaeology Centre of the National Institute of Oceanography, Goa, at Dvārakā as well as Bet Dvārakā have brought to light protohistoric settlements. They were later destroyed by the sea. Much of the pottery reported here has been collected from the intertidal zone and seabed excavations.

A comparative study of the pottery from Dvārakā and Bet Dvārakā with that of Rangpur which is an index site of Harappa, late Harappa and post-Harappa cultures is attempted here. A brief description of the pottery from Nageshwar (Kuldeep and Kenoyer: 1980) and Prabhasa (IAR-1975-76) which are two other protohistoric sites in Saurashtra is given for purposes of chronology.

Pottery has been collected from onshore excavation at Dwarka and Bet Dwarka as well as from intertidal zone and sea bed of Bet Dwarka. Most the pottery found in these sites is fragmentary because of wave action. Some shapes which are universally available from the Harappan and Late Harappan sites, were however recovered in onshore excavation of Dwarka and offshore of Bet Dwarka. For example perforated jars, carinated dishes and parts of dish-on stand in sturdy red ware, bowls in red ware and grey ware and high-necked jars in coarse red ware assignable to protohistoric period occur here. Most of the protohistroic pottery of Dvārakā comparable with the pottery of Rangpur IIC-III is described below.

The Red Ware is sturdy with a red core, while the grey ware has a light to deep smoky core. The clay used for the Red Ware is levigated and pots were fired to a high temperature.

Technique

The pottery is mostly wheel-turned. The pots with convex or carinated body are turned on a wheel and after drying to leather hardness the body surface was beaten slowly to close the pores if any, and after applying a slip of red or yellow ochre, the pot was fired in the kiln.

Decorations

The sherds recovered from the seabed and intertidal zone are waverolled and have a pitted surface. They have lost all evidence of surface treatment including painting. But pottery collected from the surface has retained decoration on the shoulder and rim. The designs are horizontal bands and roundels on the bowls executed in black on red or in chocolate colour.

Fabric

Red Ware : The most prominent ceramic type of Dwarka region is a heavy sturdy jar red in colour and made of well levigated clay. It is well fired. Except a few miniature vessels and large storage jars which are handmade all the vessels are wheel-turned, with the majority of them treated with a red ochre slip or wash. At Nageshwar the red ware is represented by the dish-on-stand, perforated jar, convex-bowl, studhandled bowl, basin, storage jar, globular pot, lid, lamp, dish-on-stand and dish having projected rim and sharp carination at the lower part. Jar with a bulbous body and projecting rim and a storage jar with heavy rectangular rim are popular types. They can be favourably compared with the pottery of Rangpur IIA and IIB (Rao: 1962-63). Bowls with incurved or straight-sided rim occur in late Harappan levels at Lothal and BDK.

At Dvārakā and Bet Dvārakā the main types in sturdy Red Ware are jars, bowls, goblets, dish and dish-on-stand. Some jars have a heavy beaded rim while others have a wide mouth. Another type is a jar with splayed-out rim and bulbous body. A high-necked jar also occurs in this ware. Bowls have thick sides and a sharp rim. The occurrence of straight-sided bowls and those with everted or beaded rim is significant as they are assignable to the late level of late Harappan period. A few incurved bowls, carinated dishes and sherds or perforated jars are survivals of the earlier period and so are the chert blades. Basin with beaded or everted rim, flanged shoulder and cylindrical performated jar in Red Ware of Lothal type occur in BDK late Harappan levels, but only in fragments. Goblets with a flat base and thick tapering sides are also present.

Grey Ware : The Grey Ware of Bet Dvārakā occurs in very small quantity. It is also noticed at Rangpur IIB-IIC, Mohenjo-daro and Kalibangan II (Rao : 1985). Its grey colour which occasionally deepens into black is attributed to the use of carbonaceous matter. It may also be due to firing under reducing conditions. The texture of the vessels is homogeneous and the surface is well burnished. The only type in this category is a bowl. But at Nageshwar Grey Ware is represented by convex sided bowl, pedestal base of a pot and a few non-descriptive sherds. The Grey Ware has also been reported from Mohenjod-daro (Mackay : 1953).

Lustrous Red Ware : It carries a thin slip of finely levigated red ochre which is burnished to produce a glittering effect. The burnishing i.e wet smoothening was done when the vessel was leather-hard, with pebbles of haematite which left a powder of iron-oxide sticking to the surface. The main types are (a) the bulbous jar with beaked rim and high bottle-neck (b) the dish with beaded grooved or splayed-out rim and cordoned shoulder and (c) the bowl with splayed-out rim and concave-convex profile. This ware is found in periods IIC and III at Rangpur and period III of Prabhas Patan. Its main forms namely the carinated bowl, dish-on-stand and saucepan-handle, occasionally painted are derived from the Late Harappan form. Other decorative motifs and bowls included loops, hatched diamond, hatched columns and volutes (IAR : 1956-57).

Pottery Description - Fabric, Type and Period

Dwarka : Red Ware (Fig 208,210)

- Jar with a beaded rim and flaring neck. Slipped red, well fired and medium fabric. DWK-3-80
- Jar of a thin and sturdy fabric with a beaded rim, ledged neck, globular body. DWK-3-80 (Compare with RGP-IIA, Type 15).
- 3. Bowl with a nail headed rim, Red wash, well fired and medium fabric. DWK III -

80 (Compare with RGP - 11A)

 Convex-sided bowl of medium size. Red slip. Well fired and medium fabric. DWK-3-80 (Compare with RGP-IIA, Type 49).

Black and Red Ware (Fig. 207)

7. Shallow bowl with a beaded rim and bluntcarinated shoulder. Interior black and exterior lustrous red colour. Illfired and coarse fabric. DWK-3-1980 (Compare with RGP III, Type 117).

Bet Dvārakā

Red Ware (fig 209)

- Thick storage jar with a heavy beaded rim and bulbous body, illfired and coarse fabric. BDK-II-85 (Compare with RGP-III, Type 61).
- Jar with a bulbous body and projected rim, raised neck. Well fired and coarse fabric. BDK-II-85 (Compare with RGP IIA, Type 3)
- Jar with a wide mouth, splayed beaded rim and bulbous body. Well fired and fine fabric. BDK-VI-88 (Compare with Lothal B-Type 237B).
- 4. Jar with a flaring rim, bulbous body. Well fired and fine fabric. BDK-I-85 (Compare with RGP III, Type 133).
- 5. Jar with a raised neck, slightly beaded and undercut rim, grooved interior. Well fired and coarse fabric. BDK-I-88 (Compare with Lothal B, Type 234a).
- High-necked jar with a beaded rim and convex profile, illfired and medium fabric BDK-VI-85 (Compare with RGP-III, Type 71)
- Large thick convex-sided bowl with a sharp rim, grooved exterior, illfired and medium fabric, red slip. BDK-II-85 (compare with RGP IIA, Type 49).
- 8. Bowl with a sharp everted rim, bluntcarinated shoulder, red slip and painted in

chocolate colour with roundels. Well fired and fine fabric. BDK-VIB-87 (Compare with RGP IIC, Type 10 a).

- Bowl with a sharpened rim and convex profile. Well fired and fine fabric. BDK-II-85 (Compare with RGP III, Type 107)
- 10. Bowl with a projected, beaded rim and convex sides well fired and fine fabric. BDK-VIB 87 (Compare with RGP IIB, Type 23 and also with Lothal A, Type 61b)
- Shallow dish with a projected rim and prominent carinated shoulder, illfired and coarse fabric. BDK-II-85 (Compare with RGP IIA, Type 67a and also with Lothal A 42 f).
- Dish of a dish-on-stand, featureless rim, non-carinated shoulder, well fired and fine fabric. BDK-VIB-87 (Compare with RGP IIA, Type 77 and also with Lothal A, Type 43).
- Dish with a projected sharpended rim, blunt-carinated shoulder, well fired and fine fabric. BDK-VI-85 (Compare with RGP IIA, Type 67 a).
- 14. Goblet with a flat base and thick tapering sides, well fired and medium fabric. BDK-II-88 (Compare with RGP IIA, Type 83).

Period II — Amphora from Bet Dwarka

Conclusion

In conclusion, it can be said that the Late Harappan and post-Harappan pottery of Dwarka establishes the existence of a habitation site al least from 18th century BC. The site was contemporary with its neighbouring well known Late Harappan sites such as Nageshwar, Prabhasa and further east at Rangpur. Kusasthali, as Dwarka was referred to in the *Mahābhārata*, can be, therefore dated back to 1700-1600 BC. and it is over this site that Dwarka came to be built in 17th century BC. if not earlier.

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Fig. 211 : The charioteer standing in ekka-type chariot with two X-shaped supports; he holds a whip. Two bullocks are yoked to the chariot.

CHAPTER V

CONTRIBUTION OF DVĀRAKĀ TO THE PROGRESS OF CIVILIZATION

t is true that literature does not give a realistic picture of early historical cities such as Ayodhya, Kapilavastu, Vaisali and, perhaps, Hastinapura, Indraprastha and Dvaraka. Until Harappa and Mohenjo-daro were discovered, western scholars held the view that there were no cities in India until the Achaemenid Greeks entered the country.

Second Urbanization

Even after the well-planned cities of the Indus Civilization were discovered, it was believed that there was no second urbanization before the 6th century B.C. A. Ghosh remarked, in 1973, that hardly anything of Harappan town-planning survived after the decline of Indus cities¹. Although he admitted the devolution of the civilization, he doubted its contribution to later Indian Civilization. The Decipherment of the Indus Script (1982) had not in 1973 been published to convince him of the breakthrough achieved by the present author's decipherment, especially in the light of many other claims for decipherment. But tacitly Ghosh admitted that "the enormous fortification around Kausambi having a circuit of over six and a half kilometres was slightly earlier than the advent of the Northern Black Polished Ware (NBP) as the fortification was extant when the ware first appeared at the site²". The earliest date of NBP is 500 B.C. The author had an opportunity to examine the battered fortification of Kausambi which had a burnt brick veneer (Fig 208) and also the pottery of the earliest habitation wherein the fabric and types of Rangpur IIC period had survived. But the evidence being meagre, no definite conclusion regarding the date of its architecture could be arrived at.

The Mahābhārata lays stress on the fortifications of Dvaraka and describes the city as Vāridurga. The excavations have corroborated the description of the city given in the epic to a large extent. Dvaraka is a dronimukha situated at the meeting point of the river with the sea. Seven sectors of mainland Dvaraka partly corresponding to Ashtapada principle and three sectors in Shankhodhara (Bet Dwarka) are fortified. In Dholavira and Surkotada both dressed and undressed stones were used in the structures. In mainland Dvaraka, however, only dressed stones were used, while in Bet Dwarka both dressed and undressed stones are found in the walls. The dressed stone blocks are, 1 to 2 m in length in bastions, and 0.5 m to 1.75 m in walls, the average thickness being 0.4 to 0.5m and width 0.6 to 0.8 m. The standard size of large fraction stones is 2 m (L) x 0.6 m (B) and 0.3 m (T). Very large ones measure $2.5 \times 0.8 \text{ x}$ 0.4 m. Smaller fraction stones are 0.6 x 0.5 x 0.3 m. The masonry consists of headers and stretchers There is hardly any binding material left in submerged structures. As very few complete houses with walls are found, it is difficult to infer the average size of the houses. From a couple of examples available, it may be assumed that the large houses were 20 m long and 10 m wide, while the smaller ones range from $12 \ge 8$ m to $10 \ge 5$ m. The few pillars found are very thick and well dressed. They are invariably square or rectangular in section. One of the pillars found is tapering at the top.

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Fig. 212 : Rangpur Lustrous red ware and black and red ware of period II comparable to Bet Dväraka pottery

Small boats ferried between the onshore establishments and the harbour where a natural rocky ridge was modified into an anchorage, and its top wavecut bench was utilised for serving as wharf At E1, E2, E6 etc., walls of warehouses have been traced. The onshore enclosures might have housed the office of the shipping superintendent to which a reference is made in the *Arthasāstra*. One of the original channels of Gomati flanked by two rows of buildings enabled small boats to take cargo to large vessels (Fig. 215). The second channel to the south may be of recent origin indicating a shift in the river mouth.

The Enclosures

Enclosure 1 is an L-shaped structure formed as if by joining two enclosures The overall measurments of the Encl 1 are 240 m x 120 m on the west and 120 m x 52 m on the east. Enclosure 2, adjoining Encl 1 is 120 m long,100 + 75 wide. It has two entrances. The entrance on the west lies through Enclosure 1 and the other entry on the south lies through a guard room or the forecourt. There is a large gateway piercing the fort wall of Enclosure 1, where large stone door socket for holding the heavy wooden door jamb of the gate was found in situ. There are three inner enclosures within Enclosure 2. The Inner Enclosure 'A' is 50 x 20 m, Inner Enclosure B is 40 x 20 m and Inner Enclosure C 20 m x 20 m. The guarded entrances to Enclosure 2 suggest that some important offices such as the Port Office, or the office of the Captain and offices of the Shipping Superintendent and Customs Superintendent, referred in the Arthasastra, might have existed here.

Enclosure 3 on the left bank to the south of Enclosure 4 is Enclosure 5 which is still smaller in size.

Extent of Ancient Dvārakā

Ancient Dvārakā on the Gomati was not confined to what has been found submerged in the sea. Its landward extension can be visualised from the eroded debris of Period 1 found in the trenches excavated in the forecourt of the Dwarkadhish Temple, thus accounting for an inhabited area of not less than 1500 m x 600 m. Possibly it might have been much larger below the modern town of Dwarka stands on the mound. The pre-NBP phase of fortification of Kausambi with brick veneering and other features was in the Harappan tradition. As Ghosh was not in favour of conceding pre-NBP urbanization, he doubted the 14 c, date 2035+ 75 B. C. given to the fortification of Eran (Madhya Pradesh) because "it survived from the Chalcolithic into the Early Historical Period (700 B.C.). It must, however, be noted that the Harappan ceramic traditions, and writing, have survived in Late Harappan periods at Lothal, Rangpur, Surkotada, Daimabad and Rojdi and in OCP levels at Bhagawanpura, Banawali and many others. The evolution of Indus script into a simple alphabetic script tending towards the emergence of Brahmi script is now proved by the Bet Dwarka inscriptions. Even the language of the Indus seals is the same as that of the Bet Dvārakā inscription, namely Old Indo Aryan. In any discussion on the survival of Indus townplanning in the Late Harappan and post-Harappan sites like Bet Dvārakā and Dvārakā, the town-planning revealed at Dholavira and Surkotada should be taken into account, because the material mainly used in all these sites is the locally available stone.

At Dholavira and Surkotada the stone fortification walls are still standing. In Bet Dvārakā, portions of fortification are visible in the cliff section, while at Dvārakā they are *in situ* in the seabed upto 2 m height, despite the submergence of the city. As in Dholavira and Surkotada, the highly emphasized element of town-planning in Dvaraka is the fortification with gateways and bastions. Ancient Dvaraka must have extended upto the Bal Bhavan building, where the depression near the ridge seems to be the site of a moat. Its outer edge is marked by the ridge running from the Bus Station towards the High School building. When compared with this large fortified port-town of Dvaraka, the Harappan towns are smaller in size. For example, Dholavira is 800 mx 640 m, Harappa 625 mx 600 m and Surkotada 180 mx 150 m. The bastions in the peripheral walls of Harappa, Mohenjo-daro, Dholavira, Surkotada and Kalibangan are rectangular or square in plan while those of Dvaraka are deliberately built semicircular or circular for diverting the current and withstanding the battering of waves, the severity of which can be visualized from the battering of the Samudranarayana Temple. It would, therefore, be wrong to reject all conventional description of cities given in the Epics, Purānas and Jātakas. There is a substantial core of truth in these accounts. According to Kautilya's Arthaśāstra the real Capital of the Ruler was the Durga equated to a fort by Ghosh who considered it to be much more than a fort (Ghosh, 1976). It was a fortified city with the king's palaces and offices at the centre from which roads radiated in cardinal directions. There were temples too. The Brahmanas, merchants and craftsmen lived in separate sectors. In Bet Dwarka the wealthy merchants seem to have occupied the southern and northern sectors, while the boat builder and the craftsmen such as shell workers lived in the northern sector. Perhaps the central sector was reserved for the ruler and his officers. The 580 m long wall in BDK VIII may be a part of the main durga.

Town-plan of Dvārakā

Some significant features of the idealistic city plan have been traced in the excavation at Dwarka. The *parikha* (moat) can be traced in the depression near Bal Bhavan extending almost upto Gomati. The *prākāras* (ramparts or forts) are brought to light in the offshore excavation. There is a large number of towers (bastions). If the cluster of bastions is taken into account, the number of towers could be at least 30 or 40, if not 44, as noted in the. Dvaraka was laid out in squares or rectangles of six, while Arthasastra and Ashtādhyāyī prescribe that the city should be laid out in squares of four or six. At least 4 entrances in the prākāras of Dvaraka have been traced. There might have been more. In ancient texts, the ramparts were defensive. Ramparts of Bet Dvārakā and Dvārakā were defences against the sea and enemy. The main Enclosures were, perhaps, the antahpura (citadels) described in ancient texts. Dvaraka being a dronimukha, provision was made for warehouse on the water front and they were easily approachable from the sea by ferries (Fig.178).

Bet Dwarka

Kusasthali or Shankhodhara, as Bet Dwarka was known, is defended by the sea and the rocky promontories. The terraces at 15 to 35 m height are wooded and the northern part is covered by sand dunes. Anciently, a large area was available at the foot of the wooded hills for building a township in three sectors. There is evidence of landward and seaward fortifications or ramparts (prākāras) in the southern (BDK I-II) sector over 500 m length. The central sector has a 580 m long but low, wall, while in the northern sector (BDK VI) there are traces of a rampart of massive blocks in the sea. The largest sector was the northern one, where flat land about 1.5 km long (north-south) and 0.5 to 1 km wide (east-west) was originally available for the construction of the town. Apart from the plain land and wave cut benches at the foot of the cliff sections from BDK 1 to BDK VI, the terraces near Neelakanthamahadev Temple and Shankha Talav were also occupied (Fig.179). According to Harivams'a, four Rājamārgas (Royal paths) were ordered to be constructed by Viswakarma. There is also a reference to (Guhyantam Vesmavastuni) a secret passage underground temple in the forecourt of Dwarkadhish connecting the Kuseswaramahadev in the Gate perhaps with the underground cell (Balarama's pitha) within

the main hall of Dwarkadhish. Whether or not it was connected to the underground cellar in Samudranarayana temple is not known. The town planner was asked to lay out the *rājamārgas* following the *prakara* (enclosure wall) and connecting Centres where Agni, Indra and other temples stood. A mansion for Sri Krishna and separate mansions for his consorts were to be constructed. Kṛṣṇa's mansion was to be at the centre from where radiated 4 streets, each presided over by an *Ishṭadevata* (favourite deity). These instructions to Viswakarma, the architectcum-town planner, are followed by a reference to reclamation of land from the sea.

The Harbour of Dvārakā

As early as 2300 B.C., Lothal engineers had built a 240 m long and 13 m wide brick platform adjoining the western wall of the dock to serve as a wharf (Fig.180). A large warehouse of 64 blocks stood closeby on a high platform. Dwaraka engineers used ridge as a wharf. A few pavement stones near the ridge, are still *in situ*. Paved road in one of the Enclosures which served as a warehouse is also indicated by *in situ* dressed stones.

The rocky ridge was suitably cut, dressed and pierced for docking ships in the harbour. The extant height of the ridge, being just 2 m above the ledge of the basal rock, ocean going vessels of more than 2 m draught must have been anchored near the offshore island, while medium size ships were berthed in the nearshore shallow waters at the ridge, from where small boats ferried in the Gomati channel carrying goods and men to and from the ships berthed in the harbour or directly to large vessels in deeper waters. Large spheroid stone bases with a 15 cm wide hole were used for supporting the mast on the ship and the flag post on the shore. In Kanheri caves near Bombay there was an observation post in the 2nd century B.C., as indicated by an inscription. Perhaps beacon fires were lit up at Dwaraka, Bet Dvaraka, Gharapuri (Elephanta) and Kanheri, which were not only places of worship but also watering stations as indicated by wells have been traced recenlty near Nilakantha Mahadev Temple in Bet Dwarka.

For the first time harbour technology of building in the sea was developed by the Dvārakā Engineers. Harbour activity began north of the jetty and Balapur in Bet Dwarka and along a long beach in Dvaraka overlooking the Arabian sea. The existence of an offshore island sheltering the beach is suspected from the rock outcrops seaward of the ridge. Solid ashlar built quay is partly visible in Dwarka. By the 15th century B.C. the natural rock (ridge) was modified to meet the demands of a harbour. The ashlar wall in Bet Dwarka (BDK VI), now submerged in flow tide, might have served as a breakwater. This was also the purpose of building the bastion - studded walls of massive ashlar blocks along the Gomati channel. A large wooden member in situ in the harbour(Fig.179-180-181)may suggest a palisade.

A highly significant contribution of Bet Dwarka to Indian harbour architecture is the rock-cut slipway between the two sites BDK II and BDK-VIII on the eastern shore of the island, which was well sheltered against winds by the hills. The slipways served both as launching pads and repair slips for boats.

Another important contribution made by Dvārakā is the construction of a series of semi circular breakwaters in the form of bastions at close intervals of 10 to 12 metres interconnected by massive stone wall of ashlar masonary. The builders did not depend on any hydraulic mortar but on the weight of huge blocks held together by the L-shaped joints. In the top and bottom stone slabs, wooden wedges were used here 1200 years before the Roman harbour of Cusa (McCann: 1987)was built.

Yet another feature of Dvaraka harbour construction is the rectangular enclosure which might have served as breakwater.

Writing and Language

The Bet Dvārakā inscription is the first concrete evidence which proves that writing was known during the second millennium B.C. and that the citizens of Dvārakā were literate. Its importance lies in the further evolution of Indus script, providing one of the missing links between the Indus and Brahmi scripts. The direction of writing was also changed from left to right. More significant is the introduction of a sign for a palatal (mute) ca as in Brahmi. Other signs for palatals (cha, ja jha and na) must have been included in the script of the epic period. The language of the Mahābhārata text was simple and at the same time fully developed for expressing various concepts. In brief, it can be said that classical Sanskrit had made much headway in the Mahābhārata period. Although the extant manuscripts of the epic are very late in date, the Bet Dwarka inscriptions, in which words such as *baga* (*bhaga*) for God and Mahagaccha (mahakaccha) for sea or sea lord are used, establish convincingly the use of Sanskrit language in the Mahābhārata Age.

It is generally believed that sacred texts were not reduced to writing. Although no palm leaf, papyrus or birch bark (*bhurja patra*) of earlier than 7th century A.D., has survived, the practice of writing in ink, or some kind of paint with a fine brush, must have continued in the second millenium B.C., because in still earlier days the Harappans at Surkotada and Mohenjo-daro or the late Harappans at Daimabad, wrote on pottery with a brush dipped in black or brownish ink³.

Religion and Philosophy

Various religious beliefs and practices ranging from animism to worship of nature Gods and cosmos were flourishing in the Mahābhārata period⁴. Animal sacrifice, fire worship, worship of Indra⁵, Varuna, the Sun God identified with Vishnu, Tantric and Sakti worship, and even black magic prevailed then.

The reference in the epic to statues erected in the *Upavana* of Dvaraka is indicative of the fact that memorials for ancestors were set up. It is then not known if temples were built for worshipping Gods. The word *Bhagavadālaya* used in the epic which conveys the sense of House of the Lord may be the palace of Sri Kṛṣṇa⁶.

In view of the fact that the political and social morality had declined steeply and the code of conduct was not followed by the rulers

it became necessary for Sri Krishna to do away with wicked and sensuous rulers. As a deliverer of the innocent he had to give protection to thousands of forlorn damsels kidnapped by wicked rulers like Naraka. Sri Krishna gave them a social status. He became their husband symbolically in the sense that became their guardian. Even today the Government makes herculean efforts to rescue abducted women. It is no wonder that Sri Krishna took upon himself the duty of rescuing abducted girls. In a philosophic sense all living beings are brides and Lord is the only bridegroom capable of espousing and guiding them (Bhagavadgītā by Swami Chidbhavananda, Sri Ramakrishna Tapavanam Tirupparaitturai 1975).

Astronomy and Mathematics:

As it is already known that these branches of science were well developed during the *Mahābhārata* period, there is no need to repeat it.

War and Peace

The most significant contribution of the *Mahābhārata* is the exemplary code of conduct laid down for the ruler in the conduct of war. Sri Krishna did his best to get justice through peaceful negotiation, but failed.

Moralists argue that one should not emulate Sri Krishna in his relationship with the *Gopis*. This is a statement that stems from an imperfect understanding of his actions and environment. Sri Krishna was just nine years old when he was playing with the *Gopis* of Brindavan. Here no conjugal relationship of the lad with hundreds of women can ever be suspected. The communion of the *Gopis* with Sri Krishna was a divine communion. He taught them not to be body conscious. All the *Gopis* of Vraj joined in the mirth which had no carnality in it.

Society

The decline of ethical standards in political and social behaviour as witnessed in the infanticide practised by king Kamsa, the insulting of women's modesty by the Kaurava princes, the kidnapping of damsels by the autocrat ruler Naraka and the denial of their share of Kingdom to Pandava princes called for drastic remedies. In order to restore *Dharma* (traditional code of conduct) in social and political fields Krishna intervenes effectively by resorting to war when peace efforts were rendered useless by the greed and intransigence of Duryodhana and others.

A readjustment in social life was called for in the institutions of marriage and family and new codes of conducts were being evolved during the Epic period. In the political field

Fig. 213 : Glazed olpin (bottle for cosmetics)



also changes were taking place. Dvārakā was a city-state comprising Sankhodhara (Bet Dvārakā), Dvārakā Aramda Pindara and Nageswar. In the pre - Epic, that is late Harappan period large cities had not sprung up in Aryavarta in the first few centuries of the second millennium B.C. Certain groups of villages developed into market towns and political activity increased slowly. The result was the formation of small republics known as *Janapadas* with *Rajan* as the head of the *Vis*. These



Fig. 214 : Late Harappan bronze miniature chariot from Daimabad

Janapadas of limited political jurisdiction gradually increased their influence over the neighbouring villages and even over other Janapadas to form the Mahajanapadas of which sixteen are mentioned in the Jaina texts and Buddhist Jātakas. Gradually the pre-Mahabharata Age witnessed the evolution of vigorous and complex societies, formation of large kingdoms and emergence of prosperous towns. Science and technology started blooming but ethical standards declined. Political aggrandisement increased resulting in the swallowing of smaller principalities by large kingdoms with a view to form empires as in the case of the Magadhan Empire. There was an urgent need for resuscitating dharma - political, moral and social order - through prompt action by the true warrior class Kshatriyas charged with the duty of protecting the weak and innocent. But even a great warrior like Arjuna who was confused and hesitated to wage a war against the Kaurava princes who had the implicit support of men of character like Bhishma and Dronacharya. The need of the hour was a man of character and high ideals and at the same time very practical, whose words carried conviction with those who could act in the interest of re-establishing dharma. Such a man



Fig. 215 : Perforated vessel incense burner

of forethought, highly spiritual and practical who appeared on the scene was Vāsudeva Krishna and his teachings and actions have stood the test of time even to this day.

Art and Crafts

The skill of the artist and craftsman can be seen from glazed perfume bottle and pottery. (Fig. 209,Fig. 210, Fig. 211)The high quality of artistic production by the seal-cutter of Dwarka is admirable. Even a single seal is sufficient to prove the realism of art in engraving the figures of bull, unicorn and goat on a tiny seal in the hardest material, namely, conch shell. Shellworking was itself an important craft but seal engraving is a shining example of the high attainments of the artist.

The composite animal figure seems to represent the integration of different cultural or religious groups. The bull may represent the agricultural folk. The Unicorn is actually the horse in profile and its horn represents divinity. Agni is compared to horse in the *Rigveda*. The word *aśva* connotes both fire (Agni) and horse. The goat represents the pastoral folk. In the so called Pasupati seal the 3 bull-faced deity wearing a trident headgear is "God Agni, shining and pleasant" (Rao S. R. 1991)⁷.

MARINE ARCHAEOLOGY IN INDIA


CHAPTER VI

DISCOVERY OF POOMPUHAR SUBMERGED IN THE BAY OF BENGAL

averipoompattinam, situated on the east coast of India, variously called Kaveripattinam (Kaveripatnam), Puhar or Poompuhar, was a major port-city of the early Cholas of Tamil Nadu. According to the Sangam text, Silappadi (thi)-kāram¹, Poompuhar covered an area of 4 Kavatham, approximately 30 square upto Tarangambadi miles extending (Tranquebar), which itself was considered by Mortimer Wheeler as the legendary city of Poompuhar², swallowed by the sea. Its boundaries were marked by Karuvendanathapuram and Kadaramkondan on the west, Tiru Kadakur on the south, Kalikamur on the north, and the sea on the east (Fig. 182), encompassing within its territory 30 villages of 60,000 families. Another Tamil text, Manimekhalai,³ says that Poompuhar was submerged in the sea as a sequel to the wrath of Indra, because the inhabitants had failed to celebrate the festival in his honour. The author of the Periplus of the Erythrean Sea refers to the port Kabera (Kaveri).⁴ It is said that Kannagi, the devoted wife of the merchant Kovalan, cursed the Pandyan King of Madurai for beheading her innocent husband. The tragic events leading to the death of Kovalan and the repentance of the Pandyan King form the main story of the epic Manimekhalai. The Kannagi cult is the outcome of this epic. A sculpture of Kannagi at Poompuhar stands as a monument to the unflinching devotion of the lady to her husband.

The submergence of Poompuhar by the sea has evoked interest among archaeologists and oceanographers, who would like to know the cause for submergenee, which may throw light on the maritime activity of the Kalabhras and Early Chola Kings. The rock inscription of Pulankuruchchi in Ramanathapuram district refers to the donor as Kadalaggaperumpadaittalaivan, perhaps the Captain of a large naval force, in the year 192 of Tamil era, founded by the Kalabhra ruler Chandran Kurran.

A project for exploration of the submerged remains of Poompuhar with a view to reconstructing the maritime history of the Tamil country, was sanctioned by the Government of Tamil Nadu in 1990. Even before the project was approved for joint exploration by the Department of Archaeology of Tamil Nadu and the National Institute of Oceanography, Goa, the present author, in charge of the Southern Circle of the Archaeological Survey of India, with the assistance of K.V. Raman (now professor) explored the various segments of the ancient port town of Kaveripatnam, such as Manirgramam, Pallavaneswaram, Vanagiri, Velliyan Iruppu, Kilaiyur and Melaiyur, during the years 1962 to 1965⁵. The onshore excavation at Kilaiyur brought to light an I-shaped brick wharf (Fig. 217) in the ancient channel of the river Kaveri, which is now buried under 2 m thick sediment. The structure has two brick platforms, between which was built a drain for flow of water. Thick wooden posts were provided for anchoring boats or to support a wooden superstructure. The wood sample from the post dated 316 ± 103 B.C. by 14 C method clearly establishes that Poompuhar was a flourishing port almost two centuries before the reign of Early Chola Kings mentioned in Sangam



Fig. 217 : Brick wharf of 3rd Century BC excavated in the Kilaiyur Palaeo channel of Kaveri

literature. The channel of Kaveri was so wide that ships could sail from the sea right into the river without slackening sails. Excavations in the Pallavaneswaram area of ancient Poompuhar have confirmed that it was a Buddhist centre with a large brick-built Vihara of several rooms, datable to 4th-5th century A.D.6. An image of Dhyani Buddha was also found here. Nearby is another brick structure decorated in stucco plaster with floral designs. The Buddha $p\bar{a}da$ (symbolic feet of Buddha)⁶ carved in limestones is another important find from this site. The Chola copper coins with the tiger symbol, beads of semiprecious stones and seal indicate that Poompuhar was a busy port. Excavation in 1965 at Vanagiri, a suburb of Poompuhar, revealed a semi-circular brick structure with an internal diameter of 8 m and connected with Kaveri river through a channel. At another site, known as Manigramam, beads of semi precious stones were found in large numbers. A preliminary geophysical survey of Poompuhar by K.H. Vora7, in 1982, showed certain anomalies which, could not be checked whether they were man-made or natural works

because no diving facilities were available.

Marine Archaeological Expedition, May 1989

At the request of Mr. Srinivasan, Manager of the Tranquebar Branch of the Integrated Fisheries Department, the Marine Archaeology Centre of the National Institute of Oceanography and its Regional Centre at Waltair carried out an offshore survey of Tranquebar in May 1989 to locate a shipwreck which was said to cause obstruction to fishing operations. After obtaining the geophysical survey instruments, the Scientist-in-Charge of the Regional Centre of NIO undertook geophysical survey along with diving operations by marine archaeologists. The trawlers Sona and Koti and a surf-landing motor boat from Visakhapatnam were engaged for offshore operations from 11th May, 19898.

The Department of Culture and The Tamil Development of the Government of Tamil Nadu was kind enough to extend financial assistance for undertaking joint offshore exploration of Poompuhar. The methodology of the proposed



Fig. 218 : Local people help MAC staff to cross high energy zone in a catamaran to reach Mother boat

geophysical underwater exploration of Poompuhar to be undertaken by Marine Archaeologists, Scientists and Technicians of NIO, were specified by Director NIO, Dr. B.N. Desai, in a letter to the Secretary to the Government of Tamil Nadu, Department of Culture, Madras as stated below:

It was proposed to resume survey of suspected archaeological remains in 4-7 m water depth, if the visibility was tolerably good. Otherwise, exploration in deeper waters, where visibility was better, could be taken up.

Ramamurthy and Selvaraj, the staff members of the Tamil Nadu Archaeology Department, were given training by MAC in swimming and diving in the sea. They were also trained in the use of diving gears and the method of search under various conditions. The operation of airlift and the usefulness of magnetometer, side scan sonar and echosounder, were explained at site during the training period.

Attempts to take the diving gears and compressor on a catamaran to *Sona* failed at Vanagiri because of the heavy rolling of the craft and high waves. From 6th March onwards, *Koti* was deployed for tracking the side scan sonar and echosounder in 6 to 7 m water depth from Vanagiri towards Light Houses at 4 knots speed. A sand bar, at 5 m depth, was recorded, besides two rows of objects 1 km seaward of Kaveri mouth. A submerged channel was also noted in 6-7 m depth, seaward of Vanagiri temple. As the sea became calm from 7th March, the divers could land on the beach opposite the Shell Cottages of Poompuhar in a surf-landing vessel (SLV)⁹.

Shipwrecks

With the help of fisherman Muniswami, a shipwreck site was reached. When the spot was tracked on side scan sonar, an object 2-3 m high was seen on starboard side of Sona, at 19 m depth, at 9.50 a.m. It was identified as a shipwreck lying buried in sediment 5 km seaward of two palm tress south of Vanagiri temple, and the site was designated as PMR 1. While tracking, the tow-fish of the side scan sonar got entangled with a rope of the buoy. The alert crew stopped the vessel, and disentangled the tow-fish. The survey of the wreck site was started on the 8th March. Diver Chinni of Vishal Diving Company reported a greenish conical object (Fig. 220) protruding over the debris. Next, Manavi Thakkar and A.S. Gaur, diver-archaeologists, prepared a sketch plan of the objects lying around, including a ladder, an iron strip and two circular objects. It was also confirmed that the wrecked ship lay buried in two parts. The western part was 1 m above the sea bed and the eastern part about 2.5 m above the bed. On the 9th, the marine archaeologists dived on the wreck for 50 minutes each at 19 m depth. The wrecked ship carried a large number of lead ingots, 18 of which were in a row. It appears, after the ship sank, there was not much of a disturbance. Two steel sheets and a cannon were partly traced, but poor visibility prevented photographing the objects. Heavy growth of barnacles and oysters made it very difficult for the divers to reach the surface of the cannon and lead ingots.

While *Koti* was deployed for diving, *Sona* was used for Geophysical survey, simultaneously, 5 km seaward of Vanagiri. T.C.S. Rao reported an object 40 x 10 m in size, with the shape of a ship as recorded on sonograph. The site is designated as PMR 2, and two marker buoys were fixed at the site. The limited time of about 50 minutes that each diver had in a day to dive 20 m depth necessarily slows down the clearance operation, especially because it involves chiselling heavy encrustations. Even with a larger team of 9



OFFSHORE STUDY AREA OF TAMILNADU COAST :



Fig. 220 : PMR I shipwreck-part of radar of the ship

divers, namely Bandodkar, Gudigar, Manavi Thakar, Sila Tripathi and A.S. Gaur of the Marine Archaeology Centre and 4 divers of Vishal Diving Co., besides Y.D. Sharma, a Photographer-trainee of the Archaeological Survey of India, excavation could not be carried on for more than 3 hours daily between 9.30 and 12.30 pm, because visibility was poor and

Fig. 221 : Statue of Kannagi, its plinth is being eroded by the sea



the sea choppy. The sketch plan of PMR 2 indicates an oval-shaped object measuring 30 to 35 m East-West and 10 m North-South. T.C.S. Rao believes that the object was a manmade structure, with an opening on one side.

Sometimes, the fishermen's boats and the sound from their engines gave wrong signals, while side scan sonar survey was being conducted in 9-11, depth from Kaveri mouth to the Light House north of the statue of Kannagi at Poompuhar.

The lead ingots in the shipwreck and site PMR 1 were relieved of sediment cover and photographed *in situ*. For purposes of plotting the visible part of the wreck in seabed, 12 spikes of 2 m length were fixed along the edge of the wreck site for providing the base line and measurements were taken from this base line.

Some black patches were noticed on the sonograph seaward of a white building, north of Kannagi statue; Fig. (221& 222, 223).The diver collected sediment samples, but no structure could be identified. About 300 m seaward of the statue of Kannagi, a submerged channel was recorded on the sonograph on 12th March at 8.5 m depth. Here both Ramamurty and Selvaraj were trained in buddy diving. In an accident on *Koti*, the generator caught fire, which was immediately brought under control. There was no damage to the instruments, nor any injury to the crew.

An indication of structural remains of ancient Poompuhar is provided by brick walls opposite the present Kaveri mouth (Fig. 188) There is also a structure - like object at 25 m depth in the site designated as PMR 2. A few dressed stones were recorded in 8 m depth 300-400 m seaward of the White House. After a clearance operation at shipwreck site (PMR 1) it was found that the conical object projecting over a \overline{U} -shaped metal object was of copper alloy. Two iron pipes were exposed after airlifting the sediment cover¹⁰.

A resurvey of the object at PMR 2 in 23-25 m depth by T.C.S. Rao indicated 3 objects¹¹, the central one being oval-shaped, with an opening on the northern side. Its longer axis is 20 m. There is a clay deposit on the eastern flank,

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Fig. 222 : Brick Structure (BS2) of Medieval period, exposed near Kannagi statue in ebb flow

beyond which a semicircular structure is suspected. To the northwest of the central object, one more oval-shaped object was reported. Gaur, Chinni and Kumar, who dived at the site, reported a horse-shoe shaped object, protruding to a height of 1 to 2 m.

The ancient port city of Poompuhar was not confined to the present mouth of the river Kaveri near Vanagiri. It extended northward upto Kilaiyur, where the brick wharf was found, and southward upto Chinnavanagiri, if not further south upto Tranquebar Fig. (225, 226.) Terracotta ring wells and large storage jars, datable to 1st-5th century A.D. have been found *in situ* in the intertidal zones near Vanagiri and Tranquebar.Offshore survey opposite the present mouth, and further north, resulted in discovering brick structure in 5 to 7 water depth. Only those parts of the structures

Fig. 224 : Brick structures exposed in the sea in ebb flow near present river Kaveri mouth





Fig. 223 : Brick structure (BS1) of Sangam period excavated near Kannagi statue

exposed in low tide could be photographed but not underwater parts owing to poor visibility caused by continuous battering of waves in shallow waters.

There are disintegrated brick structures in the intertidal zone from Pudupet to Vanagiri and remnants of brick and stone structures in 5 to 7 m depth, but they need to be surveyed intensively. The shipwreck in PMR 1 and the large oval shaped structure in deeper waters at PMR 2 are proposed to be carefully excavated soon.

Thirteenth Marine Archaeological Expedition, 1992¹²

The main objective of the expedition was to search for seaward extension of the submerged city of Poompuhar and determine its landward and seaward limits, if possible.

Fig. 225 : Tranquebar trench, early historical structure-2



DISCOVERY OF POOMPUHAR SUBMERGED IN THE BAY OF BENGAL

During the present expedition, the intertidal zone and offshore area between Nayakankuppam in the north and Vanagiri in the south were explored in water depths of 5 to 7 m. The shipwreck was excavated and a stone structure at 23 m depth was identified.

The area was divided into 6 zones and in each zone underwater exploration was carried out.

Zone 1: Buoy No 1 water depth 5-7 m; diving hours 28; number of dives 43.

After a preliminary search, a few dressed stone blocks were located. More intensive diving revealed the outline of a rectangular structure in which four dressed blocks were identified (Fig. 227 & 228). The major part of the structure is buried in sediment. The pottery collected from the site includes the black-and-red ware, red ware and a sherd of amphora. Owing to heavy rolling of pottery is damaged and the shape of the vessels cannot be made out.

Zone 2: Buoy No.2; Water depth 6-7 m; Diving time 30 mts; number of dives 20.

Fig. 226 : Tranquebar - Medieval structure 1 in cliff section





Fig. 227 : Brick structure exposed in sea-bed excavation at buoy at shallow water

In the heaps of shells and coarse grained sand airlifting yielded potsherds and brickbats. No structure *in situ* was discernible.

Zone 3: buoy Nos. 5,6 and 7; Water depth 6-7 m; diving time 12 hrs, No. of dives 20.

Underwater search extended upto 11 m depth north of Poompuhar up to Nayakkankuppam. The area is full of rocks and

Fig. 228 :Brick structure exposed in sea-bed excavation at buoy No. 1, Zone 1



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Fig. 229 : Eroded early historical brick plinths of houses destroyed by sea



Fig. 230 : Eroded plinth of Yellamma temple at Vanagiri

vegetation. Hence shallow water survey in 4 m depth opposite Kilaiyur brick wharf was undertaken and the black-and-red ware as well as grey ware datable to pre-Christian era were

Fig. 231 : Early historical brick paved floor of a house built on rammed earthen platform. Most of the other bricks are washed away by the sea or robbed



recovered. Airlifting in the area yielded brickbats and postsherds Fig. 229, 230, 231.

Offshore exploration opposite Kadaikkadu brought to light some stone blocks in an area 9 x 5 m demarcated by buoys A, B and C. The dressed stone blocks measure 30 x 20 x 5 cm, 65 x 40 x 10 cm and 60 x 30 x 10 cm. Airlifting in a trench in the seabed indicated sandy clay. The pottery consisted of red ware. Part of a bowl in grey ware and a storage jar in Red Ware were found in 1 m depth of sediment. The layer consists of compact clay with coarse sand on top. In the area towards Nayakkankuppan about 300 m seaward, the seabed is sandy. Airlifting up to 70 cm in seabed yielded red ware sherds.

Zone 4: Water depth 1/N 6 to 11 m; diving time 1/N 69 minutes; number of dives 1/N 4.

The seabed is full of rocks and vegetation in 11 m depth. The sediment in 7 m depth is blackish sand. No artefacts were found here.

Zone 5: Water depth 1/N 6 m; diving time 1/N 1 hr and 51 minutes; number of dives 1/N 5. Diving opposite Ilanch Mandapam did not yield any archaeological find in the sticky clay below blackish sand.

Zone 6: Water depth 1/N 6 m; diving time 1/N hrs; No. of dives 1/N 6.

Diving opposite Kannagi statue did not yield any object of archaeological significance.

Shipwreck in PMR 1

Buoy No. 3; Water depth 19 m; Diving time 12 hrs; number of dives 1/N 27.

Detailed measurements of the visible parts of the wreck were taken (Fig 190 to 193). The

Fig. 232 : Visible parts of the ship wreck, PMR-I





Fig. 233 :Lead ingot marked, W. Blackett

length of the wreck is 50 m and breadth 15 m. Wooden planks in the deck about 20 cm wide were partly visible as a result of airlifting. A few loose copper nails and corroded pieces of iron objects were retrieved after airlifting (Fig. 233). Seven lead ingots marked W. Blackett 1791 and 1792 were recovered (Fig. 234).

Structure in PMR2

This U-shaped structure located about 5 km seaward in 23 m depth was measured. Its peripheral length is 85 m and the distance between two arms is 13 m. The extant visible height is 2 m. The central part is covered by sand, but some stone blocks are reported. In the section, a few courses of masonry are suspected. Further excavation is planned in the next fair season.

Ring wells

Among important finds, mention may be made of ring wells (Fig. 195 A&B) excavated in the ancient habitation site at Chinnavanagiri. A potsherd inscribed ma in Brahmi character and datable to 2nd century B.C. is another important antiquity (Fig. 196). The associated ring well can, therefore, be assigned to the same period. Similar types of ring well in other coastal settlements at Vasavasamudram and Arikamedu are however assigned to 2nd century B.C.-4th century A.D. The height of terracotta rings found in ring wells between Chinnavanagiri and Vasavasamudram varies from 16 to 43 cm, but the rings from Poompuhar are 15 to 25 cm in height, The submerged rings could not be photographed because of poor visibility. The associated megalithic Black-and-



Fig. 234 :Lifting lead ingot from shipwreck after excavation of a part of the wreck



Fig. 235 :Terracotta rings of ringwell in IZ near Vanagiri

Fig. 236 : Excavated ring on mud platform, Vanagiri-22



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Fig. 237 :Terracotta ringwell in the intertidal zone, Chinavangiri near Tranquebar on Tamil Nadu Coast



Fig. 238 : Terracotta ringwells buried in sand

Red Ware suggests that this area was occupied in the Sangam period, which is corroborated by an amphora sherd of 2nd century B.C./A.D.

Stone structures at buoys 5, 6 and 7 are similar to the one at buoy No. 1 and datable to

Fig. 239 : Terracotta ringwell in the intertidal zone, Chinnavanagiri



the beginning of this era on ceramic (Black and Red Ware and Grey Ware) evidence.

The brick structures in the high energy zone are reduced to heaps of reddish clay all along the 3 to 8 m water depth. Occasionally, a few bricks and parts of structures buried in sediment have survived. There is greater likelihood of stone structures, if any, surviving in this zone.

The pottery and mud platforms found in the sea near the structures suggests Sangam period buildings destroyed by sea. The rate of coastal erosion is very high here as can be inferred from the damage done to the plinth of Kannagi statue put up recently.

In addition, a few lead roll 166.5 cm in length 19 cm in diameter 3 mm, thick and weighing 420 kg to 418 kg are said to have been found (Letter from Drs. J. Vanden Akker, Alphen and Rign dated 17th January 1995).

During the 1995 expedition to Poompuhar an ingot bearing the symbol of the Dutch crown was recovered. The large opening in the deck of the shipwreck seems to lead to the lower deck or hold. Other important find from wreck are a massive copper radar. Its two arms have no horizontal extensions. The object from Dwarka has not only horizontal extensions but also prevision for fixing brass flats and arches.

Marine Archaeological expedition off Poompuhar 1995¹³

Objectives

The main objectives of the exploration during February, 1995, at Poompuhar were; (1) Underwater exploration in shallow waters adjoining the area of previous explorations; (2) Explorations in deep water especially near U-shaped structure to find out extension of this object; (3) Explorations and excavations of shipwreck which was located in the previous year; (4) Documentation of all the underwater finds with video and still cameras to the extent possible; (5) Tracing out the palaeochannel of river Kaveri north of Poompuhar.

Scope and Quantum of Exploration

To meet the above objectives, diving is an important tool for Marine Archaeological

	Analysis of lead sample by R.R. Nair and G. Prabhaharan (1991, 114)					
S1. No.	Element*	Con.	Remark			
1.	Lead	93 <u>+</u> 1 . 5%	IN %			
2.	Gold	< 10	PPM			
3.	Nickel	< 6	PPM			
4.	Zinc	8± 1	PPM			
5.	Chromium	< 10	PPM			
6.	Cadmium	< 3	PPM			
7.	Copper	130 <u>+</u> 5	PPM			
8.	Antimony	< 20	PPM			
9.	Iron	72 <u>+</u> 5	PPM			

Gold, Nickel, Chromium and Antimony were within detection limits. *Analysed on AAS 5000 Instrument by Flame Technique

Lead Ingots							
	Length	width	Thickness	Weight	Date	Inscription	
Туре 1	92 cm	15.5 cm	70 cm	71 kg	1791	W.BLAĊKETT Letters 6 cm height Danish crown symbol	

It is interesting to learn from J. Van den Akker that similar lead ingots marked W. BLACKETT and dated 1820 were found in a shipwreck in 1994. The details of the ingots are given as under:

No.	Length	Width	Height	Weight
E G 1	60.0 cm	15.5 cm	7.0 cm	46.3 kg
E G 2	92.0 cm	15.5cm	7.0 cm	71. 0kg
E G 5	92.0 cm	15.5cm	7.0cm	69.0kg

exploration. Therefore, it was planned to carry out extensive diving in the area. It was also proposed to deploy Geophysical equipment, including echo sounders side scan sonar, subbottom profiler and a metal detector handled by the diver. Diving requires the use of Surface Demand Diving Equipment (SDDE) and Self Contained Underwater Breathing Apparatus (SCUBA) system. After discovering underwater objects, cleaning, drawing, photography and filming of the objects and environment, which are critical for underwater documentation techniques were planned. In view of the importance of position fixing at sea the miniranger was deployed for offshore position fixing while satellite based Global Position Fixing System (GPS) was used to obtain accurate coordinates of shore markers on land.

Difficulties and Limitations

For a proper appreciation of the exploration carried out at Poompuhar, it is necessary to mention the constraints faced during the survey period.

The wind speed increases in the afternoon generally from 2 pm onwards, forcing the survey party to suspend operations.

Visibility: Because of the roughness of the sea, visibility is reduced in shallow water. This area being very high energy zone with breakers at 4 m water depth, the sediment is churned up and not allowed to settle. This effect reduces the light penetration to the sea bottom, making photography and videography extremely difficult.

Problems of Local Fishermen: Inspite of all the efforts made by the Department of Archaeology and Fisheries of the Tamil Nadu Government, the local fishermen could not be prevented from extensive fishing activity during Geophysical survey and diving. The fishing vessels interfere with the sonar survey. Secondly, the fishermen removed the buoys placed by the divers, with the result that the whole search process for locating objects had to be repeated the next day.

Description of the survey area

Poompuhar, in Nagai Quaid-e-Milleth district of Tamil Nadu state (11° 08' 33" N and 79° 51' 31" E.), is situated on the east cost of India. The onshore and offshore exploration area extended from Vanagiri to Nayakkankuppam, about 7 km along the cost and about 5 km towards the sea.

Two rivers join the sea in this area, namely Kaveri, south of Poompuhar and Palayar, north of Poompuhar. Apart from these rivers, a few nullahs discharge into the sea to the north of Poompuhar.

Survey Vessel and Equipment Boats

Sona, a wooden hulled boat (regd. No. KKD 1799), was chartered for Marine Archaeological Explorations off Poompuhar, from 19th January to 11th march, 1995. The vessel had good working space at the aft, especially suitable for diving, keeping diving equipment, and for operating heavy compressor of 90 CFM for airlift. There was also the facility of a good cabin, which was used for keeping the T.V. monitor. The vessel also had a marine compass and a few life jackets. Dimensions of the vessel are as follows:

Length (Overall) : 15 m.

Breadth : 4.5 m.

Drought : 2 m.

R.K. KATADI : A wooden-hulled boat was chartered for geophysical survey (Regd. no. KKD-399) for Marine Archaeological survey from 19th February to 7th March,1995. The vessel had good working space at the aft, especially suitable for keeping Geophysical equipment. The cabin could accomodate Side scan sonar, Echo-sounder recorder and other

Fig. 240 : The vessel with a facility of good cabin for keeping T.V. monitor etc.



DISCOVERY OF POOMPUHAR SUBMERGED IN THE BAY OF BENGAL



Fig. 241 : Fishing trawler used for marine archaeological survey in deep water at PMR



Fig. 242 : Another boat used for archaeological survey

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Fig. 243 : Tranquebar-91



Fig. 244 : Wooden boat used for survey instruments. Marine compass and a few life jackets were also available in the boat.

Equipment

The use of Niconos underwater camera, Osprey underwater T.V. camera, Precession shallow water magnetometer, SCUBA and SODE, has been described earlier

Metal Detector: light 8 x hand-held metal detector, used for marine archaeological explorations, has a watertight sealed chamber. Rechargable 14 volt battery can be used which will last for four hours upto a depth of 60 m. It can detect any kind of metal ranging from 9 inches to 3 feet.

Echosounder

Simrad EY Echosounder was used for bathymetry study of the present survey area. This unit consists of a battery operated (12V) graphic recorder and a transducer. The Simrad EY recorder is of the belt type with reversible paper cassette, designed on the dry echogram paper type TP6 which has a length of 20 m and width of 154 mm. The operating frequency for this unit is 70 KHZ, with a pulse duration of 0.5 millisecond. This recorder has different range selections upto maximum range of 240-360 m. For this particular survey, minimum range of 0-060 m was selected for good resolution. Each graduation in the range is equal to 2 m.

This unit is designed for operation with a circular, ceramic transducer with an operating angle of 27°. Transducer is installed horizontally by fixing it to the side of the boat with a 'L' shaped tube. The transducer element is made of a ceramic material having the property of converting electrical energy into half two-way travel time from the seabed into depth.

Side Scan Sonar

The system comprises Image processing side scan recorder (model 260), tow fish (model 272) and interconnecting cable. The transducers are fixed on either side of the tow fish, which can scan from 25 to 500 m on both the sides of the survey track depending on the water depth and range used. The system being microprocessorised, it corrects automatically for speed and slant range. The system essentially provides a plan view of the sea-floor. The topographical and lithological variation on the seabed are recorded on sonograph in the form of tonal variation.

Global Positioning System

Global Positioning System (GPS) Model JLR 4400 has been used in the survey to obtain the positions of objects, vessel, etc. This is a stellite based radio navigator system designed to provide global position data for navigation. The JLR 4400 receives five satellite signals at a time. From among these satellite signals it selects three or four with the best reception and provides the data of position (Latitude, Longitude, Altitude) and travelling speed and course. This portable system operates on 10-16V D.C. Power supply.

Shallow Seismic Profiler

To obtain the sub bottom data in the present area, the high resolution continuous seismic profiler (EG & G Sparker Unit of 3.5 khz) was utilised. The system includes model 232-A Power Supply, Model 265 trigger capacitor bank, Model 267-A spark array of 3 elements, Model 265 Hydrophone and Model 4603 E.P.C.graphic recorder. The basic principle of the system is to initiate a pulse of sound at a source point and to determine at the other point close to the source, the time interval between initiation of the pulse and the reception of the sound wavelets which have been reflected from discontinuities in the transmitting media, water, sediment and rock.

Methodology Geophysical Exploration

Offshore exploration of Poompuhar involved both geophysical and manual survey. Geophysical explorations carried out with the help of echo sounder, side scan sonar and subbottom profiler, located a couple of sites in shallow as well as in deeper waters.

Diving Operations

The diving operations at the located site were gradually extended to the adjoining areas. Each diving team roughly covered a circle of about 50 m radius in a circular search pattern. Two places were selected for diving in shallow water where depth varied from 5 to 8 m. Subsequently, the airlifting work was also undertaken to expose objects buried in sediments. In deeper water, three places, namely a shipwreck, horse-shoe shaped structure, and two small structures in 19 m and 23 m water depth were selected for diving.

Position Fixing

Global position fixing The Global Positionfixing System (GPS) consists of 18 satellites in orbit launched by USA. A receiver, with computer, issued to collect, process and compute the positions at any given point around the earth. The position of the receiver is determined by the four pseudo range received from four satellites. This will procure a three dimensional fix as Latitude, Longitude and height, apart from the position of the base. The positions of some selected objects/features. like the ring wells off Vanagiri and structure found in intertidal zone near Kannagi Status and Kilayur Wharf, were determined using GPS. Some additional reference points North and South of Poompuhar were determined for future use, if any.

Result

The findings of offshore explorations, using results of side scan sonar survey at Poompuhar, have been described below separately.

Geophysical Survey

Site 1 Small Objects of about one meter relief and 7-10 m in diameter, separated from each other by about 18 m, lie in NW direction of the big "oval" shaped object at a distance of nearly 35 m (fig. 245). When the sonar was run between the small objects of the "oval shaped" object along E-W direction, the alignment of the "oval shaped" object with the small objects has more or less N-S trend (Fig. 246). On the basic of the records, about 40 m northward of the small object, there exists a seabed scour feature (Fig. 247). The nature of this feature indicates that it could be the debris of some objects that got eroded or disturbed. Alternately, the scouring of the seabed occurred owing to high current activity. The longer axis (N-S) of the "oval" shaped object is about 30 m and the shorter axis (E-W) of the same object is about 18 m in length (Fig. 248). The peak height of the oval shaped object in general



Fig. 245 : The big oval-shaped stone structure-PMR2

varies from 2 to 2.5 m. The southern part of the objects is comparatively higher than the northern part. The seafloor in the central part of this object appears to be covered with sand. One dark spot within this object indicates that it could be a remnant of structure. The overall appearance and nature of structure and available lithological information obtained from the structure suggest that this could be a man-

Fig. 246 : A small structure near oval-shaped structure-PMR2





Fig. 247 : Scour feature on the oval shaped large structure-PMR2

made structure. The seabed depth around this object varies from 21 to 21.5 m.

Site 2

Side scan sonar surveys carried out about 1.5 km South-East of site 1 at about 22 to 23 m depth recorded an isolated object. Bathymetric record of this feature indicates about 3 m height. The diameter of the object in general is about 15-18 m. Unlike the objects in site 1, intermittent breaks in the overall shape of this object is more or less similar to the pattern of the object at site 1, but smaller in dimension because of erosion or submergence under sand cover.

Shipwreck

Sonograph obtained at the ship wreck site indicate two exposures separated by a few metres. Probably, the sinking ship must have broken into two pieces. The bathymetric records indicate that it exists at a depth of about 17.25

Fig. 248 : Scouring effect perhaps due to high current activity-PMR2



m. The overall height of the ship over the seabed is about 1.5 m.

Shallow Seismic and Bathymetric Survey

To obtain some sub surface information in the study area, shallow seismic survey lines in N-S direction following the longitude were carried out starting from 79° 51.5' to 79° 54.5'. Besides shallow seismic, the echosounding was also carried out to obtain the seabed morphology. According to the bathymetric contouring, it is observed that the southern part of the survey area appears to be of lower gradient, when compared to the northern part. The shallow seismic records' suggest that the sub surface of the study area is, more or less, uniform, except at some places where the buried channel appears (Fig. 225A). It is observed from the plottings that the buried channel is trending in NE-SW direction between the two objects (site 1 and 2) recorded in the sonograph. The lowermost reflection (central part of the channel) from the seabed in the records shows about 20 cm, below the sea bed (Fig. 6). The channel width, in general, is about 300 to 500 m. The buried channel noticed from the records and the existing Cauvery river on land may be related to each other. The width and the direction of the buried channel obtained from the records indicate that the original Cauvery river courses might have been in NE-SW direction, while the existing Cauvery river may be the tributary of the then Cauvery river. However, it needs some more profiling work for confirmation.

Underwater Exploration

Zone No. 1 Water depth: 5 to 7 m., Total diving hours : 7 ., No. of dives : 9

Observation In the areas adjoining the previous explorations, diving operation was undertaken. A few dressed stone blocks were located. One of them measured 90 x 40 x 15 cm. It is semicircular in shape with a L-shape cut on its surface. There are several other blocks of irregular shape in sand stone. The area is covered with fine black sand. Airlift operations in this area revealed the following stratigraphy:

Layer 1 This is about 10-20 cm in thickness with fine black sand in which a few marine organisms are also seen.

Layer 2 consists of sticky black clay 20-30 cm thick

Layer 3 consists of very compact yellow clay and a few potsherds. The thickness of this layer is 15-20 cm. A few patches of this type of clay also appear in the intertidal zone of Poompuhar and in neighbouring areas.

Layer 4 consists of white coarse sand. There are some stone blocks and a few potsherds in this layer.

Zone No. 2 Water depth: 22-24 m, Total diving hours: 19 hrs. 26 minutes, No. of dives : 48

In this zone, geophysical surveys revealed three objects which were manually examined by the diver-archaeologists and confirmed as structures, description of which is given below.

Structure No. 1 This structure was located at a water depth of 23 m which is about 5 km off the shore. It is semi-circular in shape. The total peripheral length of the object is 140 m. The object is hollow at the centre. The height of the object on the outer edge is 3 m, while, on the inner side, the maximum height is 1 m. The height of eastern arm is greater than that of the western arm, the width of the arm varying from 3 to 6 m. The centre of the object is covered with sediments, but hand fanning showed that the central part is rocky at a depth of 10 to 15 cm. On the northern side of the object, an open space with a few rounded stones was found.

Divers observed growth of thick marine organisms like oyster shells and gargorian on the structure, but in the section some courses of masonry are visible. Airlift operations in the southern side of the object showed a few rectangular and square blocks. Rock and sediment samples have been collected for analysis.

Structure No. 2 and No. 3 About 40 m. north of structure no. 1, two smaller objects of same stone were found lying in east-west direction. The distance between these objects is 10 m. The circumference of each object is not more than 15 m and the height is about 2 m. There are a number of wide cracks in the objects. A few dressed stone blocks 2 m in length, 1.5 m in breadth and 1 m in height, are lying near the smaller objects which measure 100 x 60 x 20 cm.

Ship Wreck Water depth : 19 m., Total diving hours : 12 hrs. No. of divers : 27

In this zone, one shipwreck was located during the last expedition and the same was relocated in this season with the help of the echosounder and side scan sonar at a water depth of 19 m. Diver-archaeologists used the metal detectors to trace the buried extension of the shipwreck. The search confirmed that about 75% of the ship is buried in the sediment. The total length of the wreck which lies northeast-southwest, is about 100 m, its breadth being 25-30 m. and height about 3 m, perhaps, more. It is a wooden hulled ship, the bottom of which is plated with copper sheets. Two round holes were noticed in the ship deck. Airlift operation inside the hole brought out ashy sand and revealed a few stone blocks, that had fallen from the deck.

A number of lead ingots were found in the wreck. Among them 4 types were noticed. Type 1; Long oval shaped ingot: inscription W: BLACKETT and date 1792 on one surface and symbol of VOC, on the other. Type 2: Oval shaped ingot flat with the inscription mentioned in type 1 above

Type 3: Long oval shaped ingot punched with a crown symbol below which the alphabet 'D' occurs.

Type[•] 4: Rectangular ingot without any inscription or symbol on the obverse while the reverse has the VOC symbol.

Discussion

During the previous expedition and the one under discussion, ring wells were noticed in the intertidal zone of the excavated area near Chinnavanagiri, where habitational site is also preserved. On the basis of associated pottery the ring well can be dated to 2nd century BC. On one of the potsherds the Brahmi sign for 'Ma' is inscribed. On palaeographic grounds it is assignable to 2nd century B.C.

Underwater exploration in Area 1 revealed a few dressed stone blocks including one which is semicircular in shape.

For the first time a well dressed stone block was noticed as part of a structure in shallow water. Along with it a number of eroded blocks also occur. It is however, not clear whether stone was used for habitational or any other kind of building, Sangam literature refers to brick buildings. Airlift operation indicated that a habitational site was buried at least 1 m under sediment. The ceramic ware found in shallow water to the north of Kaveri mouth suggests that it belongs to the early Christian era.

In the Bay of Bengal, the high energy zone extends upto a depth of 8-9m, as it is very much disturbed by high waves, currents and tides. It is very difficult to presume that some structures, particularly of bricks, which were mostly used in Sangam Period, would have survived intact in the high energy zone. It is only the stone structures which are likely to provide a clue to understand the plans of the buildings.

As far as deep water structures are concerned, there are several views about the purpose they might have served.

The local fishermen consider the big oval shaped structure as a temple. T.C.S. Rao also agrees with the view.

According to him the bigger object which is hollow at the centre is the main temple with a garbhagriha and the two smaller objects, which are situated north of the bigger objects may be the front pillars of the temple. The outer edges of both the objects are in the same alignment. Although apsidal rock - cut temples of Mahendravarman period are known at Mahabalipuram, it is too early to say that an apsidal temple of stone existed here.

Another view is that it may be a Buddhist structure. In Sangam period, Buddhist structures were built of stone, while other structures were mostly made of bricks. Scholars of Tamil literature refer to a vihara at the mouth of river Kaveri. This view has relevance, because the palaeochannel of river Kaveri is in the direction of the two structures. According to TCS Rau, sub-bottom profiler indicated the width of the buried channel to be 300 m. to 500 m. And presently it is buried 20 m below the sea bottom. Remote Sensing studies also suggest that palaeochannel of Kaveri was to the north of present Poompuhar village. If the big structure in 20 m depth was a Vihara it might have been built for monks visiting from Southeast Asian countries.

Submergence of the structures discovered in

exploration has raised a number of issues:

- 1. In 2000 years, has the sea level risen about 25 m ?
- 2. Is this due to tectonic activity or coastal erosion ?
- Are the above factors responsible for the submergence of these structures as suggested by the project coordinator Dr. B.U. Nayak

One other important discovery is the shipwreck. Exploration by metal detector suggested that about 75% of the ship is buried beneath the sediment. Airlift operation suggested that the ship was wooden hulled, with copper sheets used for bottom plating. A few more lead ingots retrieved, which are of a different shape. They bear the crown symbol below which is alphabet 'D'. This kind of symbol suggests that the ship belonged to the Dutch empire. In terms of local tradition, Mr. Thyagrajan, a school teacher, says that there was a naval war between the French and the Dutch in 1792-93 and a Dutch ship was sunk here. Perhaps, this was a cargo ship; but one cannon and a few gun powder boxes suggest that this ship was possibly used in naval war. A large copper object was recovered from the ship

The rate of coastal erosion appears to be very high here for example, in 1990, the Kannagi statue was about 50 m away from the sea, but now, during high tide, waves are battering its[±] foundation, and have destroyed the plinth.

Conclusion

Offshore explorations were carried out at Poompuhar mainly to demarcate the submerged structures in shallow waters and to explore the structure in deeper waters. Most of the stone structures and antiquities in shallow waters are buried in sediment.

Shallow water explorations confirm that stones were used in the construction of buildings. A few dressed stone blocks, semicircular in shape, were found north of Kaveri mouth. The measurement of this block is 90 x 40 X 15 cm. A large number of eroded sand stone blocks are also found in that area. Ceramic blocks evidence and structure suggest that the latter belong to the Sangam period. Explorations also confirm that habitation extended further north of river Kaveri. For the first time, it is confirmed that the Ushaped structure and two other small structures are man-made. Perhaps, this is a Buddhist structure. It explains the extension of the ancient Poompuhar 5 km offshore of present village Kadaikudu. The submergence of this structure has created interest among the scientists of a possible rise of sea level in the east coast.

Shipwreck explorations have provided valuable information on the nationality (origin) of the ship and the cause for its wreck.

Some Suggestions

Further exploration in shallow waters towards the north and south of river Kaveri is needed as present explorations confirm that there was building activity during Sangam period in this area. Systematic airlift operation in a grid, bringing the sediment on board, sieving it to collect antiquities, will expose buried structures and also yield datable antiquities.

Exploration in water depth of 10 m to 20 m is needed in the line of structure upto water depth of 23 m, which will indicate a continuation of the habitation, if any. It is suggested that the future work should include mapping on a large scale of coast line from Nayakarkuppam to Tranquebar. This will provide a picture of the extent of shoreline migration. Seasonal shoreline variation can best be studied in PMR Zone. If an old map with proper coastline is available then it will be possible to quantify the migration of shoreline.

Based on the experience gained so far, it can be suggested that a regular seafloor survey with side scan sonar, echo sounder and subbottom profiler will provide useful information for selecting the site for intensive survey in a strip from Nayakkankuppam to Vanagiri at water depth varying from 4 to 9 m. The survey should be supported by a proper real time position fixing system.

Visual inspection and exploration can be carried out by diving in the adjoining area, where pottery was collected in the present field season. It may also be necessary to organize dives in a regular grid pattern at every 50/100 m to mark clearly the extent of the site. While the airlift operation may help in exploring the bed in a vertical section, the deployment of Aquazepp will facilitates survey of large area.

A thorough study of stone blocks, pottery and other antiquities collected from PMR-TQR area along with, similar material collected from sites on land for comparison is undertaken for arriving at the cultural sequence and chronology. This is the main source available to judge the importance of the antiquities collected and finally confirm the - tentative town plan and chronology prepared on the basis of the present operation.

Fishing activity in the area during survey period should be restricted to the late afternoon, that is after 2 pm., failing which the free movement of survey vessel will not be possible. The removing of marker buoys by fishermen for petty gains, like rope of the buoys, causes severe setback to the progress of the survey, as efforts are to be renewed for relocating the position.

Pottery Description¹⁴ Introduction

Poompuhar (Lat. 11º 08' 33" N and long. 79° 51' 31" E), the celebrated port city of the Early Cholas, is now an inconspicuous fisherman's hamlet in Nagai Quaid-e-Milleth destrict of Tamil Nadu, where the river Kaveri joins the sea. Sangam texts such as Ahananaru and Purannaru, and later ones like silappadikaram, Manimekhalai and Pattinappalai, vividly describe Poompuhar as a flourishing port city. Sangam literature refers to this city as Mudur (Mudu meaning ancient and Ur meaning village). Various names like Pukar, Kakandi, Pattinam, Purandai, Puraiyam, Sambapathi, Mannakathu, Vanmathi, Cholapattinam and Mudur (Nagarajan: 1993. 9), which the city bore denotes its metropolitan character. Ptolemy refers to the city as the *Kaberis* Emporium.

Manimekhalai, a text of late Sangam period, records that Poompuhar was swallowed and destroyed by the sea, because of God Indra's wrath, when the inhabitants of the city, during the time of the Chola King Ilam Killi, failed to celebrate a festival in honour of the deity.

The art of pottery-making is referred to in ancient Tamil works like *Silappadikaram* and *Manimekhalai*. The potters were known as *Vetko* (Vasanthi : 1992).

The onshore explorations and excavations

conducted by the Archaeological Survey of India from 1962 to 1973 have clearly established that the ancient city had not been fully engulfed, At least a few portions are still lying buried on land. The exploration by Marine Archaeology Centre of National Institute of Oceanography, Goa, in the intertidal zone revealed the vestiges of ancient habitations like ring wells, pottery and brick-bats strewn all over the place, particularly opposite Nayakankuppam. The ringwells in the intertidal zone are covered by sand. Offshore explorations by the National Institute of Oceanography in 1981 have suggested some objects at water depth of 5 to 10 m (Vora : 1987), but it is the underwater excavation by MAC which throws light on the submerged part of the city.

The pottery referred to here was found during the offshore exploration in 1993. Generally, the pottery of this region is made of clay which produces a rough surface. When submerged in sea for a long time, the slip and wash on pottery surface are lost due to rolling and salt action. Sometimes, pottery is not even fired properly, as can be inferred from the grey to red colour of the core. The pottery under study was from the seabed in 50 to 100 cm section in two zones, one opposite the present Kaveri mouth (zone 2 as marked by Marine Archaeology Centre) and another opposite Kilayur wharf (zone 3) at a water depth of 5 m to 7 m.

Pottery comprises black and-red ware, dull red ware, associated ware of rouletted ware and a piece of amphora. It is difficult to recognise their original shapes, as they are fragmentary and heavily rolled.

Black-and-Red Ware This is one of the most prominent wares of South India from the beginning of the Iron Age. The ware has been obtained from numerous megalithic sites, urn burial sites and iron age settlements (Gurumurthi: 1981 p. 232). Its clay is well levigated. The shapes include jars, carinated bowls and small pots. The vessel is mostly wheelturned. However, handmade pottery is also reported in medium to fine fabric.

Grey Ware This ware is represented by a single sherd of a jar and is rare at Arikamedu and Kanchipuram too. It is suggested by the excavators that this pottery was imported from the west (Gurumurthi: 1981). It is of medium thickness and tempering materials have been used moderately.

Black Ware This ware is of well levigated clay and of medium thickness. It is represented by a deep bowl in Poompuhar.

Red Ware It is made of thick grained clay, consisting of large quantities of sand particles. Generally, the vessels do not bear any slip or polish. They are ill-fired, hence fragile. Storage jars and cooking vessels are prominent shapes in this ware.

Pottery Types

- 1. Jar with a flat rim projected externally, short and narrow neck. Surface treatment of slip lost due to water action, medium fabric and ill fired. Zone No. 3
- 2. Jar with short neck and bulbous body. Flat topped rim, smoky section well fired and medium fabric. heavily rolled. Grey Ware:
- 3. Jar with splayed out rim and bulbous body. Heavily rolled, smoky section. Medium fabric and ill fired.
- 4. Body part of a big jar, heavily rolled and pale reddish surface. Ill fired and medium fabric.
- 5. Dish of a red slipped ware with an inward projected rim, coarse fabric and treated with red slip both internally and externally. Compare with type 48 of Vasavasamudram and type 2 of Arikamedu, an early historic port near Pondicherry.
- 6. Dish with sharpened incurved rim and sagger base.
- Basin of a red ware with clubbed rim and slightly concave sides. Medium fabric, ill fired. Compare with Vasavasamudram type 32 and type 84 of Arikamedu.
- 8. Body part of a carinated *handi* or a small jar, heavily rolled, thin section. The surface appears to be the pinkish in colour, fine fabric and well fired.
- 9. Flat base of a bowl, heavily rolled and smoky section. Medium fabric and ill fired. Black ware.
- Body part of a carinated vessel. Heavily rolled and surface is treated with red slip. Medium fabric and ill fired.
- Shoulder part of a bowl, with a groove on the exterior. Greyish in section. It is a variant of black-and-red ware, heavily rolled, porous surface, well fired nd medium fabric.

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- 12. Body part of a bowl, heavily rolled, pinkish surface and greyish section. A thin layer of red slip is visible in the section. It also appears to be like a variety of Rouletted Ware, well fired and fine fabric.
- 13. Body part of a bowl, heavily rolled, interior grey and exterior pinkish in colour. A groove on the shoulder portion, well fired and fine fabric.
- 14. Part of a belly of a jar of thin section. heavily rolled, pale reddish in colour on the exterior and greyish on the interior. Corrugated profile. Pitted surface due to wave action, ill fired. Medium fabric.
- 15. Body part of a jar, heavily rolled, ill fired and fine fabric.
- 16. Body part of a bowl, interior black and a reddish exterior. Ill fired and medium fabric.
- Body part of an amphora ware. Corrugatedprofile and heavily rolled. Barnacles growth notice.

Conclusion The enormous coastal erosion, swell and current in the sea bury small objects in the sea bed and make survival of perishable

objects difficult. Pottery, however, survives in the sea and can be relied upon for dating associated brick structures submerged in the sea at 5 to 7 m water depth in Poompuhar region. For instance the Black-and-Red Ware has been firmly dated in megalithic and iron using sites on land. Identical ware with identical shapes, occurs in the sea bed. The date of Black-and-Red Ware corroborated by 14c date of the wood samples from the brick structure of Kilaiyur, a suburb of Poompuhar. So far as the structure of the first few centuries of Christian era are concerned, another dated ceramic ware, namely, the amphora of Roman origin, is also found. In Arikamedu, even the name of the factory where it was produced was stamped on amphora. The date of such factories is well known. Thus, ceramic evidence for dating onshore and submerged buildings and associated artefacts of Poompuhar is very important. It is now possible to say that the brick structures of 5 to 7 m depth are datable to 3rd to 4th century B.C., and the ring wells etc., of intertidal zones are of the first four centuries of the Christian era.



CHAPTER VII

ARCHAEOLOGY OF SHIPS

he earliest reference to Indian ships that sailed into the open sea and capsized is found in the *Rigveda*¹. The men on Bhujyu's ship are said to have been saved by Asvina. This episode should not be dismissed as a myth, for we know that Harappan ships used to visit Bahrain and Sumerian ports in 2800 B.C. It is likely that some got lost in cyclones. The Harappans had multi-oared galleys, one of which is painted in outline on a potsherd from Lothal². The epic Mahābhārata describes the navy as a wing of Sahadev's military force. According to R.C. Mukerji, Ashoka must have had armed ships for conquering the Kalingas who were a great naval power³. Samudragupta is said to have subjugated the islands adjoining the Pallava kingdom of the south (320-280 A.D.)⁴. Piracy may also account for loss of ships, the earliest mention of which is made in the Periplus (50 A.D.) and Ptolemy's Geography (150 A.D.) referred to by McCrindle in 1889. According to him Ariaka (Konkan coast) was a land of pirates. The Satavahanas must have had a fleet of ships, but there is no reference to the loss of ships anywhere, though they must have lost ships in naval battles. Later when Mauryas and Nalas ruled Konkan, the Chalukyan ruler Kirtivarman claimed with pride that his general Chandananda made the enemy meet its watery grave⁵. Pulakesin II (609 A.D) conquered the Mauryan capital Puri (Gharapuri) that is Elephanta Island off Bombay, which is described as the Goddess of the Fortunes of Oceans in the Aihole Praśanti (Ritti S.H. 1988). He is said to

have besieged the island with a hundred ships. The stone inscription at Vada in Thana district⁶ cites a Mauryan King Suketuvarma as the ruler of Konkan. The copper plate grants of Vinayaditya and those of his successors ascribe to him the conquest of Parasika, Simhala and Kamera. S. Nagaraju identifies Kamera with Khmer in Kampuchea⁷. The next reference is to a naval battle in which the King of Sind Pushyadeva crushed the Arab invasion by sea in 756 A.D. A subsequent Arab invasion by sea, 20 years later, was also crushed by the King of Sind. In the course of extensive trade between India and the Roman Empire in the first few centuries of this era some ships must have been lost in the Indian waters. During the Pallava rule in the south, Simhavishnu's successful naval expedition in 600 A.D. against Ceylon and a subsequent naval expedition by Narasimhavarman (630-668 A.D.) to support Manavarma, who occupied the Island, are clear indications of naval battles. Narasimhavarman had built a naval base at Mamallapuram now known as Mahabalipuram.

The Chola Kings, Raja Raja the Great (985-1014 A.D.) and Rajendra Chola (1012-1044 A.D.), who had to contend not only with the Pałłavas but also with the island countries⁸ built large fleets. Raja Raja annexed the Lakshadveep and Maldive islands and occupied the northern part of Lanka. Rajendra Chola annexed the whole of Lanka and also established a naval base in Andaman and Nicobar islands. The Barobudur reliefs depict outriggered Indian ships. S. Nagaraju has thrown new light on a naval warfare by Krishna III the famous Rashtrakuta Ruler of Malkhed (the ancient Manyakheta) in Gulbarga district of Karnataka⁹. The Sinhalese work Chulavamśa says that Vallabha, that is the Rashtrakuta king, sent army to Nagadvipa, i.e. northern Ceylon to conquer that country. The Chalukyas and Rashtrakutas used their west coast ports for naval expeditions to Lanka and Kampuchea. The Prakrit Champu Kuvalayamāla (770 A.D.) refers to the adventures of Kuvalayachandra, who married Kuvalayamala of Vijayapuri, a port with an impregnable fort, situated on the sea shore. It is further described that its southern wall was washed away by the sea waves. Prof. U.N Upadhyaya has identified Vijayapuri with Vijayadurga in Ratnagiri district, which was a safe haven for ships sailing on the west coast. This Epic Kuvalayamala mentions the sinking of a ship of the merchant Sagaradatta, who sailed to Yavanadvipa (Java) in search of fortune. On his way back, after reaching a lonely island, he met a lovely girl who was about to commit suicide. The Buddhist Jātakas and Jaina texts refer to sea voyage and shipwrecks, but the site of wreck is hardly mentioned¹⁰.

Hindu Kingdoms in Southeast Asia

The diffusion of Hindu Culture, literature and art in Southeast Asia was a peaceful process. Naval establishments came up after the establishment of Hindu Kingdoms. The Empire of Sri Vijaya, datable to the period 4th to 8th century A.D., was based in Sumatra, and the Sailendra Empire of 8th to 13th century A.D. was based in Java¹¹. Both were great naval powers. Sailendra kings, who had powerful navies, fought against Champa and Kamboja to conquer Lanka. K.N. Panikkar obsrves, "The expedition involving a combined action of many thousand soldiers and hundreds of ships across the Bay of Bengal constituted the last Chapter in Hindu Oceanic supremacy"12. Subsequently, the Chola and Pandyan kings had a number of naval engagements.

After the establishment of Muslim rule in India, the navy was neglected. The seaborne trade became the monopoly of Arabs until it was snatched away by the Portuguese in the 16th century. The small fleets of coastal kingdoms, such as those of Zamorin (*Ssmudrin* meaning 'the Lord of the seas') in Calicut, could not meet the challenge of the numerically and technically superior navy of Vasco-da-Gama in 1498 at Calicut.

At this stage, it is necessary to refer to the cause for the failure of Zamorin's ships to meet the challenge of the Portugueses ships. Sanjeeva Rao observes, "The heavy ships (of Zamorin's navy) consisted of Sambuks and there were any number of light ships. The Sambuks were comparatively smaller in size than the Portuguese Caravels. Although they had the advantage of speed, the ships had no guns mounted on them and the practice came to be adopted only later by Zamorin emulating the Portuguese. Even then the firing power of the Indian ships was inferior to that of the Portuguese. The light ships of Zamorin could harass the Portuguese ships to keep off the coast, but they could not pursue the caravels far into the sea and inflict substantial damage. On the other hand, the heavily armed Portuguese ships could grievously hurt Zamorin's vessels and the coastal installations"¹³. The battle of 1509 was descisive in favour of the Portuguese.

The Vijayanagar rulers had, under their control, 300 ports and a large number of ships. As they were engaged in long drawn wars with Bijapur, they neglected the sea and relied on Portuguese support. Balkrishna says, "The entry of the Portuguese in the Indian Ocean made trade an armed commerce, transacted, guarded and preserved by means of armed vessels and armed men"¹⁴. The Indian ships were without docks, had very inadequate ordnance and insufficient gunners.

The Maratha naval power made great impact for a short period in the mid-seventeenth century particularly under Tukoji Angray. Their fighting ships were grabs of 300 tons burthen and gallivats with lesser burthen. The vessels were broad with small draught. In the forecastle of the main deck two cannons were mounted. The galivats were small row boats with 90 tons burthen and were propelled by 40 or 60 oars. The Pals ARCHAEOLOGY OF SHIPS



Fig. 251 : Ancient Boat

were, however, larger and mounted with more guns as in the case of *Mahadev Pal*, which was later lost on Vijayadurg rock. Orme has given a description of how the Marathas challenged the supremacy of the Portuguese and British navies on Konkan coast. After Nana Fadnavis concluded a treaty with the British in 1783, confirming the British occupation of Salsette island, the Marathas lost their naval power.

The Wadias of Bombay became the master shipbuilders in the 18th and 19th centuries. Indian teak-hulled naval ships had to be renewed every 12 years. F. Baltazar Solvyns says in Les Hindous (1811) that "the English, attentive to everything that relates to naval architecture have borrowed from the Hindus many improvements which they adopted with success to their own shipping. The Indian vessels unite elegance and utility and are models of patience and fine workmanship"¹⁵. The Bombay Dock built 16 frigates for the British between 1736 and 1884, besides sloop built in 1817 was still afloat in England in 1978 under the name Foundroyant. The largest warship built by the Bombay Dockyard was HMS Calcutta, a frigate of 2298 tons with 84 guns¹⁶.

Shipwrecks in Indian Waters Collection of data

The most important item of research done by the Marine Archaeology Unit is the careful study of more than a thousand old records in Archives and other institutions and discussion with persons in possesion of marine records with a view to collecting precise data concerning wrecks, their locus, cargo, class of ship wrecked, etc. Even charts showing the location of wrecks have been copied and the Unit is now ready with vital information needed for starting underwater exploration. In all, 215 are major wrecks. There is a heavy concentration of wrecks in Goa, Bombay, Laccadive Islands and Hooghly waters. Other areas where some important wrecks occur are also noted below.

Major Shipwreck Zones

- 1. Hooghly Bay
- 2. Goa Waters
- 3. Bombay Harbour, Alibag and Versova
- 4. Madras Waters

- 5. Visakhapatnam
- 6. Laccadive Islands
- 7. Tuticorin and Tinnevelly coast
- 8. Vijayadurg- Chaul
- 9. Surat

Thousands of records available in the Calcutta, Madras, Hyderabad, Bhubaneswar and New Delhi Archives are yet to be examined. They may reveal zones of heavier concentration of wrecks. However, for the present, Goa waters are considered as very potential for purpose of nautical archaeology.

National Register of Ancient Shipwrecks

Collection of data needed for the National Register of Ancient Shipwrecks involves sustained research by scholars, knowing different languages and palaeography. Ever since its inception, the Marine Archaeology Centre has studied 600 records of the Bombay archives, 150 records of the Madras Archives, 100 records of the Goa Archives and Xavier Centre of Historical Research, Goa, and collected useful data. Presently, the marine records of the Culcutta Archives of Madras, Baroda, Hyderabad, Surat and Rajkot and in Peshwa Daftar are yet to be examined. The information relating to the class of ship, nature of construction, cargo carried, the circumstances leading to the loss of ship, countries and people involved in commerce, available from the records, will be useful to historians, economists and Indologists.

List of Important Shipwrecks in Indian Waters Kutch and Kathiward Coast

- 1. English ship *Indus* sank off Diu near Kodinar in 1847.
- -do- Lord Raglan sank 20.11'N, 69 48'E in 1860.
- 3. -do- *Sullamattee* wrecked near Mandovee in 1861 (Records destroyed).

Surat-Bombay, Alibag, Versova

- 1. Portuguese ship *Capitania Antiago* sank near Versova 1542.
- 2. An English Company ship (name not given) was wrecked at Verula (Worli) in 1670.
- 3. The galbat Faijmakki sank near Bassein

in 1782.

- 4. English ship *Marqish Wellesley* sank at Bombay in 1813.
- 5. The ship *Louisiana* sank near Alibag in 1861. A sketch map showing the location is available.
- 6. English ship *Pilkington* sank near Versova in 1862.
- 7. Two ships were lost in a storm in 1879 off Bassein and two more off Alibag.

NOTE: A fleet sent by Sultan Mohamed Begada to fight the fleet of 20 ships of Yakut (slave of Bahadur Gelani, Governor of Goa, who had captured Mahim) was destroyed in a gale in 1490.

Ratnagiri, Vengurla, Murud, Janjira, Malvan

- 1. The English Company ship *Friendship* wrecked at Jaitpur (Rajpur) in 1670.
- 2. Portuguese ship *Conceicao* was lost near Queimadós Island (Vengurla) in 1766.
- 3. One Maratha *galbat* was lost on the rocks of Rajpuri in 1782.
- 4. -do- *batela*, sank near Umbergaon in 1782.
- 5. -do- gurab, sank near Vijayadurg in 1783.
- 6. -do- *pal Mahadev* sank near Vijayadurg in 1794.
- 7. English ship *Wadiatool Rahman* wrecked off Culta (near Chaul) in 1862.
- 8. Forty ships of varying tonnage (10 to 70 tons) were lost on the Konkan Coast in a gale in 1879.

(*NOTE*: China Ware of Ming dynasty 15th century has been found on the banks of Chaul).

Goa Waters

The following shipwrecks have been noted from old records in various Archives and from published sources (for reference see National Register of Shipwrecks NRSW).

- 1. Portuguese ship *Rei Magos* was lost near Goa in 1582.
- 2. -do- *§ Cristovani* sank on Goa bank in 1582.
- 3. -do- *Santo Andre* was lost in Goa waters in 1607.
- 4. -do- Nossa Sra dos Remedios, sank in Goa waters in 1616.
- 5. Twelve Portuguese ships were lost in a gale in Goa waters in 1648.

- 6. Seven Portuguese ships anchored in Nerul river sank in a gale in 1648.
- 7. Portuguese ship *St. Joao Evagelista-Galeao* was lost in 1632 near Goa.
- 8. -do- *St. Tome* was lost in a combat with the Dutch in Goa waters in 1658.
- 9. English (?) ship *Bagla Sallamattee* sank in Mandovi in a gale in 1861.
- English ship Brig Champion was lost in 10. Goa waters in 1863. The naval Hydrographic charts show three wrecks in depths 6.4 to 2.4m, in Amee Shoals and two in Aguada Bay (South and South West of same pt.). Hulls are visible in both the cases. A wreck, the hull of which is visible, is shown near Marmagao Head, north of Railway Station and another (hull visible) between the boat-jetty and Vasco. Two other wrecks, hulls of which are not visible, are recorded, one to the North-West of Margao Head, another West of it, in depth varying from 15.8 to 12.4 m. A wreck, West of Gavdawada (depth 6.7 m.) and another North of Bimbade Pt. (depth 4.3 m) and a third one (hull visible) south of Grande island at 7.3 m, depth, are also recorded. The Amee Shoals pose problems for underwater exploration because of rocks and sediments. On the other hand, the wrecks in Aguada Bay should receive priority in exploration because the hulls are visible and their location agrees with details given in Portuguese and English records. The bar near Mandovi mouth, where several ships sank, should also receive priority. Next in importance would be the Grande Island where the chances of survival of the ships are as a high as in the Aguada Bay. As the Marmagao harbour has been dredged, some of the wrecks must have been lost. But two hulls are marked outside the dredged area and may be worth exploring.

Kanara and Malabar Coasts

- 1. English ship *Euterpe* wrecked near Byndoor in 1854.
- 2. English ship *Princess Amelia* lost due to fire on Malabar Coast in 1798.

- 3. Ship *Salamaty Savoy* wrecked at the entrance to the river off Honavar in 1828.
- 4. Portuguese ship *Novo Ceilao* wrecked near Mangalore in 1807.

Note :

- 1. Mangalore was developed by Hyder and Tipu. They had several frigates, sloops, etc. Vessels from Muscat, Aden and Jeddha visited this port until 1793, when it was lost to the British.
- 2. Cranganore (Muziris) was an important port in the pre-Christian era also. It was the residences of a republic of Jews, part of the manasseh, who had been carried into captivity by Nebuchednessar. He sent large numbers of them to this distant land from Babylon. Their history says that 20,000 of them came to India after a voyage of 3 years and were well treated on arrival at the Indian port.

Kanyakumari

1. Portuguese *Galeo St. Antonio* near Cape Camorin in 1609.

Tuticorin

1. English Company ship *George* sank near a reef off Tuticorin in 1673.

Pondicherry-Madras-Nellore

- 1. French ship *Duc d'Orleans* was lost in a gale off Madras in 1715 (?).
- -do- Marie Gertrude, was lost in a gale off Madras in 1715 (?).
- 3. A French schooner was lost in a gale off Madras in 1715 (?).
- 4. English *Brig Eliza* wrecked near Madras harbour in 1715 (?).
- 5. French ship *Bien Amie* was lost in a naval battle near Pondicherry in 1758.
- 6. -do- *Prizzarra* of 64 guns was lost near Pondicherry in 1782.
- 7. English ship *Success* wrecked near Rayapuram, Madras in 1817.
- 8. -do- *Wilhelmina* sank off the coast of Kistnapatnam in 1835.
- 9. -do- Brig *Appolo* caught fire in Pondicherry in 1840.
- -do- Lady Wallance sank off Crocodile Reef
 on Tinnevelly coast in 1840.

Nellore-Vizag, etc.

- English ship *Governor Keating* containing King's store was wrecked off Nellore in 1812.
- 2. English Brig *Wilhemina* drifted on shore and wrecked off Kistnapatanam in 1814.
- 3. English free trader *General Brown* sank near Bimlipatam in 1819.
- 4. English ship *Atlas* sank on Pulicat shoals in 1820.
- 5. -do- *Alfred* wrecked at Calingapatam in 1821.

Hooghly Bay

1. French ship *Insulaire* was lost on a bank in the Ganga whilst trying to make Chandernagore in 1715 (?).

(Note : Twenty thousand vessels of all description wrecked in Coringa Bay in a gale in 1737).

Laccadive Island

- 1. English ship Barque *Wazeer* sank on the Cherbaniani reefs 1853.
- 2. English ship *Byramgore* sank in Byramgore shoal in 1827.
- 3. -do- Barque *Falcon* sank in Byramgore shoal in 1844.
- 4. -do- Barque *Ceylon* sank in Byramgore shoal in 1844.
- 5. An Indian Navy ship sank near Byramgore shoals in 1844.
- 6. English ship Barque *Hamoody* wrecked on Byramgore reef in 1854.
- 7. Barque *Mahabaleswar* sank near Ancutta reef in 1880.

Maldive Islands

- 1. Portuguese ship *Conceicio* wrecked in Maldive in 1555.
- 2. -do- S. Bartolomeau sank near Maldive in 1615.
- 3. Indian Barque Samaranq wrecked in Maldive in 1849.
- 4. English ship *Bankers Daughter* wrecked in Maldive in 1854.
- 5. -do- Hossanah wrecked in Maldive in 1854.

Andaman and Nicobar islands

1. English ship Brig *Richard Bell* sank off the Great Nicobar in 1840.

Indian Ships Lost in Foreign Waters

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Australian Coast

- 1. Mersey sank in 1805.
- 2. Morning Star sank in 1815.
- 3. Lady Elliot sank in 1816.
- 4. Veletta sank in 1825.
- 5. Mermaid sank in 1817.

Foreign Ships Lost in Foreign Waters

- 1. HMS's ship *Daedalus* sank on Ceylon Coast in 1813.
- 2. English Company ship *Euphrates* sank off Dandra in Ceylon in 1813.
- 3. English Brig *Providence* sank at Martaban on Burma Coast in 1814.
- *4. Private ship *Albion* wrecked near Trincomalee in 1817.
- 5. French ship *Oriente* was lost near Trincomalee in 1782.
- 6. Portuguese Galleon S. Joao Baptista ran aground Near Colombo in 1654 (several other Portuguese ships were destroyed in a strong encounter with the Dutch in 1654).

Note :

- 1. There are references to English, Portuguese and Dutch ships which sank on the African and Arabian Coast, in Malacca, Ceylon and in Sumatra waters.
- 2. Some records make vague references. One of them says "The ship *Nau Bom Jesus* was lost in the southern part of the Indian Ocean in 1592", another record refers to the wreck of "*S Geronymo* in Indain Ocean").

Ships Lost in Encounters With the Portuguese, French And Others

- 1. The Portuguese Commander Joao de Nova, who had anchored at Andediva encountered the Calicut fleet in 1501, sank large ships and 9 Paros.
- 2. In 1502, the Calicut fleet under Khoja Ambar consisting of 20 large ships, 70 fustos and large Zambuks was attacked along the shore by the Portuguese Commander Vicente Sodre, who sank 3 large vessels.
- 3. Danvers¹⁷ says that in an encounter between the Calicut fleet under Khoja

Kasim and Portuguese fleet under Vicente Sodre Calicut lost many vessels between Calicut and Cochin in 1503. Sodar had looted many rich ships of their cargo, valued at 200,000. Vicente Pardaos was killed along with his brother Braz Sodre in May 1503 in a storm near the island of Curia Muria (a Cape at the entrance of Mecca). The storm also consumed his ships and booty (Braganca Pereira, 1936: 245-248, 322-331)¹⁸.

- 4. In October 1502 an Arab ship laden with a rich cargo coming from Mecca was sighted near the village Delhi under the King of Cananor. After a hunt the Portuguese burnt it with heavy loss.
- Sonar's fleet atacked Cranganore in 1506, burnt the town and many vessels of Muslims laden with gold and precious articles¹⁹.
- A Portuguese fleet that was crossing the Gulf on its way from Chaul to Diu in 1538 lost several vessels including 2 galleys in a furious storm at the mouth of the river Dabhol²⁰.
- 7. Siddi Ali, a contemporary of the Ottoman Emperor Sulaiman I (1494-1560) says that he escaped from the Portuguese fleet near Muscat and his vessels were carried away by wind towards Daman and wrecked in 1553 completely. But according to F.C. Danvers Sidi Alís, seven vessels out of 9 were forced to sail to Surat and the remaining two to Daman where they went on the rocks at Daman and Daru and dashed to pieces²¹.
- 8. The Portuguese found 4 Indian warships of the paros type belonging to the Pirate Kunhale Chopra. Two of these were captured and one was sunk with its guns²².
- A Portuguese ship wrecked off Cochin in which the Viceroy Fransisco de Souza Conde de Vidigueira arrived in Goa in May 1597. When the ship was about to return laden with rich merchandise, it caught fire by accident and sank²³.
- 10. A new Portuguese ship was sunk near Agasim (Chaul) in 1599. It contained

army ammunitions and articles of the king including a very well gem-threaded canoe. It is not known whether any cargo was salvaged²⁴.

- 11. Four out of five Portuguese ships that had left Lisbon arrived in Goa in 1614. One was lost near Melindo with all the travellers. The fleet on its way back lost one out of four ships near Maldive islands.
- 12. Four out of a very large fleet of Portuguese ships which left Cambay at the end of 1616 were lost in a terrible storm off Daman. Two of them went down with all men, in the third vessel that sank, only one man was saved and in the fourth all men survived.
- 13. In 1616 Dom Bernardo de Noronha rescued Cranganore attacked by Zamorin and sent Dom Henrique de Souza with 11 ships to Calicut. Henrique burnt a large vessel of Zamorin laden with rich cargo ready to sail for Mecca.
- 14. Forty merchant vessels, one of a large Portuguese fleet, were burnt or run ashore in 1654 off Achra when Dutch Admiral Van Goens attacked them. The fleet was returning from Ceylon.
- 15. Tavernier is said to have witnessed the fight of English ships *Falcon, Dove, Welcome* and *Endeavour* with Dutch ships lying at Sind. In the action *Endeavour* sank.
- In 1629 Nuno Alvares who sailed with 27 ships from Malacca found a beautiful Dutch ship up the river. It was blown by a bullet that hit her Magazine²⁵.
- Viceroy Martin Affonso lost some vessels including a galleon of his fleet when it was brought to an anchor in the action against the Dutch in 1606 before Achin (Sumatra)²⁶.
- 18. The Portuguese Pataxo Santa Tereza de Jesus was lost on 18th May 1658 in the bar of Goa while setting to sail for Bassein and Chaul. This ship contained Royal money and other goods. Some soaked goods were saved and others lost as recorded in the Proceedings of the Revenue Council of

Goa, 15th May, 1658 (HAG No. 29).

- 19. A Portuguese Galeao SanThomewent down in Goa bar in 1658. Actually, the laden Galeo is said to have been burnt by the Captain-in-Chief Bernardo de Tavora for unknown reasons. This information is contained in a letter dated 23rd January, 1659, addressed to the King by the Governors Francisco de Mello de Castro and Antonio de Souza Coutinho (HAG No. and 30).
- 20. A Calicut vessel that wrecked off Worli (Bombay) on 15th August, 1670, while sailing back from Muscat, was driven ashore but broke into pieces and 11 out of 100 men were saved along with 2 horses. The ship was plundered by coolies sent by the Portuguese Priest of Bandra. The ship contained thousnds of Abasses (Persian coins). The Priest had to restore 22005 Abasses²⁷.
- 21. A ship belonging to Veraval (in Gujarat) coming from Aden sank in the Bay of Bombay. It contained gold nuggets. Some men and gold were saved. The wreckage was caused because of a sunken rock near Shivaji coast²⁸.
- 22. In 1734, Paramanandan, an Indian merchant, started sailing to Madras from Syria in the Kingdom of Pegu which was well known for Indian shipping. In bad weather the ship broke on a reef of Barbuka near Negrai. Half the people, including the pilot, were drowned; only a small portion of goods was saved²⁹.
- 23. When the French Commander La Bordonais was ready to sail to Sumatra from Calcutta in 1746, a hurricane wrecking three of his best ships with all hands, dismasted the rest. This incident saved the British interest, but proved a great loss to the French in India³⁰.
- 24. Angria's fleet attacked, near Gharia, the Dutch ships bound for Surat in 1754. Two ships, namely *Wemmenum* and *Vrede*, were blown up and the third bark was captured with all the men³¹.

Lakshadveep Islands³² (Fig. 23) Geomerphology

The Lakshdveep group of islands lies on the northern edge of a 2,500 km long North-South aligned sub-marine Lakshadveep Chagos Ridge, which is separated from the Malabar Shelf by the Lakshadveep Sea and merges with the shelf between 11° and 14° (Lakshadveep Gazatteer). The ridge rises from 2000 m - 2700 m in Lakshadveep sea and about 4000 m in the Arabian Sea. The eastern flanks of this ridge, with a few gaps, are steeper than the western. A prominent gap is the Nine Degree Channel, separating the atoll of Minicov from the northern group of islands. A large number of atolls and some large banks are situated on this ridge. For instance, the atolls Bangaram, Agatti, Kadmat and Amini are situated in two large coral banks, rising steeply from 1500 to 3000 m. The reefs of the atolls are widest on the southwest side. The first break in the reefs occurs at a depth of 4-8 m, which extends to 12 m on the south-west windward reef, representing a wavecut platform of recent origin. After this, the depth falls off almost vertically to 50 m. The submerged terraces observed at 7-12, 15, 21-36 and 43-47 m depth occured during the Pleistocene, when the sea level was lower. The seaward reef of the atolls on the windward side is marked by numerous grooves and furrows called surge channels. The atolls consisting of the islands and lagoons are in various stages. The lagoons vary in size, the smallest covering an area of 1 km. The smaller lagoons of Chetlat, Amini and Kadmat are filled with sediments, the water depth varying from 1 to 2.5 m. The larger lagoons of Bitra, Bangaram, Suheli and Minicoy are 10 to 16 m deep. The central part is deep and encumbered with coral knolls. The banks are not well developed in the vicinity of the opening reefs, for example, the western reef of Bangaram, the northern reef of Minicoy, the northeastern reef of Bangaram, the northern reef of Minicoy, the northeastern reef of Bitra and the western reef of Suheli.

Formation of Island

The islands of Lakshadveep atolls are situated on the eastern reef margin, except Bangaram and Cheriyakara which lie in the centre of the lagoon.

The cyclones from the east have piled up coral debris on the eastern reef, while the high waves generated during the southwest monsoon have pounded the reef and broken this into coarse and subsequently fine sediments, which ere then transported and deposited on the eastern side behind the coral boulders and pebbles in the eastern reef. A gradual accretion of the sediments had led to the formation so fast that the lagoon itself may be filled up with sediment³³.

Coral Rock Formation (Fig. 218-220)

The attractive colour and shapes of coral (Fig. 252,253,254 and 255) are the outward clothing of a small marine animal. The coral polyp is efficient in assimilating the raw materials necessary for producing calcium carbonate, which is the basis of chalk, limestone and some seashell. Coral polyps can thrive only in warm water above 70° Fahrenheit. The coral animal likes light and those kinds that form reefs and atolls can grow only in water, which is less than 200 ft. deep³⁴.

Ancient Sites and Shipwrecks in Lakshadveep

Kavaratti ($10^{\circ}31$ 'N; $72^{\circ}28$ 'E) is 404 km away from Cochin (Fig. 25 and 257)

Agatti (10°31'N; 72°11'E) is 57 km from Kavaratti and 459 km from Cochin. Two wrecks: *Mahabaleswar* and *Fatteh Rasool are reported here*. There is an early historical site also.

Bangaram is the northern horizon separated from Agatti.

Fig. 252 : Corals from Lakshadveep





Fig. 253 : Corals from Lakshadveep

Fig. 254 : Corals from Lakshadveep



Androth (10°49'N; 73°41'E) is 228 km from Cochin. This island has the largest land area and largest population. Buddhist relics are found here.

Kalpeni (10°-05'N; 73°41'E) is 228 km from Cochin. This island has the largest land area

Fig. 255 : Corals from Lakshadveep



and the largest population. Buddhist relics are found here Kalpeni (10°05'N; 73° 41'E) is a beautiful and fertile atoll which includes 7 islands, 287 km from Cochin. There are two shipwrecks here.

Amini (11°7'N; 72°44'E) is 407 km from Cochin. It is a part of Aminidevi group filling the interior of the ring roof.

Minicoy (8° 10'N, Long 73° 5'E). There are 3 shipwrecks, one of which has been salvaged by a private company. Two others discovered by the Marine Archaeology Centre are being explored.

Kadmat (11°29'N; 73°00 E) is 394 km from Cochin. The nearest inhabited island is Chetlat (37 km). The lagoon is very shallow. There are storm beaches at the northern and southern ends. The ship *Vazeer* (Vizier) wrecked on the nearby reef of Cheriyapaniyam. The tomb of Capt. Primrose, who died in the island, is near the beach.

Bitra (11°36'N; 72°10'E) lies 50 km east of Chetlat. This is the smallest island and a nesting ground for sea birds.

Suheli There are two wrecks near Bangaram.

In Hydrographic Survey map, one wreck is shown in Cheriapani, two wrecks near Kiltan and one wreck in Kadmat; but all wrecks except those in Suheli and Kiltan are recent ones.

One of the most important ships lost in Lakshadveep waters is the *Byramgore*, after which the reef on which it foundered has been named. Several other ships were also lost here. The attempts made to salvage Byramgore because of its valuable cargo are briefly stated in the correspondence. These papers and sketch plans of the site were studied before the author and Bandodkar joined the Naval Hydrographic Survey team in February, 1992, for a preliminary study of Byramgore reefs, and if possible, to look for the wreck.

Byramgore Wreck

Extract from Horsburg's Directory (1864)

Byramgore, or Cheriapani reef, including its bank, is 11 miles long N.N.W. and S.S.E., and 5 miles wide, having its south point in lat. 11°48'N long. 71°50°'E. The bank, which is very steep, closely surrounds the reef, except to the N.E., where it projects 3 miles beyond it, with



Fig. 256 : Ancient site near mosque in Kavaratti island, Lakshadveep

Fig. 257 : Ancient site being explored by MAC-Kavaratti, Lakshadveep





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soundings from 4 to 8 fathoms (Fig. 258). The coral rocks forming the reef are just discernible at low water, and the bottom is distinctly visible on the bank; but, as there are no soundings near this or the Cherbaniani Reef, the approach to them is very dangerous. This is because, the noise of the surf would not be heard unless a ship were to move leeward in calm weather, and the current frequently sets 12 or 15 miles during the night, in uncertain directions, although usually between S.E. and S.W., during the months of February, March and April.

By the chart it appears that a ship may pass through the channel between Byramgore Shoal and the north-westernmost of the Laccadive Islands called Betre-Par; also, by keeping in lat. 12 °8 or 12°10', between the Byramgore Shoal and Cherbaniani Reef, but neither of these channels ought to be adopted excepting during fine weather, or in case of necessity; although the passage to the northward of those dangers over the bank of Bassas de Pedro is thought to be safe, as no shoal water has been found upon the latter bank. Captain Charles Keys, late master Attendant at Bombay, transmitted an account of these dangers, published by him at that presidency, stating the ship Competitor, from Colombo, bound for Bombay, on the 21st August, observed in lat. 11°30'N, and then saw one of the Laccadive Islands bearing E. by S., distant about 4 leagues, which was thought to be Peremul-Par; from which time steered N. 1/2 W. 31/2 miles, supposed to be Betra-Par, and after throwing part of the cargo overboard to lighten the ship, she backed off the shoal at 7 A.M. much damaged, as several of the bottom planks and 50 feet of the main keel, were obliged to be replaced after the arrival at Bombay. Captain Keys thinks that it might have been the Island Kittan, seen on the 21st August, and not Peremul-Par, as they supposed, and that she struck in a shoal to the westward of the former, and afterwards passed to the eastward of Chittae, the Byramgore Shoal, and Cherbaniani Reef, at no great distance, without seeing either of these dangers.

Wreck of the ship Byramgore

Ref: Public consultations. Date 18th January 1828. Vol. 558. pp. 242. (Tamil Nadu State Archives, Madras)

To,

The Chief Secretary to Governemt Fort St. George.

Sir,

I have the honour to enclose for the information of the Right Honorable the Governor in Council, copy of the letter this day transmitted by me to the Government of Bombay, on the subject of the wreck of a valuable ship, the Byramgore, which took place on the 17th ultimo on a reef near the *Laccadive Islands* attached to this District, and of the proceedings which have been adopted by me with a view to saving the crew and cargo - These Proceedings, though unsuccessful, form circumstances that I could not control, will, I trust, meet with the approbation of the Right Honorable the Governor in Council.

2nd.

Should the Government of Bombay be desirous of employing the services of Lieutenant Mr. Donald, the Master Attendant on this Port, in a survey of the islands and the dangers in the neighbourhood of them, I beg to solicit the permission of Government to place his services at the disposal of that Government until the survey shall be completed. Canara

Callala	
Principal Collector's	I have signed.
Cutcherry Manglore	

13th December 1827	Principal Collector
	& Magistrate

Ref: Horsburg's Directory Vol 1. p. 517.

"This ship left China August 10th (1827), with a valuable cargo for Bombay, beat down the China sea, touched at Anger Sunda strait, for refreshments, September 25th (1827), and struck on the above reef at 3 A.M 17th November, 1827".

To.

The Chief Secretary to Government, Bombay.

Sir,

On the 22nd last month Captain Crockett late, commanding the ship Byramgore arrived in an open boat at this port and reported to me that the ship had struck on a Reef of Rocks to the North of the Laccadive Islands, and that he had come to seek such assistance as I might be able to afford him in an attempt which he intended to make to save the crew and part of the cargo.

2nd

Some pattimars were procured for this purpose, and Captain Crockett, and the Master Attendant of this Port whom I had requested to accompany him proceeded towards the wreck but unfortunately the gale which had done so much damage in Bombay drove them from their course and they returned here on the 1st instant without having seen the reef on which the *Byramgore* was wrecked.

3rd

As serious apprehensions were now entertained of the crew, consisting of 3 officers and about 100 Lascars, no time was lost, the weather having settled in the mean time, in putting water on board the Pattimars, and they sailed again for the same destination under the direction of the Master Attendant and Captain Crockett, and after a passage of 6 days reached the Reef where they found the Byramgore broken up and no traces of the crew that had been left in the ship when the Commander proceeded to this Port to procure assistance.

4th

The Brig *skylark* having touched at Mangalore, I induce the Commander to endeavour to reach the wreck, but as the gale set in immediately after he sailed for that purpose, I have little hope that he was able to afford my assistance. **5th**

The Honorable company Cruizer's Amherst having been considerately dispatched by Government on the arrival of the first account of this disaster, came to anchor in the evening of the 18th instant, and I furnished the Commander with a Memorandum of the situation of the reef which had been given to me by Captain Crockett, and they sailed the same night, but the Master Attendant found the ship broken up and the crew gone on the 7th. There is little probability of any effectual assistance having been afforded by the *Cruizer*, which has not yet returned.

6th

Of the fate of the officers and crew of this unfortunate vessel, I have no certain intelligence, and if, on the arrival of this dispatch they have not been heard of at Bombay I fear there is no hope that they can have been saved.

7th

I have the honour to enclose copy of a report made to me by Lieutenant McDonald the Master Attendant, which will afford the fullest information to the Honourable the Governor in Council of the Proceedings of that officer and the Commander of the late ship *Byramgore*, and of the position of the Reef on which she has been wrecked.

8th

The *Byramgore* is not a solitary instance within my recollection of a wreck on the Reefs in the vicinity of the Laccadive Islands, and if the suggestion of Lieutenant Mc Donald should be followed up and a survey made of the islands and the dangers which are to be found in the vicinity, it would, I think be attended with considerable benefit to Navigation.

Canara

Principal Collector's Cutchery Mangalore 13th December, 1827

I have signed Signed/I. Babington Principal Collector

& Magistrate

/True Copy/ signed/I. Babington Principal Collector's & Magistrate To.

John Babington, Esq.

Principal Collector in Canara Sir,

I have the honor to inform you that I

sailed from Mangalore on the night of the 24th of last month, in compliance with your wishes, and my own feelings, in company with two other Pattimars and a Bottlea, for the purpose of ascertaining the position of the shoal on which the ship Byramgore ran ashore, and Captain Crockett and myself having great hopes of being able to save the Treasure and some of that Vessel's valuable Cargo (there being at that time no apprehension for the safety of the crew). Our hopes, I am sorry to say were disappointed on the 26th by a fresh gale from the S.S.E. which lasted till the 28th and obliged us to stand to the unseaworthy and unmanagable in such weather, on the 29th the wind veered round from the E.S.E. and the weather became more moderate, when we stood to the southward, in order to touch at this place for water, and to ascertain if any of the Boats had arrived from the Vessel. Captain Crockett and self being under great apprehension for the safety of the crew, on the 6th of December being in latitude 12°10' and 71°56'E longitude at 1.30 P.M. saw them from the boats poop hauled up S.E. and run along the east side of the reef at three miles distance from the breakers, rocks and the Boats Bottom at the depth of 10 to 15 fathoms at 4.30 P.M. saw the wreck of the Byragmore from the deck bearing south and at 5.30 on bringing the S.E. end of the breakers to bear W by S got suddenly out of soundings at sun set shortened sail, and plied to windward during the night, at day light on the 7th saw the wreck of the ship from the mast head bearing W by S stood towards it at 11 A.M. having neared it, Captain Crockett went with the late ship's small cutter to examine it more closely, and to ascertain if there was any person remaining in it, I at the same time standing off and on, with the Pattameras and although but a very light air from the N.E. the surf broke very high over the wreck and reef, and it was with feelings of deep regret, I observed that the ship had entirely broken up and the fragments of the wreck had been washed among the rocks and breakers so as to render all approach to them impracticable. At noon Latitude observed 11-48' -18'N and Longitude pr. Chr 72-1'45' East the wreck bearing NNW distant about 2 miles the

extremes of the reef from WNW to NE by E 1/2E.

The S.E. end of this dangerous shoal is in $11^{\circ}49^{\circ}$ 'N and in $27^{\circ}4$ 'N or 5 East Longitude 71°56', East. The reef extends from North to South 11 to 12 miles, and from east to west 8 or 9 miles, the east side of it trends N.W. and S.E. with soundings over a rocky bottom from 10 to 15 fathoms 3 miles from the Breakers, its south side trends W by N and E by E having soundings at about a 1/4 of a mile from the Breakers from 5 to 10 fs. The wreck of the Byramgore is on the south side off the reef at about equal distance from its East and West Extreme in Lat. $10^{\circ}50^{\circ}$ 'N and long. 72° East Mangalore bearing East 18° North distant 196 miles the reef. It was nearly calm at the time.

On a reference to Horsburg's directory and Chart, I feel convinced the above shoal is not the Cherbinian Bank, but one to the southward and westward of it and not laid down in his Chart, or in that of any other Navigator and to which is to be solely attributed the loss of this fine ship and valuable Cargo.

At 1 P.M. Captain Crockett returned and informed me that he could not approach to within two or three ships length of the wreck, and that he had no hopes under present circumstance of being able to save any thing, and in which I fully concurred. As the Pattimars had no chain cable or is there any safe anchorage about the Reef, it would only be uselessly endangering the Pattimars and the lives of their crew by remaining. I therefore agreed with Captain Crockett in opinion as to the necessity of returning to Mangalore, at which place we arrived on the 11th instant.

And it is with feelings of great concern I have to inform you that we have been able to obtain any certain information respecting the crew, there is a report there that they have reached Goa and have taken up a Pattimar to convey themselves to Bombay, and I most sincerely trust this report may be true as I am convinced if they remained with the wreck till the Southerly Gale set in, there is little or no chance of their safety. It would be impossible for any of the Boats to get from the wrecks, the launch large cutter, and Jolly Boat were left with the ship and in perfect readiness to leave her at a moment's warning, and I sincerely hope they were made available in time.

Should it be under the contemplation of Government to have the Northern Dangers of the Laccadive Islands and reefs surveyed I most respectfully beg leave to tender my services to Government for that purpose, as I could with ease perform it in two fair seasons (with the assistance of a midshipman or an intelligent petty officer of the Marine and one of the Honourable Company's Ketches) at a very inconsiderable expense to Government.

Master Attendant'sSigned/W.M. DonaldOffice MangaloreMaster Attendant12th December, 1827

/True Copy/ Signed/1. Babington Principal Collector Mangalore

General³⁵

The enchanting coral island in the Arabian Sea, earlier known as Lakshdweep, Minicoy and Aminidivi islands, lie on the sea route between West Asia and North Africa on the one hand and South Asia and Sri Lanka on the other. The islands were familar during the days of sailing ships to navigators and perhaps to the reckless pirates. The people who came to inhabit these islands in the part had to live in complete isolation amidst poverty and then from the Indian mainland.

There is no definite records of shipwrecks before 16th century in these islands. The inscriptions mention that Rajasimha (680-720 AD) and Raja Rajendra (1018-19) the Chola kings conquered many ancient islands. In this process some ships must have been lost in these islands. The earliest recorded wreck is of 1828 in Byramgore reef which has claimed at least 8 more ships.

Although thousands of ships have sunk in Indian waters, precious little could be done to locate at least a few until the Marine Archaeology Centre in the National Institute of Oceanography discovered 3 wrecks in 1987-90. Lakshadweep islands are an important region to search for shipwrecks for reconstructing the history of maritime trade and the countries and types of ships involved in it. They would also provide information about the ship-building activity. The advantage in Lakshaweep water is clear visibility which is essential for underwater documentation.

Objectives

The main objectives of the February 1998 exploration off Lakshadweep were: (1) To locate archaeological sites on land and collect data useful for reconstructing the cultural and trade links of Lakshadweep with the mainland (II) Preliminary offshore exploration of



Fig. 259 : Gaveshani Research vessel equipped with laboratories and other facilities

shipwrecks in order to ascertain the type of ships involved in trade and the country of origin, besides the cargo they carried.

Scope and Quantum of Exploration

To meet the above objectives, *R.V. Gaveshani* served as the mother ship and small boats were hired from different islands for onshore, nearshore and underwater exploration. Diving was an important tool for underwater exploration. SCUBA system was used for underwater diving. After discovering underwater objects, drawing, photography and filming of the objects and their environment were planned.

Background information Lakshadweep Group of Islands

The earliest reference to the name Lakshadweep is in the Dutch Company records. These islands are referred to as Lekker-Diva (Galletti, 1911). British records refer to them as



Laccadive islands. This name was not popular among the local people who called themselves as the inhabitants of the Divis till very recently.

The oldest reference to these islands, though indirect is contained in the *Periplus of the Erythresin Sea.* Describing the trade of Malabar coast, the author mentions "tortoise shell from the islands off Limurika" the later being the name given to Malabar or part of it in ancient times. Among the other references by classical writers is one in Ptolemy's *Geography* (circa AD 150). He refers to a multitude of islands in the Indian Ocean lying around Taprobane (Ceylon), and numbering about 1378(Gazetteer of India, Lakshadweep, 1997).

The arrival of the Portuguese in the Indian waters disturbed the peace and tranquility of the Arabian sea and the island. The frequent attacks on these islands by the Portuguese made it an irksome possession and the Kolathiri, making a virtue of necessity, the island by the middle of the l6th century as a Jagir to his hereditary admiral, the Ali Raja of Cannanore (Malabar District Gazetteer).

Archaeology

Archaeological evidence of settlement in islands goes back to the early centuries of the Christain Era, for instance Androth island has yielded Roman coins (Mohan Das: 1951). Buddha heads of 5th-6th century A.D. found in Androth are other important archaeological finds. The Archaeological Survey of India conducted exploration of these islands but no publication is yet available.

Shipwreck in Lakshadweep Sea

The Register of ship wrecks shows that 8 out of 9 ships wrecked in Byramgore and Cherbaniani reef. A few other wrecks are reported off Kalpeni, Agatti and Ankuta reef (Between Bangaram and Tinnakara islands). In February 1993, an archaeological expedition by MAC and Scientist of NIO was organized for a survey of wrecks in Lakshadweep waters.

Survey Vessel and Equipments

RV Gaveshani : (Fig 259) *Research Vessel Gaveshani* which is equipped for carrying out multi-disciplinary oceanographic research has a draught of 3 m. There is accommodation for 19 scientists besides 45 ship's officers and crew. It has an endurance of 25 days. There are four laboratories on board with an area of 134 sq. m besides a photographic room and a conference room with library. It was used primarily as a mother ship. However, diving from the ship was not possible due to various reasons and, therefore, country crafts were hired locally for the purpose.

Underwater TV

An Osprey Model No. OE 1211 Underwater TV Camera/VCR connected to a monitor on board with an Umbilical cable was deployed for producing video film and recording was done on Onida model No V-9171 PS VCR. It is an effective mode of conveying the nature and condition of antiquity or structure lying submerged. The recorded tape can be replayed as and when required for detailed analysis/ study.

Underwater Photography

For still photography underwater Nikon V Camera with 35 mm wide angle lens was used with a strobe gun of 100 candlelight. Konica 100 and 200 ASA colour film negatives, 100 ASA Fuji Chroma for slides and 400 ASA ORWO Film for Black White pictures was used.

Onshore Exploration:

Onshore explorations are necessary in marine archaeological exploration to establish the time frame and correlation with the findings from the sites submerged in the sea. Pottery is classifed periodwise based on stratigraphic evidence wherever available.

Offshore Exploration

Offshore exploration was based on Scuba diving. At the located sites two divers are engaged in exploring at a time. A life line is attacked to the surface of the boat. Three places were selected for diving off Suheli Par and Minicoy in a water depth of 4 to 10 m.

Position Fixing

Sextant was used for fixing positions. This system necessitates taking angles from minimum 3 land objects whose coordinates are well known or marked on the map. Light houses, TV towers and other shore points, for which coordinates are available from Survey of India maps, were taken into account. The angles so obtained were plotted on the map specially constructed in 1: 25,000 scale in UTM projections. Positions were also crosschecked using a Radar which was available on *Gaveshani*.

Result

The findings of onshore and offshore explorations of Lakshadweep have been described separately:

Onshore Exploration

Kavaratti Exploration at Kavaratti was undertaken at two places 1) Masjid Area and 2) Hospital Area.

The Ujira Habiwulla Majid is situated on the ancient mound, which, when scarped, yielded a number of potsherds. According to local people, this is the earliest Masjid on the island, and is known as Ujira Habiwullah. Several other mounds were habitated in the past. Pottery collected from this area includes red ware, dull red ware, black ware and one sherd associated with Red Polished Ware (RPW). The vessel shapes are the included jar and miniature vessels and a few bowls.

The hospital area in Kavaratti is completely occupied by modern houses and nothing is left for exploration.

Androth Onshore exploration of Androth brought to light a vast ancient habitational mound. Large quantities of potsherds collected from the field include red ware, dull red ware, red and black ware. Two Buddha heads were also found in earlier excavations in Kalikatta area.

Agatti In this island exploration was carried out at three places namely Waliullah Majar, Jama Masjid and a Majār. Medieval period pottery was found in these sites.

Amini During onshore exploration, a fresh section in a foundation trench dug for the construction of a public building was examined. It was about 2.5 m thick here. The pottery from the successive strata indicated medieval habitation.

Offshore Exploration

Offshore explorations were undertaken at Kavaratti, Suheli Par and Minicoy.

Kavaratti (Fig. 222,223 and 224). The main purpose of diving in Kavaratti lagoon was to film Target Search Techniques used in Marine Archaeological explorations for UGC programme.

Suheli Par According to local information three to four ships have been wrecked in this reef. One of them (LSW 1) is visible above the water. A part of it is on the reef. A military tank is visible and a number of truck tyres are lying in this lagoon. As the sea was very rough it was impossible to dive nearer to the site for examination of the wreck. Exploration was carried out at a water depth of 6 - 15 m.

Minicoy Being the southern most island of Lakshadveep union territory Minicoy is on the international sea route. Local residents mentioned several shipwrecks in Minicoy waters. During present exploration three wrecks were visible on the western side of the island.

LSW 2 This wreck lying between 4 m to 10 m water depth and about 200 m offshore is partly visible above the water . It is the southern most wreck so far noticed. (Fig. 225)

During the course of diving on this wreck it was noticed that the frame and beams of the ship are preserved and hull plate is completely corroded. It's engine part, flywheel and steam pipe are not damaged.

The width of flywheel is about 1.4 m and the, diameter is 4.5 m, and a shaft attached to it about 27 m in length. The shaft is in a very good condition. The shaft attached to the propeller of has three joints. The bearings are clearly visible. The length from engine is about 75 m, and the total length of a part of the ship is approximately 100 m. An interesting aspect is that the anchor chain is in good condition. The total length of the ship may be more than 150 m, a part of which lying in deeper waters.

The brass fixtures of the ship include the porthole with glass hinges of doors and windows and one unidentified rectangular and curved bar object. Apart from these objects some lead lumps were also noticed. This wreck is lying parallel to the shore i.e. in the north-south direction.

LSW 3 The wreck, 200 m north of LSW 2, lying perpendicular to the shore in east-west direction in a water depth of 3 to 15 m is partly visible above water.

Diving near the wreck confirmed that the hull plate of this wreck is preserved. The wreck is tilted to the south. The engine part is in good condition but flywheel could not be traced. Two huge steam boilers with nuts are, however, clearly visible. The shaft of the engine and propeller is broken into two parts. The smaller part is attached to the engine and the bigger portion seems to have fallen into deeper waters. The total length of the wreck is not less than 100 m or it may be still bigger than LSW 2. Due to heavy current and wave action working hours underwater were very limited.

LSW 4 This wreck is being salvaged by some salvage company. A major part of this wreck has already been taken out and two boilers are visible from the surface. According to the salvaging staff, this was a German ship named *Russett* which sank about 65 years ago. Some valuable cargo is expected from this wreck.

Kalpeni According to local information a

wreck is lying in 1-5 m water depth. Most of the objects from this wreck have been robbed.

Discussion

Onshore explorations at Kavaratti proved that the island was inhabited during the first five centuries of the Christain era as indicate by the occurrence of the Red Polished Ware in an ancient site here. Similarly the Red Ware found at Amini island is datable to the same period.

The Buddha statue kept in the collage at Androth is 95 cm in height. It belongs to the post-Gupts School of Art 6th-7th A.D. This figure is made of locally available rock. The early in habitants of Androth were the followers of Buddhism. The art of Andhroth came from mainland as it is evident from curly hair, sharp nose and long ears. But not a single monastery is noticed here which may be due to conversion of the entire local people at a later date Islam.

Shipwreck (LSW - 1) at Suheli Par seems to be a war ship. According to local people, this ship was carrying a number of military trucks as can be seen from the tyres at the site. It is difficult to determine the date of the wreck. Tyres are in good condition so it can be dated to the Second World War (1939-45) The warships of European countries must have here for water

Table Showing Shipwrecks in Lakshadveep Waters							
S.No.	Name of Ship	Location	Year (Sunk)	Type of Ship	Country of Ship	Remark	Source
1	Byramgore	Byramgore Reef	1828	Cargo	-	Treasure	1
2.	Ceylon	Cherbiniany reef	1844	Cargo	England	Robinson salvaged ship	2
3.	Houidy	Byramgore reef	1854	Arab Ship			3
4.	Alcheunst	Byramgore reef	1858		England		4
5.	Lord Brougham	Cherniniany	1865		Dutch		5
6.	Abel Tasman	Byramgore	1865		Dutch		6
7.	Mahabaleshwar	Bangaram	1881		Indian	In Monsoon 7	
8.	Sultan	Byramgore	1858				8
9.	Mohammad	Amini	1854		Iraian		9
10.	Pactfico Everet	Kadmath	1977		Panama		10
11.	National Piece	Kiltan		Oil Tanker	American		11
12.	Vizier	Cheriyapani reef	1853				12
13.	General Simson	Near Kiltan	1863				13
14.	M.V. Pap		1987				14

sypply.

LSW 2 at Minicoy is an important ship, but the date of the wreck is not known. The square object with an inscription LA - 1 provides some clue of the wreck. The anchor chain also provides information that the ship was anchored in about 15 m water depth as the chain is lying more than 100 metres in the offshore. During the night the ship would have drifted towards the shore and struck against the rock and sank. According to another view, the ship might have first struck against the rock and then anchored. One thing which is clear from the anchor lying in 15 m water is that the anchor was released first and then the ship moved towards the shore. If the anchor chain was released after the wreck then the anchor should have been very near to the ship while in the present position the anchor may be 150 m away. Apart from this argument, one more thing that can be noticed is that the ship is lying parallel to shore. If the ship had struck against the rock then it should have been lying perpendicular to the shore because the ship cannot run parallel to the shore as it is very shallow all long.

All the wrecks are steam engine ships having a boiler and steam pipe.

The date of these cannot be determined accurately. But steam engine ships came into use around AD 1830. In Lakshadveep waters shipwrecks could not have occured after 1865 when Suez canal was opened. So these ships can be dated between 1830 and 1865 AD. The wreck at Suheli Par seems to be of a later period as truck tyres are in good condition. During two World Wars many warships passed over here and there is a possibility that this ship is of a later period, say 50 to 70 years old.

Conclusion

The marine archaeological explorations were carried out in Lakshadveep mainly to locate the shipwrecks in different islands and for proper documentation of all the findings. Onshore explorations were also undertaken in various islands to trace their cultural history.

Onshore explorations at Kavaratti, Agatti, Androth and Amini revealed the earliest habitation belonging to 1st-5th century A.D., as is evident from Ceramic industries namely the Red Polished Ware etc.The Buddha's head at Androth suggests the influence of art from mainland Buddhist centre during the post Gupta period.

The present survey was the first systematic marine archaeological exploration of shipwrecks also resulting in the discovery of four shipwrecks in Suheli Par and Minicoy.

At Minicoy three shipwrecks were noticed. Out of three, two were throughly explored. LSW-2 is lying parallel to shore while LSW-3 lies perpendicular to the shore. Both shipwrecks are more than 100 m in length lying in 4 to 15 m water depth. One lead artefact and seven brass objects were retrieved. LSW-3 is also lying in about 4 to 15 m water depth is better preserved than LSW-2.

The most significant outcome of this exploration was the video filming of these shipwrecks. Secondly a systematic onshore exploration was undertaken and a chronology of these islands on the basis of pottery and scupltures was established.

Future Programme

As the preliminary offshore explorations at Lakshadveep provided encouraging results by way of discovery of four shipwrecks, it is necessary to explore these wrecks thoroughly and document each object *in situ* full scale underwater drawing and photograph should be prepared.

To determine the date and the flag of the ships marine records will be referred to invarious archives which may provide description of the ships, ownership destination and cargo.

After obtaining details from records and documenting the wrecks, the selected parts of ships such as propeller, and anchor bell, will be traced to get some clue about the date and country of origin of these ships.

Preservative measures for salvaged parts will be undertaken.

Exploration of other shipwrecks in Lakshadweep waters particularly at Kalpeni and Minicoy may be undertaken.

In the prposed Maritime Museum at Goa, one of the important wrecks should be reconstructed with the help of experts.





CHAPTER VIII

ANCIENT PORTS OF INDIA

West Coast Kutch

he Gulf of Kutch is an east-west oriented indentation north of the Saurashtra peninsula,with a depth of 60 m at its mouth and 15 to 20m at the head, the total area being 7300 square km. The semi-arid condition has drastically reduced the run-off during the last 2000 years, but between 3000 and 2000 B.C. the largest river of India, the Saraswati, fed by the Yamuna and Sutlej, joined the Gulf of Kutch, perhaps, near the Harappan port of Dholavira (Kotada). Its palaeo channels have been traced in Rajasthan desert recently by the National Remote Sensing Agency.¹

Saraswati is known by various names, such as Ghaggar and Hakra (Fig. 25). With a width varying from 4 to 12 km, it served as the most important waterway in the Vedic and Late Vedic periods, but started drying up partly by 2000 B.C. By 1500 B.C. Late Harappan settlements were made on the dried-up channels of the Ghaggar.² The importance of Dholavira, an impressively planned town, and the stone fortification walls, could be attributed to its geographical position, namely as an outlet to the western sea from Saraswati-Ganga hinterland. L.S. Rao is of the view that the harbour was situated near a low-lying hill of limestone about 5 km west of the town of Dholavira, which needs confirmation by intensive onshore and offshore exploration. Other Harappan ports on the northern boundary of Kutch and the southern limit of the Rann of Kutch are Luna, Khirasar and Lakhpat. It may not be surprising if Pabumath, which has yielded several Harappan

artefacts such as seals, weights, blades, beads etc., was also a port, especially when the Rann was navigable in the 3rd-2nd millennia B.C. The sediment from the Luni and other rivers must have rendered the Rann impossible to navigate later. On the western shores of Kutch are Bhedi, Todio, Navinal, Mundra and Mandvi. Todio and Navinal are Late Harappan ports. Further exploration may bring to light the Harappan settlements near what are now deemed to be early historic ports of Mundra and Mandvi. The Little Rann too must have been navigable, but the discharge from Banas and Saraswati in Mehsana district which may be distinguished as Little Saraswati, and from Rupen river has rendered it useless for navigation during the last 2000 years. The Late Harappan sites in the delta region of these rivers are Jekada, Pirojpur, etc. Upstream of Little Saraswati is Sujnipur, a post-Harappan site, revealing cultural interaction between post-Harappan lustrous Red Ware and Black-and-Red Ware sites.

Saurashtra

Phala, Hariana and Hajnāli (Shikarpur) are small Late Harappan ports in Jamnagar district on the northwestern coast of Saurashtra. Shikarpur, excavated by the Gujarat Archaeological Department and Deccan College, is said to have had a wharf. The most important proto-historic ports so far known in Saurashtra are Bet Dwarka (Fig 263) and Dwarka (Fig 264) situated at the northwestern tip of the peninsula.

The discovery of the submerged city of Dvārakā, said to have been founded by Sri Krishna, is described in Chapter V. Far south is Prabhasa, where offshore explorations have yielded evidence of a submerged port which

MARINE ARCHAEOLOGY IN INDIA



Fig. 262 : Two circular bastions basalt adjoining a long wall standing on boulder foundation near buoy-28

included Somnath and Verawal (Chapter V). Between Dwarka in the north and Somnath in the South is Porbandar, which is said to be the hometown of Sri Krishna's classmate and friend Sudama. In fact, Porbandar is known as Sudamapuri. There is a Late Harappan site now known as Kinderkeda (Kinnara Kshetra), which is yet to be fully explored. On the east coast of Saurashtra is the port of Hastabra, (referred to by *periplus*) at the modern village Hathab near Gogha. The ancient dock of Gogha is still in use. Near Hathab there is also a Late Harappan site, but it is landlocked. Vallabhipur, the modern Vala, was also an important port for more than 1500 years from 3rd century B.C. to 1200 A.D.

Lothal

The Harappan port city was discovered by the

author in November, 1954, and excavated from 1955 to 1962. It is situated at the head of the

Fig. 263 : Protohistoric port Bet Dwarka



ANCIENT PORTS OF INDIA



Fig. 264 : Dwarka : A shark caught in a net by a local fisherman

Gulf of Cambay (Khambhat or Sthambhatirtha of the early historic period) between the rivers Sabarmati and Bhogavo. The ancient approach from the Gulf to Lothal through Bhogavo (Bhogava) and Sabarmati rivers is now partly silted up to the north of Bholad on the Bhogavo and Moti Boru on the Sabarmati. The spring

Fig. 265 : A group of college students who witnessed underwater exploration at Dwarka discusses the features of the ancient town with the author





Fig. 266 : Modern Dwarka town overlooking the Arabian Sea

tide reaches Utelia near Lothal and the creek from Bholad upto Lothal is silted. Floods are also very frequent in Bhogavo river and even as recently as 1989-90 Lothal mound was inundated. The Director of Ports, Gujarat State, has in his report stated "anciently an arm of the sea extended upto Lothal".

A Well Planned Port City

Lothal was one of the best planned cities of the Indus Civilization, protected against recurrent floods by a peripheral mudbrick wall. The city was divided into two major parts now designated as 'Acropolis' and the 'Lower Town.' Within the Acropolis complex lived the Ruler who could oversee the transactions in a unique warehouse of 64 blocks. Close to the warehouse, a ramp led to the largest tidal dock of the world built in the 3rd millennium B.C.The Lower Town was subdivided into a number of sectors, the central one being the commercial centre (Bazaar Street). The industrial sector, where the Bead Factory was situated, was on the west and the coppersmith's smelters were on the north near the nullah. The city was kept meticulously clean by providing underground and surface drains, manholes, cesspools and inspection chambers.

Marine Engineering

The prosperity of Lothal depended on its overseas trade sustained by the industries and brick-built dock. The basin of the dock measuring 210 m long, 35 m wide, was connected to the sea through a nullah and river. Ships used to enter the dock at high tide and also leave at high tide through the northern inlet. A 230 m long brick wharf was provided for handling cargo. In ebb tide the lockgate system in the southern embankment regulated the flow of water. By lifting the wooden gate, excess water in flow tide was let into the river through a spill-way but a minimum water column of 1 m was retained when the gate was closed in ebb tide. All the cargo was examined and sealed in the warehouse. As many as 64 clay labels bearing positive impressions of the seal on the face of the sealing and of packing material such as cloth, bamboo mats, etc., on its back have been found in the passages of the warehouse. The sealings are preserved due to an accidental fire which had reduced the cargo and wooden superstructure of the warehouse to ashes. Next to Harappa and Mohenjo-daro, Lothal yields the largest number of Indus seals and sealings (impressions). The overseas trade of Lothal extended to Bahrain, Sumer (Iraq), Elam (Iran) and Africa as attested to by the presence of a Bahrainian seal. A distinct pottery known as the Reserved Slip Ware and terracotta models of gorilla and mummified human figure of Egyptian origin. The terracotta chessmen of Lothal origin are found in the tomb of Queen Hatchepsout. One of the merchants of Lothal engaged in foreign trade had several Indus seals, gold jewellery and imported earthen vessels in his house. The main export items were gemstone, beads of semi-precious stones, ivory artefacts and some perishable articles.

The analysis of the sediment from the floor of the basin of the dock shows the presence of the sea organism *foraminifera*. It confirms that sea water used to enter the basin when it was in use. The construction of the Lothal dock for berthing and servicing ships near the mouth of the river Sabarmati or Bhogavo, whose course shifted in later years, points to the fact that the Harappans possessed a high degree of knowledge relating to the ebb-and-flow of tides. "This structure, the earliest and probably the only one of its kind in the world so far discovered, also presupposes a sound knowledge of hydrography and maritime engineering

possessed by the users of the Lothal port. It is likely that they constructed the dock after observing the tidal phenomenon and the effects thereof. Their study of tides did not stop with observation alone, but included the effect of tidal water on brick-built structures, since the four walls of the dock are found to be built of kiln-fired bricks". Precautionary measures were taken against erosion and scouring effect of tidal waters by providing buttresses. The Lothal dock is superior in design and construction to the Late Bronze Age dock at Byblos and a later one in Alexandria. It is larger in size than the modern dock at Visakhapatnam. The calibrated 14 C date of the wood sample of phase III of Lothal, when the dock was put to maximum use, is 2300 B.C. It was built in phase IIA around 2400 B.C. (calibrated to 2700 B.C)

A large ship motif engraved on a seal from Mohenjo-daro has a sharply upturned prow and stern. A terracotta model of a boat from Lothal has a stern and prow, both curved.

Marine Engineering in Late Indus Civilization

"India played a major part in the maritime trade of the world from the very dawn of civilization. A concrete evidence of which is the dock, four walls of which are found to be built of kiln-fired bricks. It would appear that the knowledge of hydraulics and methods of collection and discharge of water from their habitations were useful in developing ideas pertaining to inlets and outlets of tidal water at Lothal.

Other Harappan ports, which are partially explored, are Shikarpur and Kuntasi. M.K. Dhavalikar excavated Kuntasi, wrongly called Hajnali, on behalf of the Deccan college, Pune and found the site extending over 2 hectres. It is a large structure complex, enclosed by a double fortification wall and having a watch tower in the southwestern corner. The walls and other structures are of rubble set in mud mortar. The township was flourishing in Harappan period from 2000 to 1800 B.c. and also in the Late Harappan phase (1800-I600 B.C.) Habitation area extended outside the fortification also. The structure complex on the west consists of large chambers 7x4 m with storage facilities such as bins, jars, pits and silos built of mud bricks. There are also pottery kilns and furnaces. There was a separate building for the chief of the town. The major part of the town resembles Harappan citadels, but there is no Lower Town at Kuntasi³, according to the excavator. Dhavalikar is of the view that the "Harappans came to Saurashtra for trade, they acquired raw materials such as carnelian and shell, manufactured finished goods inside the citadel, and exported them to west Asia. The Lower Town is nothing but the shanties of the local people who were in the service of the Harappans. The chiefs and artisans who came with them lived inside the citadel. This mercantile model explains the Harappan occupation of Saurashtra". The conclusion arrived at by Dhavalikar is not at all applicable to important sites like Lothal and Dholavira. In fact, the Lower Town people enjoyed civic amenities which were as good as the facilities for the ruler and his entourage in the citadel or Acropolis. The merchants and craftsmen in the Lower Town of Lothal were quite prosperous in the mature phase. It is only after the overall decline of the Harappan towns started that the Ruler left Lothal in the Late Harappan phase. The bead-workers were in Lower Town and not in the Acropolis at Lothal. In reality, the flourishing bead-industry existed even before the arrival of Harappans at Lothal. The Harappan merchants, however, increased its export and established workshops. The idea of employing cheap local labour or poverty stricken craftsman in the citadel to work for the Harappan is not proved. There is little left of any stucture at Kuntasi that could be identified as dock or jetty. There is, however, a warehouse. The role of other Late Harappan and post-Harappan ports at Dwarka, Bet Dwarka, Nageswar, Pindara and Somnath (Prabhas)is described in the Chapter of Submerged Dwarka. It is not necessary to go into the history of later ports, such as Visawada, Miyani, Porbandar, Gogha, Hathab (Hastaba), Khambhat and

Valabhipur (Vala).

Rajyagor⁴ mentions that, "Orangi near Karachi connected the trade centres of Kutch, Saurashtra and south Gujarat on one side and ports of Baluchistan, Iran and Mesopotamia on the other, but directly or indirectly they reached the cities of the Anatolia, Crete, Greece and Egypt through Sumer". The role of Lothal in west Asian trade is mentioned in detail elsewhere. (Rao S.R. 1973)

Other important ports of Gujarat in the early historical period mentioned by the author of the Periplus and others including Strabo, Pliny and Ptolemy are Bordexima (Porbandar), Manglosson(Mangrol), Ashtakapra (Hathab), Barygaza (Bharuch/Broach) and Navasarip (Navsari)⁵, Khambhat, (Sthambhatirtha) and Valabhi are mentioned in Indian texts such as Panini's Ganapātha. Prince Vijaya is said to have migrated to Ceylon in 543 B.C. from the port of Simhapura, passing by Sopara on the way⁶. Simhapura is identified by some scholars with modern Sihor near Bhavnagar. There is a proverb in Gujarati mentioning "the bride of Lanka and bridegroom of Gogha." There is a dock at Gogha and a Late Harappan site nearby.

Valabhi

This Capital of the Maitraka Rulers of Gujarat is situated on the creek of Ghelo river and ships from distant lands used to visit Valabhi (Vala). Its main industries were spinning and weaving, iron-smelting, ceramics and brass ware. As mentioned in the *Ganapātha* of Panini⁷ assigned to 6th century B.C. by some scholars. The rich merchants of this port city are referred to by Hiuen Tsang. It is said that valuable products of distant land were stored here in large quantities for being sent to different parts of India. The merchant captain Navikpati Guhagupta, who vied with Kubera in riches and got his daughter married to Balabhadra of Madhumati (Mahuva), is mentioned in Daśakumāra charita of Dandin, while Kathāsaritsāgara mentions merchants Vidyadhara and Devasena and the Yavana ships in Valabhi.

Khambhat (Cambay)⁸

This must have been a port in the Harappan times. Nagara near Cambay has yielded Carnelian beads of later period. Khambhat was known for leather and beads in medieval period. About one hundred years ago Khambhat was a port approachable by steam ships from England.

South Gujarat

Anciently known as Lāța, it was the home of the sage Bhrugu. Bhrugukachcha is mentioned in the Vana parva and Sabha parva of the Mahābhārata. Bhrugu had his hermitage (āśrama) on the banks of the Narmada. It is now known as Bharuch or Broach. To the author of the Periplus it was known as Barygaza.

Mehgam⁹

The Harappan settlement Mehgam (Lat 21°42'N; Long 72° 45'E) was perhaps the original Bhrugukaccha, but when it was destroyed by the floods in the Narmada, the people moved to the interior at Nangal and Broach. The Old Testament mentions that Hiram had sent ships to Ophir in 1015 B.C. to bring ivory, monkeys, peacocks, gold, sandalwood and precious stones. Rhys David identified Ophir with Bharuch but others identity it with Sopara further south near Bombay. The author's excavation at the port town of Mehgam in Ankleswar Taluk of Broach district in 1957 confirmed that it was Late Harappan settlement, datable to 1900-1600 B.C. or slightly later.

In one of the trenches, two high-necked jars of Rangpur IIB-IIC type were found buried in a pit along with a dish- on-stand and a flat dish. In this burial a few fragments of bone were also found. At the mouth of the Kim river, the mature Harappan site of Bhagatrav (Lat.21°29'N,Long 72º42'E) was also destroyed in floods. Perhaps, the flood stricken Harappan refugees had moved from Bhagatrav to Mehgam on the northern side of Narmada estuary. Still later, the Late Harappans of Mehgam moved to Nagal situated 8 Km west of Ankleshwar on the Narmada estuary. K.V. Soundara Rajan's excavation at Nagal yielded post-Chalcolithic phase of 1st millennium B.C., which is traceable upto 2nd century B.C. The floods in the Narmada might have been a less serious danger than the sea level rise causing

destruction of the settlements of the Indus, Late Vedic and Epic periods.

Broach

For Marine Archaeological investigations, Broach (Lat. 21º42'N; Long 73º05'E) is very important, as much of the cargo from the Ganga-Yamuna and Narmada valleys passed through Broach. The highly valued semi-precious stones such as agate, jasper and carnelian needed for manufacturing beads and jewellery were available from the Ratanpur and other mines of Broach district wherefrom the Lothal lapidaries and their successors obtained their supplies. Even now, the lapidaries of Cambay procure the raw material from this area. Bhrugukaccha of the Mahābhārata, Jātaka stories and Purāņas is referred to as Barygaza in the Periplus. It was one of the most important ports on the west coast which has a long chequered career. Sri Krishna is said to have sailed in a boat from Bhrugukaccha to Prabhasa. The products of its hinterland extending up to Varanasi used to be exported through this port. The best among the pilots, namely Supparaka, who could guide the captains to distant lands, lived in Bharukaccha¹⁰. Situated as it is in the delta region of the mighty river Narmada, Bharukaccha was submerged several times during the last 3500 years. Orginially its port was at Mehgam at the mouth of the Narmada, as attested to by the mooring stones found in the heavily eroded Late Harappan mound at Mehgam, where a small scale excavation was conducted by the author in 1957. Onshore and offshore survey of the island of Alia Bet and further seaward will furnish data for sea-level fluctuation studies based on the submerged structural levels. Bhrugukaccha, seems to have been a major port from 1500 B.C. to 1800 A.D. As and when the sea swallowed the port installations, or when the Narmada silted up the approach channels of the port, new townships sprang up landward. Jātaka stories refer to regular trade between Bharuch and Sopara on the one hand, and Suvarnabhumi (Burma) and Yavadvipa (Java) in the east, on the other. By land, Bharuch had extensive trade with Varanasi (Banaras), Ujjayini, Pratishthana (Paithan), Vidisa (Bedsa), Kausambi (Fig 268),



Fig. 267 Rajbandar submerged port, Elephanta island (Gharapuri)

Sravasti, Rajagriha and the South Indian cities of Vaijayanti, Kalyana, Kanchi and Madurai. Its overseas trade in the west extended to the Red Sea and Persian Gulf ports. According to *Bäveru* Jātaka, the exports of Broach to Babylon consisted of cotton, peacocks, etc. Baveru is identified with Babylon by some scholars and with Baharain by others. Vividhatirthakalpa



Fig. 268 Brick wharf excavated at Rajbandar in Elephanta Island near Bombay

mentions Sakunika Vihara and a merchant prince of Bharuch who had been to Ceylon. Satrunjaya Mahātmyā refers to trade with China. A merchant by name Bhavad is said to have imported gold in 18 ships from Sumatra and horses from Arabia in early medieval times. In this connection the reference to traders from Java going to Dwarka for selling jewel-studded blankets is highly significant, With the Arab

invasion of Bhadbhut, near Broach, and Gogha in 639 A.D., both the ports suffered heavily.

Jaina *Prabandhas* refer to traders of Bharuch¹¹ going to Java, Sumatra, Iran and ports of Mangrol and Hormuz, taking with them oil, spices and cloth and bringing back precious stones, gold, etc. Masudi describes the tidal bore at Khambhat. Suleman Sairafi, who visited Gujarat ports in 851 A.D., states that the spears of Bharuch and shoes of Khambhat, Sanjan and Sopara were well known; Idrisi mentions ships visiting Broach from Sind and China. *Nilam* fruits, etc., were other exports. Gujarat imported metals, pearls, ivory tusk, diamonds, while cloves and cinnamon, cotton textile, leather goods and indigo were exported to Arabia.

The author of the *Periplus* warns that in entering the Gulf of Kutch and harbour of Barygaza the captain of the ship should be wary of sand banks, surf, currents etc.

Elephanta Island¹²

The island of Elephanta, also known as Gharapuri or Puri, (72°55 to 72°57'E; 19°57' to 19°58'30"N) off Bombay, is famous for the relief sculptures of Mahesamurti and other Hindu deities of the 6th-7th century A.D. carved in the rock cut temples of the hill. Less known is the earlier Buddhist brick stupa on top of the hill. There is a defunct harbour known as Rajbandar, (Fig-267) which provides entrance to the valley at the foot of the hill. The Public Health Department of the Government of Maharashtra bulldozed a section of the cliff for leveling the floor of the valley for a water reservoir and construction of an earthen dam. A brick structure of Satavahana Period was exposed in the course of this operation, and the author undertook systematic excavation of whatever was left of the ancient building. It was found that the orginal 2 m high burnt brick wall was raised twice in height by one metre each time. Two scour marks of High Water Line are clearly visible in the brick structure (Fig-268) and the adjacent habitation debris corresponds to two later phases of construction of the structure. The small round copper coins found in the early levels of habitation debris are the Kārshapanas, which were in circulation from the first century B.C. to 2nd century A.D. Coins of later periods, namely the Roman, Kshatrapa and Gupta coins have been found in the Morabandar habitation area, where brickbuildings of the Gupta and earlier phases are noticeable even on surface, a metre above the High Water Line. There are brick-built walls suggesting a prosperous township. The excavation in Rajbandar harbour area has brought to light a brick jetty and wharf built along the quay of the valley, where ships could take shelter and haul cargo. The pottery from the excavated trenches consists of the Red Polished Ware and Roman amphora confirming the existence of a flourishing port even before the Christian era. The Satavahanas, who were known for patronizing overseas trade and had sway over Aparanta (Konkan coast), must have built the jetty and wharf of Rajbandar. The Aihole copper plate of the Chalukyan Ruler Pulakesin II refers to his conquest of Puri, the mistress of the seas. Recent exploration of sea bed and Morabandar has yielded Phoenician amphoras of sturdy yellowish fabric suggesting sea trade in protohistoric period. (Rao S.R. 1999, Keynote address)

Surparaka (Sopara)

The earliest mention of Surparaka is in the Vana Parva of Mahābhārata and again in Śānti Parva. The Pandavas¹³ rested at this city which is said to have been founded by Parasurama, who resided on the Chaturanga hill. However, there is a reference in the Mahābhārata to Jamadagni, father of Parasurama, as the founder of Surpāraka. Among the five centres manufacturing swords mentioned in the Agni Purāņa, Surparaka is one¹⁴. According to Majumdar, Sopara traded with Baveru, identified by some with Babylon. Dipavamsa, a Buddhist text, mentions that the residents of Suppara helped 700 passengers when their ship lost its way and reached Sopara. The Divyāvadāna mentions a householder by name Bhava at Surparaka, when the Buddha was living at Sravasti. The fragmentary Rock Edict VIII of Asoka found at Sopara suggests that it was such a flourishing port town in the 3rd century B.C. that it received the attention of Asoka¹⁵. The Karle inscription refers to a gift of a pillar containing relics by Satimita of Soparaka. Similarly, the Nasik Cave inscription of king Usavadata mentions Ramatirtha of Surparaka, which is also referred to in the Mahābhārata. Both Surparaka and Kalyana are mentioned as important port in the Periplus. Surparaka must have had very brisk trade with the Mediterranean countries. The Buddhist monasteries of western India to which wealthy merchants, engaged in overseas trade had given large donations, had

accumulated much wealth. The Karle, Junnar, Nanaghat and Nasik inscriptions mention names of the merchant donors of Surparaka, Vaijayanti (Banavasi) and Kalyan. The author's excavation in Kanheri caves has yielded evidence of metal extraction in the viharas. The extracted metal must have been exported through the ports of Sopara and Kalyana in the 7th-8th century A.D. A preliminary survey of the nearshore area and the creek that once extended from the sea upto the stupa undertaken by the Marine Archaeology Centre in 1994 indicated that the transgression of the sea had partly sumerged the harbour of Sopara. The lowlying mound at Gas has yielded Red Polished Ware, but the port installations must be in 5 to 8 m water depth within 2 km distance from the shore. Some local fishermen say that their nets get entangled in some places (may be wrecks). Further exploration of this seaward zone will be undertaken soon along with that of Vasai (Bassein), another important port of the early historical and medieval periods. Chaul¹⁶

Chaul (18°33'N and 73°), situated on the Kundalika river 50 km south of Bombay in the Alibag district of Raigarh, was an important port even before the begining of the Christian era. According to tradition, Arjuna, one of the Pandava princes, is said to have visited Champavati, which is identified with Chaul. The first mention of Chaul is by Ptolemy who calls it by the name Symulla or Tamulla. Hiuen Tsang called it Chimolo, while the Arab travellers mention it as Saimur. According to B.C. Law, Cikula of Barhut inscription is a reference to Chaul. It exported rice, cloth and sugar to Egypt. Perhaps, Permula, mentioned in Ptolemy's Geography, may be the same as Chaul, the emporium situated midway between Hyderabad in Sind and Cochin in Kerala. The Kanheri cave inscriptions also refer to Chaul as Cemulla.

Chaul was not only a trading but also a shipbuilding centre. Teak being available easily and labour being cheap, ship-building could flourish here as late as the 17th century. During the early centuries of this era, Chaul was under the Satavahana and Kadamba rulers. The merchants from Gulf countries settled here. Later on, the Silaharas, Yadavas of Devagiri, Vijayanagar rulers and Mughals controlled the trade. The Siddis of Africa, who were good seamen, had assumed control of Chaul on behalf of Mughals and Bijapur rulers.

Except a row of Buddhist caves on a hillock, no relics of the early historical period exist at Chaul as they were destroyed by the Portuguese. Almost all caves are in a dilapidated condition. Some dilapidated buildings of the Mughal Period, locally known as 'Haweli' and 'Hamam Khan' still exist here. At the nearby village of Revdanda, the Potuguese fort is also in ruins. A large quantity of Chinese pottery datable to 1400-1700 A.D. can be seen in an ancient site on way to the old port. Piracy and naval warfare seem to have contributed to the decline of Chaul. The Portuguese and rulers of Gujarat lost a few ships in the naval battles here.

Gopakapattana¹⁷

The 'Gomanta', mentioned in the Mahābhārata, is said to be a reference to Goa. The name Gomanchala is mentioned in the Purāņas. The earliest Greek record that mention Goa as 'Komba' is Ptolemy's Geography. The earlier capital of Gomanta was Chandrapura (Chandor), on the river Paroda. The excavations conducted by H. Heras, and later by the present author, confirm that it was an important river port and capital of Gomanchala from 2nd-3rd century B.C. to 11th-12th century A.D. The capital was shifted to Gopaka (modern Vodlem Goem) on the bank of the river Zuari by Viravarmadeva in 1049 A.D. Jayakesrí's copperplate inscription refers to the assembling of a large fleet at Velakula, the port of Gopaka, in 1052 A.D¹⁸. The Kadamba port of Gopakapattana (Goa Velha) (Long. 73°51'36"E", Lat. 15°25'40"N) on the river Zuari inTiswadi Taluka of Goa State was prosperous for more than 200 years from 1020 to 1247 A.D. owing to its extensive overseas trade with Srytem (Sumatra), Pusta (Pulikat), Chanda (Chola), Pandya, Lāța, Kerala, Gurjara and other kingdoms. After a joint survey of the ancient port site of Gopakapattana by the author and Dr. P.P Shirodkar, Director of Archaeology and Archives, Goa, A.S. Gaur of the Marine Archaeology Centre conducted excavation at

the site. In the trenches dug, the laterite rubble was found serving as soling for a road which may indicate the continuation of the Royal Road (Rajvidhi) of ancient Gopakapattana passing through this area under Kadamba and Portuguese rule. At present, the ancient highway extends upto ancient Siva Temple of Goveswara and further beyond upto St. Cajetan Church in Old Goa via the hillock known as Bonbo or Brahmbhu. This layer of soling of the road is 5 m wide, if not more. In another trench, dry masonry of laterite underlying the mortar laid in courses of laterite suggested two different periods in construction of the long walls along Zuari bank, now partly submerged. The pre-Portuguese construction of the earlier phase of the wall could not be precisely dated for want of datable associated finds. It is, however, necessary to continue further exploration in IZ and look for shipwrecks reported to have occurred here.

Ports in Karnataka

The Karnataka coastal strip extending over 560 km in a straight line has several ports of importance. They have natural harbour facilities, navigable water routes with deep channels and creeks. In Uttara Kannada District itself, there are two island ports namely Devgadh and Anjadiv, a bay port with a perfectly sheltered cave at Sadasivgadh and a creek port at Karwar. The esturaies of Kali, Bedthi, Sharavati and Aghanasini have navigable upstreams for long distances. There are also pre-sail halting stations such as Jalikunda (Karenitran) or Kanatra mentioned by Ptolemy. Haigunda and Basawarajadurga are other stations of importance to sailors¹⁹. The most valuable products of the nearby forests are teak, arecanut and pepper which are in perpetual demand outside India. The imports included China silk and war horses. The continuous supply of war horses from Arabia through Honnavar, Bhatkal and other ports necessitated not only political control but also development of these ports. In the early historical period, the Kadambas of Banavasi, the Chalukyas of Badami and the Rashtrakutas of Malkhed had control of the coastal zone and ports. The rich merchants of Vaijayanti gave donations to Buddhist Chaityas at Karle. Haigunda, a small hilly island in the

Sharavati river 20 km east of Honnavar port was a Buddhist centre. From the point of view of marine archaeological investigations,Honnavar deserves attention.

Honnavar²⁰

Deminisqui (1323 A.D.) mentions that Manibar adjoins Hunnur (Honnavar) and it is named as the country of pepper (Nainar M.H.S. 'Arab Geographers' knowledge of Southern India, Madras University Islamic Series No.6, 1-34 testifies to the fact of the prosperity of Honnavar through trade and commerce. The great economic prosperity of the ports on Mahibar (Karnataka) coast due to overseas trade is borne out by the accounts of European travellers. During the Vijayanagar period Ankola, Mirjan and Honnavar were the main ports through which war horses were supplied. The Vijayanagara kings established two divisions, namely Honnavara Vishaya and Barakuru-Vishaya for better administration and checking the menace of piracy. Nuniz says that the Vijayanagar king obtained horses from Ormuz in Iran and Adeem (Aden). He paid for the horses irrespective of what the Arab merchants demanded. During Haidar Alí's time, a naval yard and a fort for the protection of the town were built.

The naval battles between the Dutch and Portuguese fought off Honnavar port resulted in the loss of 52 ships. This must have happened when Keladi Shivappa Nayaka drove the Portuguese out of Honnavar Fort with the help of the Dutch army. A dock unit was built by Hyder at Honnavara to repair damaged ships and build new ones. Buchanan says that in the lake of Honnavara (mouth of Sharavati river) there are wrecks of ships sunk by the English.

Ports of Uttara Kannada Coast

K.P. Poonacha and S. Visweswara have studied literature pertaining to ports of Uttara Kannada District. Sundaresh²¹ has explored some of the ports in the same region. The geosetting has gifted this coastal region of Uttara Kannada District with two island ports, namely Devgadh and Anjadiv, besides a river port at Sadashivgadh and a creek port in Karwar. The estuaries of the rivers Bedthi, Kali, Sharavati and Aghanasini are navigable. Teak wood, pepper, arecanut



Fig. 269 : Corals in Byramgore, reef near Lakshadveep islands

and spices from the hinterland were exported through these ports, Pliny, Ptolemy and the author of Periplus mention the vigorous overseas trade of Alvakhada (Olokhoira), Malpe, Mangalore (Mangarouth), Udayavara and Barakur- all situated in the present Dakshina Kannada district and Basrur and Honnavara (Naura) in the Uttara Kannada District. The trade and cultural contacts of the ports of Karnataka are brought to light by the inscriptions of 4th to 9th century A.D. with Thailand, Malayasia, Cambodia, Phillippines, Maldives, Vietnam and Burma. On palaeographical grounds it can be said that they were influenced by Indian epigraphs. The mention of two master mariners (Mahānāvika), namely Buddhagupta and Usauna, is very significant. Haigunda, a small hilly island in the river Sharavati, about 20 km from Honnavar, is an important site from

the point of view of Underwater Archaeology, not only because it is close to Honnavar port but also because Buddhist sculptures have been found in its neighbourhood.

Udyavara or Udayapura is referred to in inscriptions as Odara in the Oxhyrhynchus Papyr²². It was the capital of Alvakheda (Olokhoira), as well as an important port The pottery from the ancient mound known as Baleragudda in the village dates back to the Megalithic period. It is at Udayavara that a Greek ship, mentioned in the Oxhyrunchus Papirus of Alexandria, is said to have foundered and the Greek sailors were saved by the Ruler of Malpa.

The Arab traders, who had settled at Ankola, Honnavar, Bhatkal and Mirjan in Uttara Kannada, traded in war horses from Arabia, as they were needed by the Vijayanagar kings.



Fig. 270 : The diver points to the submerged structure covered by vegetation.

Ports of Dakshina Kannada District

The ports Malpe (Malippala), Gangolly (Kambolim), Mangalore (Nitra Mangarouth), Bauidoor (Baidanur), Basrur (Barceloré Barace) and Udyavara were surveyed by Sundaresh in 1990. They are mentioned by Greek writers Herodotus (484-431B.C.), Megasthenes (302-288 B.C.), Strabo (54 B.C. - 24 A.D.) and Pliny. Casmos says and the author of *Periplus*. According to *Indica* by Magasthenes. The fifth category of people were ship builders and navigators. According to Strabo, 120 ships sailed from Myos Hormos to India every year.

Gangolly (74°40' 30" E; 13° 38' 45" N) situated at the confluence of the rivers Haladi and Chakranadi is protected by rocks against cyclonic effect. The sea has encroached on the fort and other installations at the pórt site known as Aluvina Bagilu. The ancient port of Gangolly was 3 km north of the present port.

Basrur (13° 37' 45" N, 74° 43' 50"E), situated 6 km east of Coondapur on the bank of Haladi Basrur and ruled by Chalukyas of Kalyan (973-1190 A.D.), was an important port until 17th century²³. There are remains of Late medieval buildings in the town. Barkur was formerly known as Barkasur, which was the capital of the Alupas. There are several temples in the town, anf it was prosperous under Hoysalas and Vijayanagar kings also.

Kaup (13°13'40"N,74°45'E) situated 12 km south of Udupi was a flourishing port town from the 14th to 18th century. Among several ships that sank in 1911-1914 in the waters of Dakshina Kannada District, particular mention may be made of *Shabul Hamid* off Coondapur, *Dhan Prasad Ballaka* at Malpe, *Rasul Nadath* at Udupi and *Waroo Machwa* at Coondapur.

MARINE ARCHAEOLOGY IN INDIA

Ports on the East Coast (Bengal, and Orissa) Tamralipti

Tamralipti, a Dronimukha located at the confluence of the sea and the river, was an important port of ancient Kalinga and is identified with modern Tamluk in West Bengal²⁴. The sea ports through which Kalinga carried on her overseas trade, namely Tamralipti, Palura and Pithunda, were presumably connected with the arteries of roads within the hinterland of Orissa" Ptolemy, Hiuen Tsang and other foreign travellers mention that sailors and merchants landing at Tamralipti, located on the bank of navigable river Ganges, could sail in the Ganges upto Champa, Pataliputra and Varanasi. From Tamralipti, there was a regular sailing of vesels, which either proceeded along the coast of Bengal to Malayan Peninsula and to the East Indies and Indo-China, or even beyond that region. In the days of Asoka, Indian Missions to and from Ceylon passed through Tamralipti. Prince Mahendra is said to have made his journey by water from Pataliputra to Tamralipti and on to Ceylon. Asoka also travelled to see off Sanghamitra carrying a branch of Bodhi tree to Ceylon by ship. The Mahavamśa informs us that the journey from Tamralipti to Ceylon covered 7 days only. In the fifth century AD, the Chinese traveller Fa-hien found it a strong maritime settlement of the Buddhists. He left for China via Ceylon from Tamralipti. Hiuen Tsang, who came to India during the regime of Harshavardhana, visited this port and learnt about Ceylon and the perils of the southern voyage. It-sing arrived at Tamralipti in 673 AD by the sea route from China and learnt Sanskrit and Philosophy(Sabda Vidya)in Varaha monastery, where both monks and nuns lived in perfect discipline.

The excavations at Tamralipti, carried out by the Archaeological Survey of India, have yielded copper coins and terracotta figurines dated to Sunga period (3rd century B.C.) besides the Rouletted ware and other objects which indicate overseas contact of Tamralipti with the Roman world²⁵.

It is believed that the ancient port town of Tamralipti stood on the banks of Rupanarayana river and a part of the city is said to have been buried under the river silt. The temple remains and houses are found in 5 to 6 m depths in excavation. A number of silver and copper coins bearing Buddhist symbols have been recovered from the debris on the banks of Rupanarayana.

Che-li-ta-lo (Charitrapura)

Che-li-ta-lo or Charitrapura was another important sea port of ancient Kalinga²⁶. The Chinese pilgrim Hiuen-Tsang, who visited India in 7th century A.D., says, "Near the shore of the ocean in the south east was the city Che-lita-lo about 20 li in circuit, which was a thoroughfare and resting place for seagoing traders and strangers from distant lands" in the Wu-tu country (Orissa). It was not only a great mart for rare commodities but also a great cultural centre. During the 7th century it was also a centre of Buddhism in Orissa. Its identification still eludes scholars. K.S. Behera says that Chelitalo was probably situated in the vicinity of Chilka lake and tentatively identified with Chhatragada. Starting on the shore of Chelitalo, Hiuen Tsang could visualise the glittering rays emanating from the gem placed on the tooth relic of Buddha at Ceylon. Dr. Waddel tried to identify Che-li-ta-lo near Nendra on the bank of Chitrotpala, a distributary of the river Mahanadi in the district of Cuttack. The traces of an old fort at Chitrotpala are pointed out in support of this view. Saral Mahabharata of Sarala Das in Oriya has identified Charitrapura with Chandrabhaga near Konark. The references to the river Chandrabhaga in the Tugu inscription of Java and Srikshetra in Talang and Tuwo inscription of Sumatra indicate that the people of Java and Sumatra were familiar with Puri and its vicinity. General Cunningham identified Chelitalo with modern Puri, the seat of Lord Jagannath. Cheli-ta-lo seems to be a Chinese version of Ksetra (religious centre). As Fang-Chih renders Chi-lita-lo as Chiao-hsing-che which may mean "having religious observance". Its identification with Puri made by Cunningham is tenable because Puri was recognised as a holy place in the 7th century A.D. Although Rhys Davids David do not agree with Cunningham's identification, there is greater likelihood of being Puri Charitrapura for reasons cited above.

Manikapatna²⁷

Manikapatna in Brahmagiri taluka of Puri district on the bank of Chilka is described by Abul Fazal (1595-96) as a sea port where taxes on salt were collected. In the later period Mughals invited the Dutch to start a factory at Manipatna. The place is mentioned in the maps of the 16th-17th centuries and Gujarati sea manuals of the 18th century. Manikapatna lies on the land route from the South and served as the entry point to Orissa. The British troops moved to Cuttack in 1803 through Ganjam, Manikapatna and Puri.

The excavations conducted by the Orissan Institute of Maritime and Southeast Asian Studies, Bhubaneswar, at Manikapatna from 1989 to 1993 revealed remains of early historical period such as Rouletted ware, fragments of amphora, red-glazed ware, Puri-Kushana coins and a Kharoshti inscription on a pot-sherd. In the upper levels, Chinese Celadon ware made of jade green celadon occurred in huge quantities. Other finds are a damaged Chinese copper coin with a square perforation in the centre. These findings indicate that Manikapatna had overseas trade contacts with Arabia, Rome, Ceylon and China. Manikpatna played an important role in the maritime history of Orissa from 1st century B.C. to 19th century A.D. The discovery of Shasamalla's coins from Manikapatna in Orissa, Polonnaruwa in Sri Lanka and Kotchina in-Indonesia, proves a maritime network, linking coastal Orissa, Sri Lanka and Sumatra.

In the course of exploration by the Marine Archaeology Centre, Goa and Department of History, Berhampur University in 1993, terracotta ring wells were noticed on the shore of Chilka at Manikapatna. They are submerged in flow tide and exposed in ebb tide. A large quantity of Chinese ceramics was also encountered at the same site. In areas adjoining Manikapatna site, there are some mounds in which pottery of the early historical period is found.

Dantapura

Dantapura in Kalinga figures prominently in Buddhist literature. According to Jirjingi Plates of Ganga Indravarman, Dantapura was more beautiful than Amaravati, the city of Gods. The Pali text Mahagovindasuttanta refers to Dantapura as the capital of Kalinga. According to Subba Rai, Dantapura was situated on the southern bank of Vamsadhara river, about 4.5 km from the modern town of Srikakulam. The Korni Plates of Anantavarma Chodaganga refers to Dantavarapukota as the capital situated on the banks of river Vamsadhara. Sylvain Levy has identified it with Palura. Ptolemy refers the apheterian immediately to the South of Palura, where the vessels bound for Malay Peninsula ceased to follow the littoral and entered the high seas. The fame of Palura or Dantapura was due to its being the point of departure for the Far East. Dantapura is mentioned in the Buddhist Dhatavamsa written by Dharmakirti as the place from which the tooth relic of the Buddha was brought to Anuradhapura in Sri Lanka in the fourth century A.D. The Natural History of Pliny and the Simhalese Buddhist Chronicle Mahavamsa refer to it as well known international port.

The port of Dantapura linked with important highways facilitated overland trade with Tamralipti, on the one hand, and Burma, Ceylon and the Far East, on the other. Dantapura played a vital role in strengthening the cultural relations of Kalinga with the outside world, particularly East Indies and Ceylon.

The *Chulla Kalinga Jataka* mentions that Dantapura of Kalinga was connected with many kingdoms by good roads. Dantapura is also referred to in the *Mahagovindasuttanta* of the *Digha Nikaya*, also in the Jataka, the *Dathavamsa* and the text *Jaina Uttaradhyayana Sutra*. Perhaps, it is this Dantapura which is referred to in the *Mahābhārata* as Dantakara, the capital of Kalinga. Pliny speaks of a town called Dandaguda or Dandagula, which is said to have stood at a distance of 625 miles south of the mouth of the Ganges.

The explorations and trial digging by the Department of Archaeology, Government of Andhra Pradesh in 1993 at Dantavarapukota on the bank of the river Vamsadhara revealed ruins of Buddhist structures spread over an area of 500 hectares of land. The pottery included knobbed ware of foreign origin. The geographical position and archaeological evidence corroborate the identification of Dantavarapukota with ancient Dantapura.

Palur²⁸

Ptolemy (2nd Cetury A.D.) refers to Paloura as an important port of the Kalinga country and a 'point' of departure (apheterion) for ships bound for Khryse. The 'Golden land', that is Suvarnabhumi (island of Southeast Asia), was immediately to the south of a town in the territory on the Gangetic Gulf called 'Paloura', Khryse denotes different parts of Southeast Asia such as Khryseonesos (Suvarnadvipa), Khryse Khora (Suvarnabhumi) and Khryse Khersonesos. Generally it included Sumatra, Java, Pegu, Burma and some parts of Malay Peninsula and Indonesia. Paloura or Palur is identified with modern Palur in Ganjam district of Orissa, located in the southern tip of Chilka lake. It acted as the only port of departure to the East on the Coromandel coast as well as east coast of Bay of Bengal and Malay region. During the early centuries of the Christian era, the importance of Kalinga for trans-Asian maritime trade can be assessed from the fact that even large vessels from Lanka sailed upto Palur before crossing the Bay of Bengal to go to Southeast Asia. According to Sylvian Levi, Dantapura is identical with Palura. K.S.Behera agrees with this view. Pallu in Telugu means 'Danta' (tooth) and 'Ur' means 'Pura' (city). According to the Pali text, Datha Vamsa composed by Dhammakirti, a tooth relic of the Buddha was presented by the Thera Khema to king Bramadatta of Kalinga, who deposited it in a magnificent stupa at Dantapura. It remained there as a precious relic till the reign of Guhasiva, who for security reasons despatched it to Ceylon to be in the safe custody of his son-in-law Dantakumara and daughter Hemamala. It is worth noting that this tooth of the Master is worshipped even today at Kandy in Ceylon.

The exploration by the Archaeological Survey of India in 1984-85 at Palur and the adjacent sand dunes yielded red ware bowls with flaring rim and a fragmentary terracotta dabber. On the basis of a comparative study, the pottery was assigned to 12th-14th century A.D. There are also some early medieval temples which are buried upto the plinth level from siltation. While digging the fondation of a house at Palur a huge quantity of pottery of medieval time was discovered.

The importance of Palur started declining on account of the Portuguese menace. Useful historical data are available with the descendants of a royal house of Palurgarh living in Berhampur town 40 km from Palur.

Kalingapatnam²⁹

Kalingapatnam, the ancient port city of Kalinga, is situated at the mouth of the Vamsadhara river in the Srikakulam district of Andhra Pradesh. The city was previously called Kannagar, Katikardana and Kartikeyadhama. Scholars differ about the identification of Kalingapatnam. Alexander Cunningham, suggests that the location of Ganga-Kalinganagara is at Rajamahendry. Fleet suggests the location Kalingapatnam at the mouth of the river Vamsadhara. G.V. Ramamurty considers Mukhalingam on the left bank of the river Vamsadhara to be the site of Ganga-Kalinganagara. The Eastern Ganga king, Indravarman, in his Chicacole grant and Hastivarman in his Narasingapalli plates refer to Kalinganagara, the capital city situated near the sea. From this evidence it can be inferred that Kalingapatnam enjoyed for some time the position of the capital of Kalinga. Kharavela continued in the old capital of Kalinga kings by repairing its gates, walls and buildings that had been damaged by storm. Pliny has referred to it in his Natural History as a thriving port.

The excavations at Kalingapatnam by Bhattacharya (1928) revealed a fortified settlement and the habitational remains ranged from 2nd century B.C. to early medieval period. A number of Gupta period gold coins were also found at the site of ancient Kalinganagara. According to some estimates, Kalingapatnam was an emporium of trade even in the 8th century. The Asokan inscriptions indicate that by the third century B.C., Kalinga was a force to reckon with.

From the Archaeological Survey of India excavations in the Stupa Mound in 1977-79 it has been possible to date the pre-Stupa occupation of Kalinganagara to 300-B.C. The size of the stupa and the offerings made to it in the form of gold grains suggest that it attracted a large number of wealthy patrons, probably entrepeneurs trading in rice. Some remains of a brick wharf have also been recorded.

Khalkatapatna³⁰

Khalkatapatna is situated 11 km east of Konark on the left bank of river Kushabhadra in Puri district. As per the local tradition, Khalkatapatna is known as old Palace (Garah) of Langull Narasimha Dev (1216-1235 A.D.) of Ganga dynasty. The right bank of the river forming a narrow barrier of sand between the ancient township and the bay served as a groin wall.

Excavation at Khalkatapatna in the year 1984-85 by the Archaeological Survey of India have revealed the existence of a brick jelly floor, which might have served as a loading platform. The pottery found in excavations consists of Chinese Celadon ware, Chinese porcelain with blue floral design on white background and egg-white glazed ware besides glazed chocolate ware of Arabian origin. Another ceramic ware is the dark gray and red slipped indigenous ware. The contact of ancient Orissa with Africa and the Arabian countries can be assumed from the sculptural depiction of a giraffe on the Konark temple and the Arabian and African costumes of the merchants.

Important antiquities recovered in excavation include arecanut-shaped beads of terracotta, fragments of bangles of glass and copper, fragmentary terracotta animal head, the celadon ware and Chinese porcelain. A Chinese circular copper coin of 14th century with a square perforation and legend in Chinese character is an important find from excavation. The occupation at this single phase site can be dated between 12th to 14th century A.D., the period of the Imperial Gangas. No structural remains have been found in the habitational area so far. As the mound is close to the seashore, ancient structures might have been washed away by the tidal waves. However, a group of four to five ring wells was found in the habitation area. Each well is supposed to have been connected with a house and served as soakage pits.

According to Wan-Ta-Yuan, a Chinese writer of the 14th century A.D., Khalkapatana was a flourishing town in the Ganga period. The sculptures in the temple suggest that Konark was on the southern facade of the Jagamohan depicts the king sitting among people, and it is in this group that a motif of giraffe appears. Probably, it was brought to Khalkatapatna as a present to the king when the temple was built.

Ports of Tamil Nadu

The port of Tamil Nadu have a long history going back to the 4th century B.C., if not earlier. They reached the zenith of their prosperity between 3rd century B.C. and 3rd century A.D. Almost all the important ports are situated at the mouth of the rivers, for example, Arikamedu³¹ on Aryakuppam, Kaveripatnam on Kaveri, Alagankulam on the Vaigai³² and Korkai on Tamraparni rivers. Oher ports of considerable importance are Kadal Mallai or Punjari (Mahabalipuram), Nagapattinam, Devipatinam, Marakanam referred to by Ptolemy.

The Raja Valliya refers to the sea voyages of prince Vijaya Simha, banished by Simhala (Simhabahu) of Bengali to Ceylon in 543 B.C. on the day of the *nirvana* of the Buddha. He is said to have come from Simhapura in the earstwhile Gohilwad district of Saurashtra via Sopara. The Ajanta murals depict the landing scene of Vijaya, as described in Simhala Avdāna. On finding resistance from local people to his landing in Simhala, he sought the help of a Pandyan king, presented him with a gem and got in return a Princess. The Mahavamsa says that the ship in which he brought the Princess was very large. Vijaya must have embarked from Korkai, which was the port and capital of the Pandyan kingdom. According to Sangam text Agananuru or (Akananuru), Korkai was a port in the time of the Pandyan king Valuti. Kollchoi or Colchi as an Emporium is mentioned by Ptolemy. It was famous for pearl fisheries, according to the author of the Periplus. Korkai is situated in Srivaikuntam Taluka of Tirunelveli District. Formerly, the Tambraparni flowed close to the town but now it is 3 kms away. The ships used to sail up the Tambraparni from the Gulf of Mannar, which is about 6 km. The excavation by Abdul Majeed has confirmed that the port town flourished in the 5th century B.C., if not earlier. The C 14th date 2755±95 for the sample of earlier level should also be taken note of.

The close trade and culture contact between Mesopatamia (Iraq) and South India is attested to not only by the Dravidian words adapted for rice etc., in the chronicles of the *Old Testament* but also by the occurrence of Malabar teak in the temple of Moon God at Ur built by Nebuchadnezzar. It is during his reign that the persecuted Jews left for Malabar where they were welcomed between Egypt and South India is indicated by a potsherd inscribed in Tamil Brahmi wite the name 'Cattan' found at Quseir al Quadim, the 'white Harbour' of Egypt. **Arikamedu**³³

Roman contact with Arikamedu situated on the river Ariyankuppam near Pondicherry has been proved by Wheeler's excavation in 1946 and recently by Vimla Begley. A.Sundara is of the view that the earliest habitation of Arikamedu goes back to Neolithic times in view of the fact that the Neolithic Gray Ware and polished stone axes have been encountered in the prestructural phase.

The most important port of Tamil Nadu was Kaveripattinam (Poompuhar) from 3rd century B.C. onward. The results of the underwater exploration off Poompuhar by the author in collaboration with the Tamil Nadu Department of Archaeology have been mentioned in chapter VI.

Periyar

The occurrence of a very large number of Roman coins at Periyar near Kodumanal in Perumdurai Taluka of Periyar District and Roman pottery at Alagankulam at the mouth of Vaigai river has further highlighted the extensive trade of South India with Roman ports. Sangam literature uses the term *Navay* for foreign ships, the local ones being called *Kalam. Navay* had many sails and masts. An interesting find from Rameswaram coast is a prismatic stone anchor of the type found in Dwarka.

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In 1981 India established the Marine Archaeology Centre for exploring shipwrecks and submerged ports such as Dwarka, Poompuhar, Somnath, and to search for shipwrecks. The present publication *Marine Archaeology in India* gives a detailed account of the exploration of India's underwater cultural heritage during the last decade and half, highlighting the problems faced by the pioneers in the field, the excavation techniques followed and the results achieved.



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