CHAPTER - 5

TRADITIONAL SHIPBUILDING
There are a number of ships represented in ancient Indian art. Similarly, ancient Indian literatures are full of references to the shipbuilding. Religious texts as well as secular literature give innumerable references of ships and shipping in the ancient period in India. But there are no detailed accounts of the shipbuilding describing the construction of boats and ships before 11th century A.D. Most of the descriptions in the literature are vague or poetic where one has to minutely study the passages and texts and interpret them to generate data on contemporary shipbuilding technology. However, these ancient literatures suggest that the ancient Indian ships were quite huge with a number of masts and sails. They were well-built and able to carry 500 to 800 passengers and also a heavy load of cargo but it is difficult to visualize the exact shape, size, and construction.

There are a variety of traditional crafts built and used in the Indian rivers and in the sea. Different geographical regions all along the
Indian coast had their different crafts having different shape, dimensions and the names. The ships of Coromandel Coast vary from the ships of Malabar Coast or Konkan coast. Not only that even the ships and boats of Bengal, Kalinga, Andhra, Tamil Nadu, Kerala, Karnataka, Konkan and Gujarat coasts vary considerably.

A variety of traditional boats are still constructed all along the Indian coasts. Different sorts of vessels are correspondent to accounts in ancient literature. The hundreds and thousands year's old traditions are still in practice without many changes. The monoxyla, described by the Periplus of Erythrean Sea is still in use for about 2000 years.

The volume of information can be obtained by scientific study of traditional Indian boat building. Systematic study of ancient maritime activities and indigenous techniques of boat and shipbuilding in western and south Indian regions was conducted under a NISTADS project. Several groups of scholars and researchers carried out extensive fieldwork and documented the traditional ships and boats on entire Indian coast. An attempt is made to peep into the long past of Indian traditions of boat building.
The shipbuilding is among the earliest industries in India. The shipbuilding had started during the prehistoric period. Prehistoric rock paintings are the evidence of ship-designing and shipbuilding abilities of ancient Indians. The Harappans maintained a brisk commercial maritime connection during 3rd millennium B.C. This commercial activity across the vast expanse of sea naturally implies considerably advanced techniques in the art of shipbuilding and navigation.

Ancient ships were of a great variety. The different areas, material, purposes, sizes and types of these ships necessitated different methods of construction. Their shapes, size and construction was intended to meet the various requirements of the area where they were built and seas in which they were navigated.

The ancient and traditional ships and boats were constructed in a number of ways and with different methods. The shipbuilders estimate the measurements of the ships roughly. According to their size, nature of work and the area they varied considerably. There is no uniform or fixed ratio seems adopted for construction of the ships. These different modes of building of craft offer certain advantages over the others. These differences are due to several reasons.
Some times it is due to material used or to make them cheap to build or to have long life. There has always been a debate that which method is most advanced or the best. There may, perhaps, no criteria to judge any construction method as the best except that the method suited to the owner or the shipbuilder under the circumstances thus be called the overall best.

Traditional boats are deeply related to the societies who built and used them. This relation of man and boat is unique in Andaman and Nicobar and Lakshadweep, the isolated groups of Islands off the coasts of India, in Bay of Bengal and the Arabian Sea. Boats and ships were the lifeline of these people and all the events of their history, culture or the daily life are related to the boats and ships, in one way or the other. Islanders were very good boat builders and navigators since antiquity. People of Lakshadweep set voyages and their ships used to sail to distant lands. Till very recent past a variety of boats, from simple wooden rafts to large sailing ships up to a carrying capacity of 400 tons, were built in these islands.
Boat Building by Tribes at Andaman and Nicobar Islands

Boat building by tribes at Andaman and Nicobar islands provides a unique opportunity to study an age-old boat building tradition. This boat building tradition evolved indigenously and remained unaffected by any outer influence for millennia due to their segregation from the main land by the vast stretch of the ocean. Abundance and variety of building materials in the vast forest area and a vast coastline of 1200 km provided ideal conditions for the evolution of boat building since antiquity. The inhabitants of these isolated islands are dependant on the surrounding sea. Boats and ships could be the only means for their movement and contact with fellow islanders on other islands.

Boat building technology of aborigines also remained unaffected by the traditions brought by the settlers in past few centuries. The boats used by tribes of these islands attracted the attention of all those who visited these islands. Brief accounts of these traditional crafts are found in various early works and researches on these Islanders (Mouat, 1863; 1899; Man, 1932; Radcliffe-Brown, 1948). Some of the tribes like Nicobarese, Shompens and Onges are comparatively accessible but due to inaccessibility of some tribes and their hostile nature to outsiders not much is known about their boat building traditions.
Aborigines of Andaman and Nicobar islands belonging to the Negroid and Mongoloid stocks are among the most primitive communities. Some of the tribes in these islands are still living in a hunter-gatherer stage. Tribes like Shompens and Great Andamanese are at the verge of extinction. Tribes with different ethnic background build different kind of boats. Some of these traditional vessels are confined to particular Islands. The boat building technology of tribes has evolved independently in segregation and due to isolation has remained unaffected for several millennia. There are only a few varieties of these traditional crafts

The boat building techniques of these tribes are of great interest to archaeologists to study and understand the development of shipping and shipbuilding technology in antiquity. Most of the settlements are located on the seashore and fishing, hunting and food gathering are their main occupation. These tribes are mostly dependent on the sea for their needs and fish, turtle, crabs, oysters, dugongs, etc. constituted the major part of their diet. They have very intimate association with the sea and well versed in seafaring activities.

Their boat building technology was evolved with their experiences during last several thousands of years. Despite their isolation certain
uniformity observed among the crafts of all the tribes is surprising.
All the tribes of these islands, namely the Nicobarese, Great Andamanese, Shompens, Onges, Jarawas and Sentinelses use only dugout canoes with outriggers. Only Jarawas construct a raft, considered to be one of the most primitive forms of boats.

All the raw materials required for making boats and fishing gears like fishing nets, arrows, bows, harpoons and spears were also procured from the forest. A variety of timbers are available in the forests of these islands. Besides wood, other materials for ropes, sail cloths like coir are also available locally. Different tribes and settlers use different variety of timbers for boat building. Other materials like sail cloth and coir ropes are procured locally. The fishing net is made of bark fiber with cane reinforcements. The resin, used for caulking, is a natural product from the forest and available in plenty. They used only pointed stones for boat building. Other tools for cutting and boat building were made from Nautilus shells. Some bivalve shells were also sharpened and used for canoe makings.

It is interesting to note here that different tribes of different islands used different timber. Some of these tribes make similar type of boat and their method of construction is also more or less same but the
timber used by them is different. The selection of specific timber for making boats is based on their long experience in the forests and in the sea.

The settlers use at least 20 types of woods for boat building. Among these, the following are important.

Padauk (*Pterocarpus dalbergioides*)
Pyinma (*Lagerostromia hypoleuca*)
Thingam (*Prunus marthabensis*)
Black Chuglam (*Terminalia manii*)
Gurjan (*Dipterocarpus SPP*)
Thitmin (*Podocarpus nerifolia*)
Thingam (*Panjanelia rheedi*)
Mohwa (*Diploknema butyracea*)
Lakooch (*Artocarpus lacoocha*)

The tradition of boat building at Andaman and Nicobar Islands can be broadly divided in two groups - boat building traditions of tribal and boat building traditions of settlers. Aborigines of these islands are living here for thousands of years while the settlers arrived some 200 years back. The difference in the boat building activity of these
people is very clear. The settlers use modern methods, practices and ideas in boat building, which are different from those of tribes.

These tribes still follow an age-old tradition of boat building, which has remained unadulterated by external influences. Even today primitive dugouts can be seen in the waters of Andaman.

**Tribal Boat Building**

The aborigines of Andaman and Nicobar Islands are of two races, Mongoloid and Negroid. The mongoloids are confined to Nicobar group of islands and the Negroid inhabits Andaman groups of islands. There are four distinct tribal groups with different cultural, linguistic and ethnic backgrounds. They include Great Andamanese, Jarawas, Onges and Sentineless. Mongoloid has two tribes, Nicobarese and Shompens.

The tribes use only dugout canoes. These canoes are also used with an outrigger. Except Jarawas, there is a great similarity in boat building traditions of these tribes. The difference is seen in the structure and shape of stem and stern, size of the hull, thwarts,
mode of joining the cross planks, mode of attachment of booms with
the hull, number of booms, the mode of joining the floats with the
booms and materials used, etc.

The Great Andamanese

The Great Andamanese living in settlement in Strait Island off the
East coast of Middle Andaman. The Great Andamanese are one of
the most primitive tribe, still living in hunter-gatherer stage. The
Andamanese use only dugout canoes with or without outrigger for
fishing and catching crabs. The dugouts used by the Great
Andamanese are comparatively small in size. They can carry only 2
or 3 persons. A small platform like horizontal extension of the stem
is provides. This projection of the dugout evolved due to their
requirement to have a convenient place for harpooner. These
dugouts are long and narrow. The length width ratio in these boats is
1:16 - 1:17.

Their dugout does not resemble any vessels in the Indian waters
(Hornell, 1920). The most peculiar feature of their dugout is a
platform like extension at stem and stern (Fig 114). The dugout is
connected with the float by three booms. Long bamboos are used for boom. Three long sticks are used to join boom and the float.

For constructing a canoe a suitable tree is selected in the forest. The size of the tree determines the size of the canoe, which may be up to 8 m long. Selected tree is cut and both the ends are roughly shapes and trimmed. The instrument used for the process is like an adze. The lower side is rounded and shaped with chisel. The upper side is made flat to hollow the central portion. Scooping is done with the same instrument. This unfinished vessel is transported to the working site. Further work is carried out by the person who wants to build the canoe. Mud plaster is applied on the hollow part to avoid over burning. The vessel is places on a trench in inverted position and the scooped portion of the vessel is burnt. After firing further finishing is carried out while the log is hot. The uniform thickness, 3.5 to 4 cm, is maintained. To measure the thickness small holes are made in lee above the watermark. A small stick is inserted in these holes to check the uniformity of the thickness.

To expand the side planks pressure is applied and wooden logs are inserted between the sides to prevent their shrinkage at cooling. These insertions are removed after a day or two till that time it
assume its permanent shape. Now the stem and stern are
such a way so that they form a platform projecting on eith
This platform is used for harpooning. Some times a few cross bars
are also provided.

When the canoe is finished the outrigger is shaped and attached
with it. Earlier up to 11 booms were used but now 3 to 9 booms are
used. a float is made of wood having great buoyancy and light in
weight. Timber of Barringtonica asiatica and Anthocephalus
cadamba are preferred for making float. It is shaped with the help of
an adze making both the ends pointed. The booms are 15 to 16 feet
long and connected with float with the help of three wooden sticks.
One end of these sticks is inserted on the upper side of the float and
the other end is lashed with the booms with bark fiber. Holes are
made in the sides of the dugout to connect the booms. The booms
pass through these holes in both the sides and are lashed with the
sides by bark fiber. The outrigger is always attached to the starboard
side of the hull. They are propelled by one or two paddles. The blade
of the paddles is wider and thicker.

For turtle hunting a large and a small canoe are taken together.
Harpooning is done from smaller one and the bigger one is used for
storage. One may recall here similar theme depicted in Mesolithic rock-paintings in the prehistoric rock shelters in Uttar Pradesh.

This process of building a dugout is common in all the tribes, collectively called the Andamanese. The canoes of each tribe have some minor variations in shape, size or the method of attachment of outrigger, etc.

**Onges**

The Onges are native of little Andaman. They are inhabitants of Dugong creek of Middle Andaman. They make dugouts with a horizontally extended stem and stern attached with an outrigger. Their dugout slightly varies from others. The number of booms in their outrigger is only two. They do not burn the inner side of the trunk to hollow it, but use the adze. The stem and stern of their canoe have a distinct shape and are squarely cut. One person does the whole work of canoe making. The outriggers are 6-7.5 m long and 30-45 cm in circumference. They do not use crossbars to tie booms
The Onges use variety of local wood for building their canoes. A locally available bamboo (*Ficus religiosa*) is used to support the side planks of the canoe. A climber called *Hibiscus tiliaceus* is used as cordage for lashing.

**Sentinelese**

The Sentinelese, inhabitants of the North sentinel island off the West coast of South Andaman use dugouts with outriggers, which are small in size than other tribal canoes. Not much is known about the boat building tradition of Sentinelese because of their secluded nature and severe hostility to outsiders. They use dugout canoe with outriggers, which are smaller than the canoes of Onges. They are used for transportation, fishing and turtle hunting in the coastal waters. The Sentinelese use forest produces like trees, climbers, etc. for canoe making, they mostly use *Garcinia speciosa*.

**Jarawas**

Jarawas do not make or use dugout canoes or outriggers. They use raft made of bamboo or tree trunks in the shallow waters of the creeks, separating Middle and South Andaman. They are made of
two layers of bamboo tied together with bark. Each layer consists some 16 to 17 bamboos. They are tied together with the help of 3 or 4 bamboo placed at right angle and tied with strings of bark. The average size of the raft is 3 X 2 m. They are propelled by a long pole. Such rafts are mostly used in the creeks separating the middle and South Andaman.

**Mongoloids**

Nicobarese and Shompens belong to Mongoloid group. Their language, culture, habits, etc. are different from the Andamanese tribes. They inhabit all the islands South of Andaman with high concentration at Car Nicobar, Chowra, Katchal, Little Nicobar, Nancowry and Great Nicobar. The Shompens are found in the interior and coastal areas of Great Nicobar. The Nicobarese and Shompens have come in contact with outsiders.

**Nicobarese**

Nicobarese also use outrigger dugout although they are separated by the Andamanese by the sea stretching nearly 200 km. Still there are several similarities as well as differences in their crafts. Dugouts
of Nicobarese with outriggers show some variations in workmanship and structure. They do not have the extended platform at prow. Instead, a piece is attached to it, which extends vertically. The hull is heavily decorated with grooves and paints. The outrigger booms are always two in number. They are generally made of Thingam (*Prunas marthabensis*) and are 3 to 4.5 m long with 25 to 40 cm in circumference.

The boat building begins with the selection and felling of a suitable tree for the canoe. The either ends of the log are first rounded and shaped with adzes. Then the lower portion is shaped and upper portion is made flat. This flattened part is scooped till the desired thickness of the sides is achieved. The thickness is carefully monitored by making holes at a few places through which a stick is inserted to assess the thickness. Then, this roughly shaped canoe is burnt from inside and outside. The sides are expanded by applying pressure and inserting the wooden or bamboo reinforcements. Once the canoe is cooled and the shape is achieved these reinforcements are removed. To give the additional strength to the sides a bamboo is attached and lashed to the whole length of the gunwale. For lashing the bamboo holes are made at uniform distance.
The hull is beautifully decorated and the stem and stern are also shaped differently in different Islands. The canoes of Katchal and Kondool islands have a stem, which is very extensively drawn out horizontally with the tip bearing a wooden plate or flag. In the Chowra and Teressa Islands, the stem is drawn out to a pointed end with several crossbars. The extension of the stem is made by attaching a separate piece of wood.

The outriggers of Nicobarese dugouts are more developed in design and workmanship (Fig. 115). The outriggers are attached with only two booms. The booms are lashed by bark over the edge of gunwales and no holes are made in sides for them. The other end of the boom and float are attached with 8 short wooden sticks. One end of these sticks is inserted on the top of the float and other end is tightly lashed with the boom. The length of the float is almost equal to the dugout.

The shape of the stem and stern in the Nicobarese canoes, are vertically drawn out very extensively. This difference in the shape of stem and stern in Andamanese and Nicobarese canoes is due to distinct fishing habits. Andamanese fish by harpooning where as Nicobarese fish with net and arrow.
The Racing Canoes of Nicobarese

Nicobarese also built racing canoes for recreation. They are 20 to 25 m long and can carry up to 80 persons. Numerous bamboo crossbars are provided for the seating of the rowers. They are propelled by the oars only. The racing canoes are built in Car Nicobar, Chowra and Teressa islands. They are 20 to 30 m long and 80 to 90 cm wide. They are used for recreation only. They are driven by up to 80 oarsmen. Several, rectangular crossbars at a distance of about 35 to 45 cm are tied with gunwale to provide seats to rowers. A bamboo is lashed with the bark all along the gunwale to give additional strength. The stem is a little higher than the stern.

The construction of racing canoes is a joint effort. The time and manpower involved is enormous and at times, it takes about 6 months to complete one racing canoe.

The Nicobarese are said to be the best boat builders. They use a variety of woods for boat building. This includes Artocarpus chaplasha, Diploknema butyacea, Lania cormandalica, etc. Their boats also have mast and sail. The mast and outrigger are made of bamboo (Ficus beteropodus).
Shompens

The Shompens are confined to the interior and coastal belts of Great Nicobar. They use a dugout with outriggers which are extremely small and can carry only one or two persons at a time. These small dugouts can be used in rivers. They are about 10 feet long and less than one foot wide. These dugouts are the smallest among all the tribal vessels. They also make rafts. There are 7 - 8 cross bars and the stem is highly elevated than the stern. These canoes are so narrow that at a time it can accommodate only one person.

The outrigger is attached with only two booms, which are lashed over the gunwale with the bark. The boom is connected with the float by short wooden sticks. The canoe of Shompens is built with local woods namely *Artocarpus chaplasha*, *Calophyllum inophyllum*, *Sterculia macrophylla*, etc.

The boat building techniques at Andaman and Nicobar Islands are unique. The settlers who migrated from the mainland build their vessels according to the topography, weather and purpose of sailing. The tribes, with their age-old knowledge and limited needs
construct small dugout canoes with outriggers, which is an all weather craft. Difference in material, perfection and workmanship can be observed among the tribes as well. The Nicobarese construct boats of different pattern and size, exhibiting a higher workmanship and perfection. In comparison to that the Andamanese vessels are crude in design and building technology. No tribe borrowed or allowed any influence from new technology despite their contact with the settlers over a hundred years.

**Settler's Boat Building**

There is a great uniformity in boat building traditions of these islands. Plank built dinghies in islands show some modifications in size and building technology. They are used for fishing, generally within 10 km from the shore and transport between the islands. Changes or modifications in the traditional boats of settlers who migrated from Bengal and Andhra regions some two centuries back also reveals how the local environment effect the traditional boat building. The boats on the main land are still made as they were made few centuries back. A comparison of similar boats will tell the local effects forced by the environment.
Dhmghi is the main type of vessel used by the settlers. They are with or without keel. The Padauk (*Pterocarpus dalbergioides*) and Taungpeinne (*Artocarpus chaplasha*) wood are preferred for the construction of these boats. Unlike Lakshadweep group of islands, nails are used here in the construction of boat.

Dinghis are 5 to 10 m long and 1.25 to 1.5 m broad. Generally 3 oars are used, two propulsion and the third one for steering. Seldom are these Dinghies also provided with mast and sail. At least 3 thwarts are provided to give the strength to the hull. It is operated by three fishermen and can carry 3-5 tones.

Keel-less Dinghi are comparatively shorter in dimensions. The hull is made of local wood but better quality of wood, like teak or Jack tree, is used for making the stem and stern posts. They are generally used for fishing in near shore and propelled with three oars. The bigger oar which is used to steer the boat measures 3-4 m in length. It can carry up to 7 fishermen. Another variety of Dinghi is 10-12 m long and about 2 m wide. Their hull is provided with strong ribs.
Dhinghi (Keeless)

The keeless Dhinghis are plank built and used in shallow water. They are 12 to 36 feet long and about three and a half feet wide. There are made of 11 to 28 planks depending upon the nature and size of the vessel. Generally Taungpeinne (*Artocarpus chaplasha*) and Jackfruit tree is preferred construction of these vessels.

For constructing a *Dinghi* stem and stern are laid on two central planks. The stem post is 30-40 cm higher than stern. After that ribs are laid and nailed to the central plank at equal distances. They are ‘U’ shaped and made of 3 pieces; one central and two side logs. It follows fixing of side planks. The lowermost plank is widest and there is a uniform reduction in the subsequent planks. The planks are jointed edge to edge with nails. After the shell is made an additional plank is attached at the sides of the uppermost plank to strengthen the gunwales. A mast is provided in the mast step. A triangular sail is used in favourable wind conditions. The size of the sail and mast depend on the size of the vessel. The ratio of length of the boat and the mast is generally 1:5.
Jute fiber is used to plug the gaps between the planks. It is interesting to note that the coir which is easily available is not used for caulking. A paste, specially prepared and called gukkulu, is then applied over the gaps to make them watertight. The paste gets hardened with contact of water.

Construction of keeless Dhinghi requires 20-25 man-days. The vessel last for more than 10 years without any major repairs. It is suited in places where the sea bottom is rocky and shallow. Due to this they are constructed in Middle Andaman only and not in Nicobar and other Southern Island.

Dhinghi (Keeled)

Keeled Dhinghi is more elegant in shape and superior in technology. They are constructed in Middle and South Andaman Islands and propelled by oars only. They have a higher carrying capacity and are used in longer fishing voyages. They are 2.5 to 10 m long and 1.5 to 2 m broad. Construction of a medium sized Dhinghi require about 50-60 man days work. Keeled Dhinghis can carry as many as 12 persons and it last for 10 to 15 years.
For constructing a keeled Dhinghi the keel is laid first. It is made by joining three pieces together. Taungpenne (Artocarpus chaplasha) wood is used for keel while the side planks are made of padauk (Pterocarpus dalbergioides). The stem post is little higher than the stern. In some vessels it ends as a transom. At first four planks, two on either side, are added to the keel. Besides these, there are generally seven more planks on either side.

There are three different methods joining the planks. Edge to edge joining is considered better than the other two methods. The gaps between the planks are filled with jute and cotton. A paste made of naturally available resin is applied on the joints to make them watertight.

Once the shell is made the ribs are added. Padauk (Pterocarpus dalbergioides) and gurjan (Dipterocarpus sp) wood are preferred for ribs. They are arranged at a distance of about 60 cm and nailed with frame. Generally four thwarts and flooring is added. On completion of the construction both inside and outside of the vessel is treated.
Dhinghis are propelled by oars. They are generally three in number, having oblong shaped blade. One of the oars which is bigger in size is used as steering oar. Sometimes they also carry sail which is triangular in shape and made of thick cotton cloth. They are seasoned by boiling with a kind of wooden pieces, which make the sail stronger, besides imparting colour. A seasoned sail lasts for about two years. Sails are not very popular in these islands.

**Traditional Boats of Lakshadweep**

One of the best examples of co-existence of boats and men, in India, can be seen in Lakshadweep where boats or ships are related to all the major and minor events of their history, culture and also to all the activities of their life in one way or the other. Traditional boats are not only the art works of the local folk but also the result of their centuries long experience in the sea around them. These simple, crude looking boats represent the frontiers of the technology, which these societies possessed and could offer them. In other words a traditional craft of an area is the code of the prevailing sea conditions in that particular area (Tripathi, 1993).
Lakshadweep Island, off west coast of India, separated by deep sea, are irregularly scattered over nearly 77,000 sq. km. area in the Arabian sea between $8^\circ$ and $12^\circ30'$ north latitude and $70^\circ$ and $74^\circ$ east longitude. In this archipelago of 12 atolls, 3 reefs and 5 submerged banks only 10 islands (north to south - Chetlat, Bitra, Kiltan, Kadmat, Amini, Androth, Kavaratti, Agatti, Kalpeni and Minicoy) are inhabited. Though the Union Territory extend to a colossal three quarters of a million sq. km. But the land mass is merely 32 sq. km. which changes with seasons and tide.

The land area of inhabited islands is further less, only 26.2 sq. km. (Gazetteer, 1977:3). General pattern and disposition of all these island is almost identical and except Androth they lie north to south. These boat shaped coral islands have sandy beaches and lagoon on the western side and stormy beaches on eastern side. Though the area of these islands is limited to only a few sq. km. It is interesting to note the large variety of boats built and used there since antiquity.

History of boat building in Lakshadweep goes back to the arrival of man on these islands who would have reached here by no other means but a boat only. Not much is known about the early settlers of
Lakshadweep and the early history is based on various legends and local traditions (Saigal, 1990:35-39; Tripathi, 1994:125-127). In local tradition all major events of the history, discovery of these islands and culture and conversion of islanders to Islamic faith are related to ships (Tripathi, 1991:12-13). Boat was a must for islanders not only for trade or communication but also for their basic needs such as food and clothes. Islanders were, undoubtedly, master craftsmen, very good ship-builders and navigators. Their ships set voyages not only to the mainland but also crisscrossed the sea to distant lands. Till recently a variety of ships and boats were built and used in Lakshadweep.

Coconut Ship

In different islands different kinds of boats were built for specific purposes. These boats may bear some similarities in material, techniques or in shape or size with other boats built on Indian coast or elsewhere but there were also unique indigenous boats. These most remarkable boats were made entirely of diverse products of the coconut tree locally available in abundance.
The keel used to be made of strong coconut trunk and so the planks, ribs and other parts. Planks were holed and stitched together, again, with coir. Afterwards these holes were filled with coconut husk and katharanam. Mast, ropes and even sails were also made of coconut products. Oars, steering gear and all other parts and fittings were also made of the coconut tree (Gazetteer, 1977:145).

It indicates the adoptability of the boat builders of these islands to use coconut wood. Probably the wood used for building boats on mainland would not have been economically viable for these copra and coir producer islanders. Besides that transportation of timber from mainland by the returning Odams loaded with rice and other necessary commodities bartered with copra, coir and marine products like tortoise shells, cowri etc. would not have been easy. The economical viability and transportation of timber from mainland would have forced them to exploit their own resources and to find a substitute in locally available wood.

Coconut wood is still used in local boats. Such changes in boat building through increase in communication with outside world can be seen in every island but the southernmost island Minicoy was more adoptive to new techniques than the other northern islands.
Boats of Lakshadweep can broadly be divided into two categories based on their use (I) trading vessels and (II) Fishing vessels or according to the regions where they are built and used (I) Boats of Minicoy and (II) Boats of Northern Islands.

Minicoy Boats

Traditional boats of Minicoy (8°17’N, 73°04’E) are said to be superior to the crafts of Northern islands. Sailing vessels of Northern islands generally used to ply between islands and mainland whereas sailing vessels of Minicoy used to sail to Bengal via Colombo and Nicobar Islands and also to Maldives, Burma, Arabia Persian gulf and Singapore.

By the end of the last century large sailing vessels with a carrying capacity up to 400 tons were built in Minicoy. Vessel of 400 tons Bareues and 200 tons Odi were the largest sailing vessels of Lakshadweep. These decked, vessels with two masts were very seaworthy with 2-3 square-rigged sails on foremast and square rigged or lateen sail on aft. They were piloted by the Thakrufans.
Present small ships belong to the third type of sailing vessels (Band Odies) of Minicoy. These vessels of Minicoy were square rigged, seaworthy and strong built with iron nails unlike other boats of Northern islands.

**Odam**

In Northern islands the most widely used traditional craft is Dweep Odam or Valiya Odam. This fair weather crafts was used for centuries for mainland trade and transportation. These two-masted vessels with a low draught have lateen sails. They are decked and have a cabin and a Chathri on the poop to accommodate the crew. No nail is used throughout the structure of these boats and they are stitched and carvel built.

**Fishing Crafts**

Besides large ships a variety of small and medium size boats for fishing and other purposes were also built. Different kinds of boats bear different names and are used for specific purposes. (Tripathi, 1993)
Table 5.1  Trading vessel of Lakshadweep

<table>
<thead>
<tr>
<th>No</th>
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<th>Carrying Capacity</th>
<th>Mast / Sail</th>
<th>Island</th>
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<tr>
<td>1</td>
<td>Bareues</td>
<td>400 tons</td>
<td>2 masts, 2-4 square rigged and lateen sails</td>
<td>Minicoy</td>
</tr>
<tr>
<td>2</td>
<td>Odies</td>
<td>200 tons</td>
<td>2 masts, 2-4 square rigged and lateen sails</td>
<td>Minicoy</td>
</tr>
<tr>
<td>3</td>
<td>Bandodies</td>
<td>70 tons</td>
<td>2 masts, 2-4 square rigged and lateen sails</td>
<td>Minicoy</td>
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<tr>
<td>4</td>
<td>Dweep Odam or Valiya Odam</td>
<td>50 tons</td>
<td>2 mates, lateen sails</td>
<td>Northern Islands</td>
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</tbody>
</table>
Tharappan is the simplest form of fishing crafts in which unfinished, light wooden logs are tied together at 3 or 4 places with the coir rope. They are of two kinds. Valiya Tharappan and Cheriya Tharappan. In Valiya Tharappan 14 logs are tied together whereas in Cheriya Tharappan 4 to 8 logs are used. The outermost logs are kept comparatively longer than the others. These rafts are moved with the help of a long bamboo and are used for fishing in the lagoon. Tharappan reminds one of similar practice in northwestern Maharashtra and adjoining areas of Gujarat where Banana tree trunks Fastened together in similar fashion are used in ponds by local villagers.

Odam is the main crafts of Lakshadweep. Valiya Odam are used for mainland trade whereas Cheriya Odam are small canoes used for fishing. Based on the size and number of oars used it is further subdivided into four categories – Chottu, Naluvalikinde, Aruvalikinde and Ettuvalikinde. In ancient times these boats were made entirely of coconut wood but now other woods like lyini or teak is also used.

Mas Odis are peculiar pole-and-line tuna-fishing boats of Minicoy. They were also made of coconut wood earlier. These boats are keeled and have two masts with lateen sails, of which the forward one is taller than the mizzen. These boats can sail windward and are
also propelled with 14-18 oars of 3.5 to 4 m long coconut wood handle. Hull is divided in compartments by perforated planks for live bait, and other compartments for fish hold and fishing accessories. A fishing platform at the stern is provided for rod-and-line fishing. These crafts are hauled to shore in the evening on every Thursday and launched on Friday evening.

*Odi Jahadhoni* does not have fishing platform and is mainly used for towing sailing vessels from lagoon to outer sea. *Mahajahadhoni* like *Mas Odi* has fishing platform, inter-compartmental etc. but has better stability and is used in monsoon season too. A small boat with a fishing platform at aft is used by master fisherman, *kelus*, for fishing or live bait collection in lagoon and is called *Kellukkam Dhoni*. *Allam dhoni* or *Dhoni Ara Dhoni* is also used in lagoon for hand line operation.

Besides these trade and fishing crafts, long beautifully decorated boats of Minicoy *Jhaha Dhonis* need special mention. These narrow and sleek boats were used for race in lagoon on special occasions. Thirty-two rowers sitting in a line use their oars left and right
<table>
<thead>
<tr>
<th>No</th>
<th>Vessel</th>
<th>Length m.</th>
<th>Width m.</th>
<th>Height m.</th>
<th>Propelled by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tharappan (Raft)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Valiya Tharappan</td>
<td>6.60</td>
<td>1.50</td>
<td>-</td>
<td>Bamboo</td>
</tr>
<tr>
<td>1.2</td>
<td>Cheriya Tharappan</td>
<td>4.50</td>
<td>1.00</td>
<td>-</td>
<td>Bamboo</td>
</tr>
<tr>
<td>2</td>
<td>Odam (Reef Boat)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Chottu</td>
<td>3.00</td>
<td>1.00</td>
<td>0.35</td>
<td>2 oars / lateen</td>
</tr>
<tr>
<td>2.2</td>
<td>Naluvalikinde or</td>
<td>5.00</td>
<td>1.30</td>
<td>0.40</td>
<td>4 oars / lateen</td>
</tr>
<tr>
<td></td>
<td>Naluvalikkuna Thoni</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Aruvalikinde or</td>
<td>6.00</td>
<td>1.70</td>
<td>0.50</td>
<td>6 oars / lateen</td>
</tr>
<tr>
<td></td>
<td>Aruvalikkuna Thoni</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Ettuvlikinde</td>
<td>8.00</td>
<td>2.00</td>
<td>0.70</td>
<td>8 oars / lateen</td>
</tr>
<tr>
<td>3</td>
<td>Mas Odi</td>
<td>10.12</td>
<td>2.75</td>
<td>-</td>
<td>14-18 oars /</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 lateen</td>
</tr>
<tr>
<td>4</td>
<td>Odi Jahadhoni</td>
<td>10.00</td>
<td>2.60</td>
<td>-</td>
<td>Oars / sail</td>
</tr>
<tr>
<td>5</td>
<td>Mahadha Dhoni</td>
<td>8.30</td>
<td>5.60</td>
<td>-</td>
<td>Oars / sail</td>
</tr>
<tr>
<td>6</td>
<td>Kelukkam Dhoni</td>
<td>6.70</td>
<td>2.30</td>
<td>-</td>
<td>Oars / sail</td>
</tr>
<tr>
<td>7</td>
<td>Allam Dhoni or</td>
<td>5.00</td>
<td>1.70</td>
<td>-</td>
<td>Oars / sail</td>
</tr>
<tr>
<td></td>
<td>Dhoni Ara Dhoni</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table - 5.3 Race Boat of Lakshadweep

<table>
<thead>
<tr>
<th>No</th>
<th>Vessel</th>
<th>Length m.</th>
<th>Width m.</th>
<th>Height m.</th>
<th>Propelled by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jhaha Dhoni</td>
<td>20.00</td>
<td>1.50</td>
<td>0.50</td>
<td>32 oars</td>
</tr>
</tbody>
</table>

alternately, to pull the boat with the high speed. These race boats are most beautifully decorated and tastefully painted with bright colours. Earlier Jhaha Dhonis were owned by all the Athiris but now only a few such boats survive in the islands.

**Boat Building Technology**

Odam is the most widely used typical boat of Lakshadweep. The first step to build an Odam is the laying out of keel. For curved aft and rear parts, first two strong “v” shaped wood having two arms are carefully selected and then a strong keel proper is laid horizontally on ground. Once the keel is laid out first horizontal planks or garboard strakes are fastened to either side of it and later other planks are stitched with coconut fiber to their outer edge. Boats of Lakshadweep are sewn and carvel built with, edge to edge joined planks. For joining the planks their surface is smoothened. To make
the joints waterproof a cloth of cotton dipped in a mixture of boiled crude oil and Malabar dammer (katharanam) is placed in between these joining edges. Once the structure is prepared ribs are cut accordingly and fixed with the hull and planks with the help of wooden pins and coir rope at intervals.

Odams have a raised pointed bow and transverse thwarts. They are also decked with a removable thatched roof amidships and have a small cabin and a Chathri, to accommodate the crew. There is also a bunghole to drain out water. The inner surface of the hull is located with shark liver oil or other fish oil Belakkenna, whereas outer side is given a tar coating or coloured black with oil charcoal mixture and dried in the sun. Seasoning by application of oil and tar coating not only prevents leakage but also gives strength to the planks and provides some protection against marine woodborers (Santhakumaran, 1990:101). These crafts have two masts on which lateen sails are used along with one or more fore sails. Sometimes oars are also used. These oars are 3.5 to 4 m long and have a handle of coconut wood with 20 x 30 cm blade tied on one end. Vessels made in this fashion have a lifetime of 40 years (Tripathi, 1993).
Boats in Lakshadweep were not built for sale but only for the use of islanders. Construction of a traditional vessel is a time taking procedure, which includes many traditional rituals too. These boats are distinct in regard to lines, workmanship and finish from similar boats of west coast of India.

**Stitching**

All traditional boats of Lakshadweep, except some of Minicoy, in which exceptionally iron nails are used, are stitched with coir (Hourani, 1975:91-92). For stitching planks together small holes are bored near the edge at a distance of 4-6 cm from each other and 2-3 cm from the edge. Dried coconut husk along with coir rope is placed above the joints and then planks are stitched together enclosing the husk and coir with specially spun coir rope of 2-3 mm diameter. For preparing the coir for stitches husk is not soaked in water but the fiber is abstracted from green husk. Grooves and holes bored for passing the stitches are later filled tightly with small pieces of dried coconut husk and *katharanam* from both the sides. These stitches are straight, vertical or horizontal, on outer surface. Boat builders of Lakshadweep are still having mastery in this age-old technique of sewn ships and no nail is used throughout the structure.
Material

Earlier Lakshadweep boats were made entirely of diverse products of coconut tree, from structure to fittings but later other woods were also used. The keel is now generally of iyini (Artocarpus lokdocha), Karimaruthu (Terminalia tomentosa) or Uruppu. Coconut wood is now used for bulwarks, masts, cross stays, side ribs etc. In other parts such as deck under the poop, cabin, and removable thatched roof amidships etc. mango tree wood or breadfruit tree (Artocarpus incisa) is used. Venteak, Poon, Thespesia wood is also used in some boats. Coir is still used for ropes and stitches and thick cotton for sails.

Construction Material

Antony Lambert wrote in 1802 about the materials of which the Bengal ships were constructed. They are made of teak timber and planks imported from Pegu; saul and Sisoo timber from Bihar, Oudh, Bengal and Behar. The ribs, knees and breast-hooks or the frame of the ship are composed generally of sisoo timber, the beams and inside planks of saul, and the bottoms, sides, decks, keels, sternposts, etc. of teak.
Timber has long been the traditional material for boat and shipbuilding. This is because of its buoyant nature as well as its ability to mold and shape it. The low density of timbers facilitates easy joining and fastening. It can be cut in planks of different thickness and sizes, according to requirement, to construct the structures of any shape or size. High strength of the wooden hull makes them resistant to the buffettings and bumping encountered by a ship.

The abundance and variety of construction materials available for shipbuilding, in India, gave ancient Indian shipbuilders a tremendous scope to select a variety of timbers to build their ships. The builders of small crafts made many experiments and had a greater choice to select different type of wood. In the process many species of trees were found suitable for shipbuilding. Some of these varieties could be used in their natural state and several others were used after treatment and seasoning to withstand the rigors of a marine environment.

The ancient shipbuilders had a good knowledge of the varieties and properties of wood. These timbers were classified in four groups according to their properties. The ancient Indian shipwrights used a
variety of locally available wood in building their ships. For sea going ships the timbers were selected carefully and were also imported from other regions. There was the reluctance to use unknown varieties. The excellence of Indian teak for shipbuilding and its durability are well known. The habitually specified mahogany, oak and rock-elm was used for the main parts of the ship. Arabs and Persians also imported teak wood or coconut wood from India to make strong ships.

The Periplus of the Erythrean Sea enumerates "timbers of teakwood and logs of Blackwood and ebony" among the items of exported from Borygaza (Broach) to the ports on the Persian Gulf coast. The evidence of teakwood in the palace of Nebuchadnezzar (604 - 562 B.C.) and in the Temple of Moon-God rebuilt by Nebuchadnezzar and Nabonidus (555 - 538 B.C.) recalls the earlier import of teakwood into Mesopotamia probably form India.

Teakwood, blackwood or sissum, ebony, cedar, mango, khair, fir, pine are traditionally preferred for building ships in India since antiquity. The timber preferred for the construction of catamarans in Ceylon and along the Eastern and Western coasts of India is the
dup wood, or the piney tree (cherne maram). Canoes of the Malabar coast are made of the angeley-wood tree (*Artocarpus hirsuta*).

The Nivar tree which has heavy and tough wood is used for making boat knees. Wood of Pangara tree, known as mochi wood, is used for making rafts. Lightwood of silk cotton tree Savar, is hollowed and used for canoes. The *Balyav* on the west coast is made of teak. The *Hodi* is build by using locally available wood of mango and jack tree. Sailing ship like *Baglas Kothias*, *Machva*, *Padav* and *Navdi* are built of Malabar and Burma teak. The Gujarat Batela and Machva are constructed mainly of *Bulsar teak*. *Shibadis*, *Balaos*, *Galbats*, *Mhangiris* and *Fatehmaris* are constructed of Malabar and Bulsar teak as well as undy wood. The Undi-wood is considered as equal to Malabar teak.

All kinds of trees were used to build the various parts of the ship. Panhai or Pooni wood is used for masts as this wood can stand the pressure of the wind better. Masts made of teak or any other hard wood is liable to crack in heavy storms.

The most common traditional method of joining the hull planking is stitching them together. This sewing is done with coir, twine, ropes,
etc. Among tree-fibers that of the coconut was commonly used. Marco Polo has given interesting account of making coir ropes. He writes "They beat this nut until it becomes like horse-hair, and from that they spin the twine". The nut mentioned by him can be easily identified with the cocoanut.

Metal nails were not used by ancient Indian shipbuilders. Bhoja has given the reason for not using iron nails in the hull of the ship as these nails would be influenced by the magnetic rocks in the sea and the ship may sink. Foreign travelers also testified that Indian ships had no iron fastenings. It is a well known fact that the rusting of iron nail causes problems in the maintenance of the ship. To avoid it ancient Indian shipbuilders developed and adopted other methods of joining the planks. Instead they used treenails, wooden pegs and wedges of wood. The use of iron nails in traditional ships is rare. It started in some parts only after the arrival of Portuguese.

A variety of materials were used for caulking by ancient and traditional shipbuilders along the Indian coastline. These materials varied depending upon the availability of raw materials in various parts of the country. These substances used to join the planking, in
ancient times, were extracts of trees, animals or some time simple locally available materials like clay.

Natural substances like clay and moss were used for caulking in primitive canoes. Traditional boat builders prepared and used a variety of caulking materials from locally available materials. These local products were mixed with some other substances to produce a waterproof cementing material.

A variety of vegetable oils, including groundnut oil, coconut oil and linseed oil were used for preparing caulking materials for boat building. Glues extracted from plants and trees in local forests were also popular. Caulking material varied from place to place. A paste, *lambi* is prepared and used by boat builders on Bombay coast. To prepare the past locally produced resin and linseed oil are boiled together. Local chunam is added to it to prepare the caulking paste. Another caulking material, locally known as galgal, is also used along the Maharashtra coast. On Gujarat coast a preparation by mixing of Chandrus and Ral is used.
Besides vegetable products certain animal products were also used for preparing cementing materials. The fish oils were also used for the caulking. The Whale-oil is said to be mixed with other materials which was applied on the joints of the planking. Use of oakum for caulking was also popular.

Construction and Parts

Before applying the caulking materials the gaps are filled with various fibrous materials like cotton, jute, coir, etc. These fibrous materials are filled in the gaps with the help of chisel and hammers.

Cotton, jute and coir was also used to produce various other components of the ship like sails, yards and ropes for the rigging, etc.

Keel

The keel is the principal timber in any vessel. The strength of the hull greatly depends on the keel and its fittings, frames. It can be compared with backbone and ribs in human body. However it is the most important part of the ship but it is neither described nor
indicated in ancient representations. The portrayals of ships in sculptures, paintings and on coins depict no details of the keel. The hull in most of the depictions is often unrealistic and stereotyped.

Deck

There are not much information about the type of decks in ancient Indian ships. Most of the traditional boats and ships have some sort of a deck. Descriptions of huge ships carrying hundreds of passengers suggest that they were having decks. Accommodating a large number of passengers is not possible without having some arrangements of decks. The ship with three masts and rectangular sails painted in the murals of Ajanta also depicts a poop deck. The ships carved in the temples of Delwara also show several decks.

The deck in traditional boats, appears when the hull assumes large dimensions. It was found very useful particularly in a sea-going vessel. Provision of deck not only provided roof to the ship’s hold but also increased the area of activity many folds. With the introduction of deck the goods could be stored under the deck safely. It protected them from sun, wind and rains. Besides it provided a large area for
the movement of the ships crew and prevented the ship from taking in seawater while rolling and pitching.

Cabin

Super structure of a ship is very important feature. Ships engaged in long distance voyages required sufficient accommodation for the crew and passengers. A shelter from sun, wind and the rain was also necessary for safe journeys not only for the crew but also for the goods. Initially in early ships such super structures were small cabins amidships. These cabins were probably thatched shed made of the reeds from which the very ships used to be built.

Terracotta emulate found at Mohen-jo-daro depicts a cabin amidships. Boats carved on the stupas at Sanchi and Amravati also have similar super structure. Ships in the murals of Ajanta also have a cabin. The Yuktilkalpataru of Bhoja classify the ships on the basis of the length and position of the super structure, i.e. Sarvamandira, madhyamandira and agramandira types.
Mast

Mast is essential for hoisting the sail. Therefore it was essential part of a sea-going vessel. Masts are noticed on Indian vessels since the Harappan times. It is a long piece or system of pieces of timbers, which are placed nearly perpendicular to the hull on which the sails are hoisted. The position of masts depends on the number of masts. The single mast is positioned amidships. A ship having two or three masts would arrange them in such a way so as to keep up the balance of the vessel. Ships with masts are also depicted on the Andhra-Satavahan and Pallava coins, sculptures and paintings. Increase in the number of masts suggests sophistication as well as increase in the dimensions of the ship. Masts are named variously. In smaller boats bamboo is use as mast but the bigger ships have compound masts also. They are supported with yards and stays. In ancient literature also there are mention of the masts and their functions. Milinda Panha refers to the function of the mast as to carry ropes, braces, and sails. The arrangement at the top of the mast to hold a man also provided possibility of sighting of land from distance. The Yuktikalpataru mentions that a vessel having four, three, two and one mast is to be painted white, red, yellow or blue, respectively.
Yard

Yard is a spar suspended to the mast for the purpose of extending a sail. It is locally called Parman or Parban.

Sail

The earliest sails were square or rectangular in shape. They were probably made of mats or of some strong cloth. They caught the enough wind to push the ships but it would not have been very easy to track the ship in changing winds. Square or rectangular sail were perhaps used by Harappans also in their reed ships, although, there is no direct material evidence to support it. The Ajanta mural show rectangular sails.

The lateen sail was also used by Indian seafarers. On the basis of the ship representations on the Andhra coins, Lallanji Gopal has suggested that lateen sail was not unknown in ancient India. However, it is believed that the lateen-sail is not indigenous but borrowed from other countries. Numbers of sails depend on the number of masts, size of the ship and her rigging.
Sail Cloth

Cotton cloth was preferred for the sails. Sails made of jute and coir was also used in some of the traditional Indian vessels. Ancient Indian shipbuilders used a coarse cotton cloth, dhoti. Sails were treated in various ways to make them strong and long lasting.

Oars are the earliest device for propulsion. *Rgveda* mention *Aritra*. It is a light pole with a blade attached on the other end. The shape and size of blade as well as the length of the pole depend on the size and the construction of the boat. Till the introduction of rudder, oars were used to steer the ancient Indian ships also. Many ancient Indian ships datable to 12th – 13th century A.D. depict oars as the only steering gear. The depiction of rudder is rare and found only in the representations of later period.

Outrigger

The out-rigger is a wooden log or float attached to the hull of the boat with the help of long poles or spars. The purpose of the outrigger is to balance a ship and prevent it from capsizing. The traditional Indian ships were well built and strong enough to carryout
sea voyages safely. The use of outrigger in ancient Indian sailing ships does not seem popular or essential to ensure balance and safety. Many seagoing traditional Indian boats, however, used outrigger for better safety.

Anchor

An anchor is a must for a voyage in the sea. Early anchors were made of stones. Stone Anchors are as important in the study of ancient shipping as the potsherds in the archaeology. Frost called them potsherds of Marine Archaeology "because both serve as evidence in system of deduction" (Frost, 1973: 397).

Ancient Anchors provide a number of valuable information alike other artifacts. Their detailed but very careful study is proved very useful to understand the seafaring activities in a better perspective like other ingredients of the archaeological data. This antiquity of earliest economically viable, non-perishable material, used by the seamen plays a significant role, though in a limited way, to identify the nature of the ship, her voyages, development of shipping and also help up to great extent to assess the differing degrees of culture, trade relations of the ancient civilizations and to pull the
antiquities in a chronological order. Study of ancient anchors has played a great role in the search and to reconstruct missing links of the Maritime History (Tripathi, 1988: 259 – 269).

The anchor is called *nangara* in Sanskrit and mentioned as *lankaro* in the Buddhist works. *Milinda Panha* also describes its functions. *Tilakmanjari* gives very interesting information about ancient anchors. According to it when a ship halted, its heavy anchors made of rocks were lowered down. Underwater archaeological researches have proved that the ancient Indian ships were using stone anchors for several millennia.

Marine dictionary defines an anchor as “a heavy forgoing or casting comprising a shank with large shackle or ring at one end and two arms with palms at the other, so shaped as to grip the sea bottom and by means of a cable or rope hold a vessel, boat or any other floating structure in a desired position regardless of wind and current” (Kerchone, 1961: 13). But it is a picture of modern anchor, which reached to this form after long evolution which is the result of the experiences gained and dangers witnessed by seamen in last thousands of years.
In the earliest stage a stone of no particular shape lashed to a rope, was used to moor most probably small canoes. The practice is still continued in sailors. Such stones tied with rope or with a piece of fishing net to secure small fishing boats were noticed by researchers in course of his study on Konkan coast. But the practice was not found convenient and effective although viable economically.

Friction caused by waves and currents would have cut the ropes thus such anchors would have been found of not much use on hard bottoms. The need to tie the rope in a safer way would have been realized therefore emerged the anchors. These earliest anchors were nothing but a stone with a hole to tie the rope. Single holed crude stones and lumps of coral to moor small boats are still in use on many places (Chittick, 1980:76).

With the development of shipping pierced stone, which were poor in holding on the sea bottom, was also needed to give a suitable shape to meet increasing requirements. Consequently anchors acquired more longish shape with new experiences and development of knowledge. In the process of giving suitable shape conducive to quick and good holding power under different conditions, strength to hold the vessel, quick tripping, freedom from fouling, facilities of
stowing, sweeping and transport in or by boat it passed through several changes and modifications were made in shape and size.

This process to bring excellence gave anchors various popular shapes i.e. round, elliptical, triangular, square, rectangular, trapezoidal, rhomboid, polygonal etc., which are of immense, help to study their origin and chronology. The need for better grip to increase holding power on the bottom led to make another hole on the other end of the stone to accommodate a straight wooden arm. Two holed flat, ovoid stone anchors with wooden arm are still in use at some places (Chittich, 1980:75-76).

Furthermore number of holes increased to three to give added strength. Round straight arms could not meet their requirements against heavy current and winds, where in great strain they were likely to come out. It was also not possible to fix curved arms therefore round holes slowly turned to square or rectangular. Further efforts were made with modification of two square, V or L shaped arms, pointed on one end and in all probabilities one each side for excellent quick grip and good enough holding power. These trapezoidal three-holed anchors of stone with turned arms further developed in four-armed long stone shank. This is the last stage of
stone anchors which lead to stone stocked wooden anchors. It is gratifying to note the largest stone anchor is found on Indian coast, off Mandapam in Tamil Nadu.

Kapitan has given a little different evolution of anchor (Kapitan, 1984:35). It is evident that the trapezoidal stone anchors do not mark the last stage and later stone anchor shanks were developed and used widely. The evolution of stone anchors suggested by the researcher is more practicable. It is based on the detailed study of stone anchors and earlier works by other scholars on the subject. The hypothesis of researcher is also strengthened by various other evidence and later forms of anchors.

Stone stocked wooden anchors, the next step in evolution, also had V shaped arms, similar to the hooks suggested with three holed stone anchors. It also dose not appears acceptable that the whole concept and the form of anchor changed and modified at once. The change in shape of the anchor was gradual where stone shank was replaced by wood and a stock was introduced to add sufficient weight.
Anchors are comparatively very small in size but it does not affect their great importance. Anchors used and left behind a ship provide a number of valuable information about her. Anchors made of different materials in various shapes and sizes, different origin and stages of their evolution, are largely found from several sites in India and other places. In many cases the ships which used these anchors do not survive and we find only the anchors which can reveal information about the ship. These anchors are not only recorded from the ocean floors or collected from the shores but have also been found in excavations on the land.

Ancient anchors were so simple in look that in some cases it is difficult to recognize them correctly. Anchors made of stones were also reused as building blocks by later people. On the contrary sometimes their great importance for a safe voyage and lives of seamen was realized by others and several anchors are found worshipped as a sacred object. Worship of anchors proves its importance in seafaring.

A careful study reveals several valuable information to reconstruct the missing links of the maritime history and to understand seafaring activities. It plays a significant role, though in a limited way, to
identify the nature of ship and her voyage. Shape, size and material of an anchor tell about its origin, ancient routes (Rao, 1987:53; Frost, 1985:281-321) and also can indicate the frequency of the traffic.

Size and the weight of an anchor are directly related to the size of a ship and its carrying capacity but one has to take into account the nature of the ship. A heavier anchor is not an indication always for bigger ship. Anchor used by the sailing ships were heavier in comparison to the ships of same size propelled by other means. As the same size of ships used anchors of different size so the same size of anchors may belong to ships of different sizes. Finding of less number of big anchors also does not show the less number of big ships but they generally did not lose them. Minute differences in size, shape, position etc. may indicate towards several important aspects of ancient seafaring.

Beside, natural factors also played a significant role and researcher must keep these factors in account along with the climatic, environmental, geographical, geophysical and other related studies. All care should be taken in interpretation of data before reaching on any conclusion.
In India the antiquity of anchors can be traced back to third millennium BC. A triangular stone anchor has been identified hung on a ship engraved on a square seal (find No. 2125) unearthed from ‘F’ area at Harappa. Ancient anchors are not only depicted in art but have also been found in excavations too. Some stones from Mohenjo-daro and Harappa have been identified by Haribishnu Sarkar as anchors. Five single hole stones, four round and one trapezoidal in shape, unearthed at Lothal have also been identified as anchors datable to 1900 BC (Rao, 1973:125; 1979:132, Pl. CVI-b; 1985:56, 577, Pl. CCLX a – CCLXI a, fig. 126; 1988: Pl.2).

A number of anchors made of stone and weighing 100-672 kg were discovered in Arabian Sea. Anchors found on the sea bottom speak about maritime activities, trade and cultural contacts with distant lands and the nature of harbour. A deep corollary found between a ship and her anchor, reveals valuable information to identify the nature of a ship, her voyages, development of shipping, trade and cultural contacts with distant lands apart from solving various difficult problems like dating (Tripathi, 1988: 259 – 269).
Traditional Indian boats also used a variety of anchors which developed locally. Naturally turned wood was commonly used to make the anchors. The anchor of the Dhoni was made by lashing together three crooked branches of a tree. Putting the weight was necessary with wooden anchors to sink them to the bottom. It was loaded with heavy stones. The anchor was tied with thick ropes made of coir.

Crew

Kautilya’s Arthasastra mentions that the ship was controlled by the captain (sasaka). The crew of tradition boats and ships is known differently in different regional languages. The captain of the ship is known variously as nakhwa or nakhuda, Tinde or Tandel.

Ancient Jain works refer to the crew (jabbhija) including pilot (nijamaya) and boatmen (Kuchhidharaya). The pilot who takes the ship in or out of a harbour or Channel is called Bhoyo or Arhati.
The Amarkosa also mention the guide (niyamka) as the crew of a vessel. The assistant or the officer under captain is called Malum or Sarang.

Kautilya’s Arthasastra mentions the crew of a ship. The ship was controlled by the captain (sasaka) and operated with the help of pilot or steersman (niyamaka), holder of sickle (datragrahaka), probably carpenter to repair the ship, holder of ropes (rasmigrahaka) and servant to pour out water (utsecaka). The Ramayana also mentions helmsman and oarsmen. Ancient Jain works refer to the crew (jabbhijja) including helmsman (kansadhara), pilot (nijjamaya) and boatmen (Kuchhidharaya).

The crew of traditional boats and ships is known differently in different regional languages. Sailors are commonly known as Khalasis. In Kachchha Hindu sailors are known as Kharwas where as Mohammedan sailors are known as Bhadalas. In Kathiawar the Mohammedan sailors are known as Kahavalias. In Maharashtra sailors are known as Kolis, Bhandaris, Bankotis and Malwanis, etc. The steersman of the boat is called Sukani.
*Arthasastra* mentions that the ship was operated with the help of pilot or steersman (*niyamaka*). The *Ramayana* also mentions helmsman and oarsmen. Ancient Jain works refer to the crew including helmsman (*kamadhara*). The *Amarkosa* also mention the helmsman (*kamadhara*).

The study of traditional boats is not an isolated but an overall study of the societies, which made and used them. A serious study of traditional boats can play an important role to solve some of the problems, which are still not solved due to lack of archaeological evidence. A minute scientific study of traditional crafts and their comparison with those depicted in ancient art or described in ancient literature throw fresh light on the ancient shipping and shipbuilding.

Topography and physical parameters also play a great role in deciding the shape and size of the boats. Besides that cultural background and traditions are also important factors. Physiographic formation, general pattern and disposition of all the islands in Lakshadweep are almost identical. They have sandy beach and lagoon on one side and the stormy beach on the other but a clear difference is seen in the boats of Minicoy and Northern Islands. It is well known that culturally Minicoy is different from other islands,
which is also reflected in boat building technology. Their contact with outside world have made them adoptive to new ideas and techniques in shipbuilding.

The arrival of Portuguese in Indian waters affected age-old Indian traditional boat building techniques. The use of iron nails was introduced which was adopted by some boat builders in mainland as well as in islands. In Lakshadweep, Minicoy alone adopted this change otherwise no nail is used in Lakshadweep boats through out the structure.

With the modernization of shipping industry, traditional boat building has come to a standstill and popularization of light mechanized boats has proved a great danger to traditional boat building. This change in boat building needs a through study and proper documentation of these age old traditions, technology, traditional boats and their builders, some of which still surviving (Tripathi, 1993).

Boats of Andaman and Nicobar represent the earliest stage of evolution of Indian shipbuilding. The traditional boats and ships of
Lakshadweep are the representatives of various stages of development. Besides them a large variety of ships and boats are built and used on the Indian coasts. The variety is so great that they cannot be described in a monograph. The variety of these traditional vessels can be imagined from the very fact that there are hundreds of names and types of these boats. Some of the traditional crafts built and used on the western coast are mentioned below.

**Bagla**

This is one of the most ancient traditional ships. Its average length is about 15 m and capacity varies from 50 to 400 tons. It has straight keel and high poop which forms a cabin. It generally has two masts which carry lateen sails. Some of the large ships have three masts. The poop is used by the Captain (*nakhoda*). They are built of Malabar timbers and the crew averages 30 men. The prow in some cases prow ends in a figurehead. The peculiarity of form of these vessels is said to have remained unchanged for about two millennia.

**Balav**

The *Balav* or *Balyav* is a peculiar fishing boat of Konkan coast. It is built as *machhva* but is lighter than them. It has one mast and a
single lateen sail and goes for deep-sea fishing. The crew of the
*balav* averages about 15 men.

**Barkas**

Ordinary coasting crafts on Maharashtra coast are popularly known as *barkas*.

**Batela**

The name *Batela or Batille* probably derived from Portuguese *botel* meaning boat. It is larger type of *padav* having carrying capacity from 20 to 200 ton depending upon its size. It has two masts and carries three sails and the jib at front. It has a crew of eight to twelve sailors. The Gujarat *batela* is deep-sea coasters.

**Botel**

*Botel* is a vessel with two-masts, high poop and a heavy sternpost and rudder. It has average length of about 20 m and capacity about 85 tons. In vessels of different sizes it varies from 50 to 150 tons. Its carved sternpost is a distinguishing factor. They are built in a rough
manner and also have decks at fore and aft. Makran Botel is a lateen-rigged vessel used in the sea.

Canoes

Canoes used on Indian coasts are of two kinds - hollowed tree-trunks and plank-built. Plank-built canoes are more popular on Gujarat coast where as dugout canoes are popular on the Malabar Coast.

Due to the suitability of their shapes and forms Canoes are largely used in rivers, inland waters and also in the open sea. They vary from 8 to 25 feet in length. They are propelled and steered with oars. Some of them also have a mast made of bamboo and a small lateen sail. The canoes which are used in the sea have an outrigger to balance them so that they do not capsize in the rough sea. The canoes on the Maharashtra coast are known as hodi, toni, shipil and barakin.
Dhingi

The name Dhingi probably derived from a Dravidian term and corrupted into the English as dingy. Dhingi is comparatively smaller than the Arab dhau or Dav. Average Dhingi is about 50 feet long and has average capacity of 60 tons. The carrying capacity varies from 20 to 170 tons according to their size. It has two masts and no deck. The crew number from 10 to 25. The hull has peaked keel and gunwale line rising slightly to the bow. The rudder is hung in a peculiar way which leaves a considerable space between it and the stern. It is generally built of Malabar teak at the mouth of the Indus and is popular on the Makran, Sind and Kachchh coasts. These vessels are well designed and sails to a speed up to 10 knots under favourable wind. Sindh Dingi is a lateen-rigged vessel used in the sea. It is a peak-keeled vessel.

Dobash Boat

A special class of large balavs is known as Dobash boats. They are 20 to 25 m long having carrying capacity from 10 to 25 tons. Some of these boats have two masts. The main mast is 10 to 12 m high and carries a large lateen sail. They are seaworthy vessels and set
voyages as far as 200 miles from the coast. They sail for a week or ten days at a time.

**Dohodia**

The *Dohodia* is used on Gujarat coast. It is known as *Dohodia* meaning one and a half, because it had a long and a short mast.

**Doni**

The *Doni* of the Coromandel Coast is a huge vessel. It is about 20 – 22m long. They have only one mast and carry a long sail.

**Galbat**

Larger vessels are commonly known as *galbat*. The *galbat* was originally a rowboat. The Maratha *galavats* were also large rowboats, not more than 70 tons. With forty or fifty oars a *galavat* can sail at a speed of four miles an hour. They were successfully used in naval battles and also carried six to eight three-four pounders.
**Galbat** are common in the Gulf of Cambay. It is sharper built and had a rounded or angular stern. They have two masts bearing a large triangular sail.

**Gharab or Grab**

*Phatemaris* are also known as *gharabs*. Grab generally have two masts. They were the chief Maratha war-vessel. Based on their size they are of two types. Those having two masts have tonnage up to 150 tons. Some of the large vessels have three masts and can carry the double the cargo than those having two masts. They are effectively used in naval battles and also carried canons on their decks. They are broad and draw little water.

**Jahaz**

The term *Jahaz* is commonly used for sailing vessels or a ship. Term *pota* in ancient literature is also used in similar sense.
Kotia

Kotia is a canoes used for fishing on Maharashtra coast. Kotia is a straight keeled vessel with two masts. They are like a bagla both in construction and rigging. These vessels of 25 to 100 tons capacity are never painted above the water line. Rusted heads of iron-nails on these unpainted boats give them a dotted appearance. They are up to 20 m long and have deck. The crew is usually 6 to 15 sailors.

Lifeboat

Sandy beaches, natural anchorages and the tidal variations on the Indian coasts were some of the reasons that the Indians never built dockyards. Their ships anchored close to shores in safer depths and small boats were used for loading and unloading. Indian sailors always found it safe to have small boats attached to their ships. These boats were also use in case of emergency when the ship get damaged or destroyed. There are also many references to such small boats attached to ships, in ancient literature. Some big ships carried as many as ten lifeboats.
Machhwa

*Machhwa* is a sailing boat used for fishing on Maharashtra coast. They are of two types - single *Machhwas* or double *Machhwas*. The single *machhwas* are decked and protected by a railing. These boats carry bullock carts and about 20 passengers. *Machhva* is also known as *duval* in the south Konkan.

The taraphas consist of two boats, supporting a platform, which is surrounded by a wooden railing. Taraphas are built entirely of teak and large enough to carry four laden carts with bullocks. All have masts, sails, oars and punting poles. They are also used as ferry boats. Taraphas are identified with the trapaga mentioned by the Periplus of the Erythrean Sea.

Three other types of boat *manja*, *mum* and *phan* are also of the *machhva* Class.

Mhangiri

Mhangiri is a local coaster on the Maharashtra coast. It is about 20 m long having carrying capacity of 20 to 35 tons.
Nav

*Nav* is the most popular term for the small and medium sized boats. It is commonly used for all types of water crafts since the Rgvedic period. The term is commonly used for ferry boats.

Navdi

*Navdi* is a sailing boat used for fishing on Maharashtra coast.

Padav

The name *padav* probably derived from Dravidian *pad* meaning open. It is a local coaster on the Maharashtra coast. It has two masts of teak and three sails made cotton cloth or *doti*. *Padavs* are remarkably quick in going round.

Panai

On Gujarat coast we find tradition boat known as Panai. They are 5 to 12 m long and have carrying capacity from 1.5 ton to 6 tons. It is a flat-bottomed boat having a single mast. They also carry two oar and two bamboos. Depending on the size it has different names.
The smallest Panai is called *adhadia* meaning half. The medium sized boats are called *Ponia* meaning three quarters.

**Phatemari**

*Phatemaris* are narrow and low built vessels. They have two masts and lateen sail. They are made of good quality timber and are very strong with average carrying capacity of 25 to 100 tons. It has high-pointed prow and keel consisting of two or three pieces of timber. They are said to be among the best built and navigated traditional vessels on the Indian coast. They are up to 15 m long and are also known as *Patimar* or *Fatemar*. The Konkan *phatemari* is deep-sea coasters. Depending upon its size it has carrying capacity from 20 to 200 tons.

**Raft**

Use of rafts is still common in various parts of the country. In Maharashtra and Gujarat, rafts made by tying wooden logs or banana trunks are used in tanks. In Lakshadweep islands, located in Arabian Sea, rafts (*Thrappan*) are used for fishing in the lagoons. A variety of Catamaran (Tamil, *kattu* = tying; *maram* = log) is used on
the east coast of India. These are also a form of the raft. Tying 3 to 7 wooden logs of different shapes and sizes together makes them (Thivakaran and Rajamanickam, 1992: 17-31).

Sambuk

The name *sambuk* probably derived from *sabk* meaning fast.

Shibar

It is also a type of large *phatemari*. They are up to 30 m long and can carry 250 tons. They are also known as *shybar*, *shebar*, or *sibad*. They have two masts and are without deck. Mast is up to 18 m high. They sail slowly along the coast with a crew of 25 to 30 sailors.

Kachchhi Kothia

Kachchhi kothia is a lateen-rigged vessel. It is very sea worthy and used in the sea. The name *kothia* possibly derived from *kothar* meaning a granary. *Kothia* is identified with the *kotimba* mentioned by Periplus of the Erythrean Sea.
River Boats

Besides these coastal boats a large variety of boats are built and used in inland waters. These boats include the transport vessels used in the rivers and also fishing boats used in rivers, lakes and ponds. The shapes and sizes of these river boats varies considerably depending upon the nature of the river or water body.

Attempt has been made to peep into the long past of indigenous tradition of boat building and navigation in India. The volume of information can be obtained by scientific study of traditional Indian maritime activities.

In previous chapters we examined the evidences of ancient Indian ships in the art and literature. Their importance and limitations were also discussed. Study of traditional vessels may be useful to better understand the ancient Indian shipping, as most of the traditional ships were built and are being built in the same fashion as they were built a few centuries back. These traditions have remained unchanged for several centuries therefore the study of tradition ships
may take to a researcher in the distant past to visualize the ancient
seafaring and shipbuilding technology.'

Hundreds of type of traditional ships and boats are built on the
Indian coasts as well as inlands, which may be a subject of study of
its own. The present study tries to examine some aspects of the
traditional shipbuilding to reflect long tradition of shipbuilding which
has remained more or less unchanged for several centuries. More
emphasis is given to the traditional shipbuilding in the islands of
Lakshadweep in the Arabian Sea and Andaman and Nicobar islands
in the Bay of Bengal as they remained isolated and therefore least
affected by the outer influences. Besides, the ships and boats were
the most important for them and every aspect of their life was
directly related to these watercrafts. Some of the traditional vessels
built and used on the Indian coasts are also referred to illustrate the
grandeur of the ancient Indian shipbuilding traditions.

Traditional boats are deeply related to the societies who built and
used them. This relation of man and boat is unique in Andaman and
Nicobar and Lakshadweep, the isolated groups of Islands off the
coasts of India, in Bay of Bengal and the Arabian Sea. Boats and
ships were the lifeline of these people and all the events of their
history, culture or the daily life are related to the boats and ships, in
one way or the other. Islanders were very good boat builders and navigators since antiquity. Till today a variety of boats, from simple wooden rafts and primitive dugout canoe to large sailing ships up to a carrying capacity of 400 tons are being built in these islands. The systematic study of these traditional vessels which are still built in very traditional way provides the missing links of Indian shipbuilding.

Indian shipbuilding technology has long tradition where changes were very slow. Despite modernization and mechanization traditional ships are still built through the length and breadth of the country. The materials used have also not changed and they are still built in the fashion as they were built in antiquity. Careful study of these shipbuilding traditions provides the opportunity to reconstruct the techniques of ancient shipbuilding.