Shipbuilding on the Monsoon Battered Malabar Coast in the pre-modern period- a preliminary study in naval archaeology

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ABSTRACT

The temperature of the water in which ships plied, underwater rock formation, presence of shoals, volume of commodities to be transported, naval confrontations on the high seas and above all the course of monsoon which controlled, to a great extent, navigation in the Indian Ocean regions during the pre-modern period has exerted significant influence on the nature of ship building especially in the choice of timber, riveting, caulking and launching of the ships. Unlike in Europe, scant number of treatises related to shipbuilding is found in India. Indian shipwrights relied mostly on the plans or designs preserved in their memory and transmitted from generation to generation. This is not to consign into oblivion *Yuktikalpataru,* a Sanskrit tract ascribed to Bhojaraja (Bhoja Narapati) of the Paramara dynasty (c.1040-1090) centred around Malwa region in central India which deals with shipbuilding. There are also a few works in Tamil related to shipbuilding in the later period, like *Navoi sattiram*, (McKenzie collection), kappal sattiram of Tarangampadi (1620) *Kulathurayan kappalpattu* (of the late eighteenth century) and Kalavettu-pattu to mention a few of them. *Kannakiyum cheermakkavum* dealing with some aspects of shipbuilding and launching thereof is the only work in Malayalam, - the native language of the Malabar coast –so far brought to our notice. In fact, a great deal of ship building activities was found on the Malabar coast especially in Be pore for centuries before the arrival of the European mariners and merchants and the expertise of the shipwrights of Malabar coast was adopted by the Europeans which speaks volumes for the quality of shipbuilding there.

RESEARCH PAPER

> *'The ship's side being four fingers thick, the passengers in the ship are only that far from death. Therefore nobody should take lightly the selection of suitable variety of timber for ships since the salvation of the sailors depended on plank of insignificant thickness set between them and death'*(Anacharsis, the Scythian c. 590 BCE)

Historians interested in highlighting the maritime heritage of their own nation and the impact of the vagaries of monsoons (South west and North East monsoon) on shipbuilding

and navigation in the Indian Ocean regions have started to delve deep into naval archaeology whereby the achievements of their ancestors in naval activities could be brought to the knowledge of the public and transmitted to their progeny**.** Some of the countries like the United Kingdom, Australia and Portugal, to mention a few , have gone ahead in setting up maritime museums in Greenwich, Freemantel and Lisbon respectively through underwater excavation and retrieval of wrecked ships with the help of divers. The retrieved ships have been restored to their original form and displayed in spacious installations near waterfront to shed light on the diverse aspects of the techniques of shipbuilding. Apart from the maritime museums put up by the navy in Bombay (shifted to New Delhi in the recent past) and Cochin, there is no such installation at the National level- a lacuna to be filled up.

The temperature of the water in which ships plied, underwater rock formation, presence of shoals, volume of commodities to be transported, naval confrontations on the high seas and above all the course of monsoon which controlled, to a great extent, navigation in the Indian Ocean regions during the pre-modern period had exerted significant influence on the nature of shipbuilding especially in the choice of timber, riveting, caulking and launching of the ships. Unlike in Europe, scant number of treatises related to shipbuilding is found in India. Indian shipwrights relied mostly on the plans or designs preserved in their memory and transmitted from generation to generation. This is not to consign into oblivion *Yuktikalpataru* , a Sanskrit tract ascribed to Bhojaraja (Bhoja Narapati) of the Paramara dynasty(c.1040-1090) centered around Malwa region in central India which deals with shipbuilding. There are also a few works in Tamil related to shipbuilding in the later period, like *Navoi sattiram*, (McKenzie collection), *Kappal sattiram* of Tarangampadi (1620*), Kulathurayan Kappalpattu* (of the late eighteenth century) and *Kalavettu-Pattu* to mention a few of them. *Kannakiyum Cheermakkavum* dealing with some aspects of shipbuilding and launching thereof is the only work in Malayalam,- the native language of the Malabar coast - so far brought to our notice. In fact, a great deal of shipbuilding activities was found on the Malabar coast especially in Beypore for centuries before the arrival of the European mariners and merchants and the expertise of the shipwrights of Malabar coast was adopted by the Europeans which speaks volumes for the quality of shipbuilding there . Here an attempt is made to address ourselves to some aspects of shipbuilding or naval archaeology on the Malabar Coast during the pre-modern or pre-Industrial era with emphasis on Beypore (Figure 1).

Beypore situated 10 kilometers south of the town of Calicut served as the most important centre for shipbuilding from time immemorial. The activities became accelerated when the Zamorin shifted his residence from Nediyiruppu to Calicut and merchants from different quarters of the world came in search of oriental goods to the port of Calicut. It was known as Ophir of the Old Testament from where King Solomon obtained large quantity of almug wood[1] , gold and precious stones through the fleet he sent under Hiran to Ophir. He used the timber for the temple and his palace.[2]

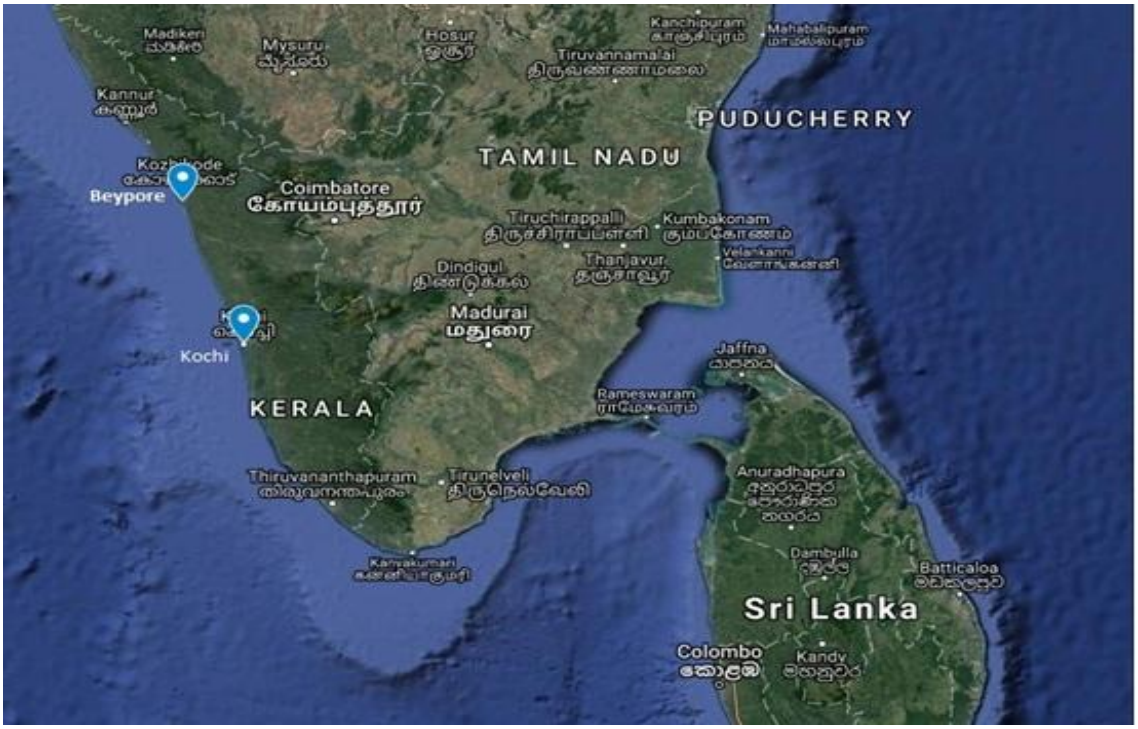

Figure 1: Location Map of Beypore and Cochin

Beypore had almost all the important requirements for a shipbuilding centre of high quality, such as: a) access to the centres of production of various sorts of timber required for different parts of an ocean going vessel, b) qualified shipwrights and the work force in terms of skilled and unskilled labourers and c) the facilities for drawing the ships ashore for careening as well as launching the vessels into the sea. It is situated on the bank of river Chaliyar known also as Beypore River. Beypore is connected with Nilgiri Mountains and Waynadu Ghats through the two branches of River Chaliyar which join together in the Nilambur Forest. River Kallai joins Chaliyar River before it opens itself into Arabian Sea and

[1] Almug is believed to have been the sandalwood of the East.
[2] I Kings Chapter 10 ver.11-12 and 2 Chronicles chapter 8, vers.17-18

so Beypore gets access to river Kallai too. Beypore is also connected through the river Kadalundi and the Arabian Sea with Kadalundi known for the best timber. Thus, Beypore has access to the timber producing areas.

The trees selected and cut from the forests in the hinterland like Nilambur and the neighboring places were brought to Kallai and Baypore through rivers originating in the Western Ghats. The main river that empties itself into the Arabian Sea through the estuary of Beypore is Chaliyar, the fourth longest river in Kerala with a course of 169 kilometers. It is known also as Chulika or Beypore River. It originates at Elambalari hills in the Waynadu plateau. Six major streams namely, Chaliarpuzha, Punnapuzha, Kanjirapuzha, Karimpuzha, Iravanjipuzha and Cherupuzha are tributaries of this river. The southern part of the estuary of Chaliyar River is Chaliyam and the northern part is Beypore. River Chaliyar does not get dried up during the summer months of March and April as other rivers of Kerala. It was extensively used as water way for carrying timber from the forest areas in and around Nilambur. Kallai, the internationally known centre of timber, is located near Baypore. Rafts made of logs were taken down stream during the monsoon to Kallai which is linked with Chaliyar on the south by a man-made canal. Kallai river originates in the Western Ghats at an altitude of 45m.and is 40 kms long.

The well known types of vessels known as *Uru* and *odam* have been built in Beypore (Figure 2) from time immemorial. They are famous wooden vessels. Even the Arab literature has reference to the excellent timber available on the Malabar coast and to the skilful carpenters who built exquisite vessels. *Urus* made in Beypore is unique. They are built entirely of timber fastened by coir ropes and caulked with special glue made of animal fat, calcium, *punna* oil and wooden nails or pegs.

Figure 2: Beypore Village

Shipwrights

Shipwrights in Calicut were the *Thachans* belonging to *Viswakarma* community who were engaged in shipbuilding and repairs. Carpentry was their hereditary occupation. Their knowledge of the subject was transmitted from generation to generation without the aid of any manuals. They are engaged in building ships with timber and have great specialization in the selection of timber suitable for different parts of the ship and of measurements thereof besides building the vessels of different tonnage (Figure 3).

Figure 3: Shipwright at Work

Skilled labourers attached to the shipyard at Beypore

Khalasis have been closely associated with shipbuilding and related activities. The word *khalasi* in Arabic meant dockyard worker, sailor, *lascar* and so on. They have been traditionally employed in ports and dockyards. *Khalasis* or *Mappila Khalasis* were the skilled labourers whose services were required for drawing the ships ashore for repairs, keeling the vessel as well as shifting heavy planks of the vessel and finally launching the ships once they are constructed. The *Khalasis* lay the keel on a specially placed timber or "*kalangi*" in the yard so that the *Thachans* could start their work. They used simple equipments like wooden pulleys or winches known as *sylanki*. The leader of the *Khalasis* is known as *Srank* or *Mooppan* who engages the labourers in a scheduled work and is entitled to an enhanced wage. The *Khalasis* did not use any sophisticated machinery except *dabbers* (daver, wooden winches), a network of steel wires (*sylanki*) and thick coir ropes, long wooden handles called

kazhas to transmit torque and rotation as smoothly as any high-end machinery. They were traditionally involved in the construction of famous *urus* of Beypore. The *Khalasis* were requested by the Indian Railways for retrieving the bogies from the water in the Perumam Rail Accident of July 1988. Similarly when the Kadalundi Railway Bridge collapsed in 2001, the services of the *Khalasis* were utilized by the Indian Railways. Many of them are good divers too.[3]Their strength lies in common sense, muscular strength and team work.

Importance and Varieties of Timber

Ocean-going vessels of the pre-industrial era were made chiefly of timber, the importance of which was recognized by the people in the remote past like Anacharsis, the Scythian. He visited Athens c 590 B.C and is reported to have made an interesting and relevant statement regarding the crucial role played by timber planks in the construction of ships. He stated that the ship's side being four fingers thick, the passengers in the ship were only that far from death (i.e., four fingers). Therefore later shipwrights wrote that nobody should take lightly the selection of suitable variety of timber for ships since the salvation of the sailors depended on plank of insignificant thickness set between them and death.[4]

Depending on the exposure of various parts of the ship to water, wind and other forces of nature, different varieties of timber were chosen for shipbuilding .No vessel was made of just one and the same type of timber. Writers on shipbuilding in the medieval period compare the ocean-going vessel with the body of an animal. The skeleton of the body can be likened to the frames of ships because it supports, strengthens and gives shape to the body. The frames of the ship do the same in the hull. The planking of a ship is compared to the skin in animals. The hull of a ship requires strong and hard timber because it has to bear all the weight of the ship and to withstand the forces of the sea and wind. The flanking on the other hand, must have flexibility, and softness allowing it to be bent and joined to the frame according to the curves of the ship.[5]In general, timber for the construction of ocean-going vessels should tough, dry, of bitter and resinous sap. It should be tough and strong to withstand the impact of sea and wind. It has to be dry and free from dampness before the ship is conserved in water. If only the sap of the tree is resinous, it can get itself rid of water. Bitter sap can keep off

[3] For further details ref. C.M.Musthafa Chelambra, *Mappila Khalasi Katha Parayunnu*, Calicut, 2011
[4] Fernado Oliveira, *O Livro da Fabrica das Naus*, Lisboa, 1991, p.134
[5] Fernando Oliveira, *op.cit*, p.140

shipworms found in the warm water of the Indian Ocean. Pliability is required for the timber for bending and joining as mentioned n the case of planking.[6]

Timber was used for the construction of vessels at Beypore .*Karimaruthu* (*Terminalia Crenulata*), *karivaka*, Benteak (larger *stroemia lanceolota*, *Pilavu* (*artocarpus integrifolius*), *Pali* (*palquim elepticum*), *Punna* (*Caleophyllum indophyllum*) teak (*tectona grandis*, *Ayini* (*artocarpus birustus*) and *Cini* (*Samnea saman*) were some of the species of trees used for shipbuilding. Teak and Ayini were above all the most suitable timber for outer parts of ship and European writers of the medieval period were of great appreciation for this variety of timber since they had resinous and bitter sap and were distinguishable by the crisp leaves which made them write that they the nature seemed to have created them exclusively for naval architecture.[7]Timber for shipbuilding at Beypore was obtained chiefly from Nilambur forests.

Felling and Transportation of Suitable Trees

After deciding the size of the vessels to be built, the carpenters, expert in the selection of timber suitable for shipbuilding under a *muppan* (elder), went into the deep forests to identify the appropriate variety of timber. The persons chosen for cutting the selected trees worked there for months together under the *muppan.* The wages for them were disbursed to their families directly every week. During the lean season when there was no work, they used to take advances from the timber merchants. The felling of the trees was done only during the appropriate season of the year, depending on the position of the moon. On an auspicious day and time (*muhurta*) the desired tree was felled with a ceremonial saw.

Trees for shipbuilding should be cut only when they are mature and in the proper season. If the trees are not mature, the timber would rot or create changes in the work by twisting or shrinking and opening up joints. If the trees are not mature, there will be too much sap and so the timber would be corrupted and rotten. All trees do not mature at the same time. Some get matured earlier than the others. The trees of same specie mature differently in different places. They will mature faster in warm areas than in cold regions.[8]

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[6] João Baptista Lavanha, *O Livro Primeira da Architectura Naval*, Lisboa, 1996, p.143
[7] Lavanha, *op.cit*, p. 143.
[8] Fernando Oliveira, *O Livro da Fabrica das Naos*, Lisboa,1991, pp.146-150

Elu (track) was prepared for transportation along which big logs were dragged by male elephants till the *mara elu (*wood track*). Naikan* and *Paniya* tribesmen constructed the *mara elu* to drag the felled trees selecting the route and deciding the slopes. *Mara Elu* was connected with a bigger *Elu* used by many such contractors. Sometimes the *Ana elu* (tracks used by elephants) was modified for the purpose. This was very economical. The felled trees were dragged to the river by male elephants and were floated on the river. A number of them were tied together with hundreds of dry bamboos for keeping the trees floating. This mode of transportation was called *Therappam*. Sometimes these trees were made to float with the help of *Tonis*, canoes or punts propelled by paddles or poles respectively. *Therappams* were prepared smaller in size with less number of logs in the upper river with shallow water and fast currents. Two or more such *Therappams* were joined together in the lower reaches. The *therappakar (*the persons manning *Therappam)* moved on the river day and night with stops only for food and other requirements. Large number of *makkanis* (hotels) sprang up in summer along the sandy banks especially near important ferries to provide food to the *therappakar*. *Tonis* of *Therappam* were used to carry goods on their way back from the shipbuilding or curing centres. [9]

Stages of Shipbuilding

Traditional carpenters worked in the shipyard. They had their experienced headman, called *mestris* under whom they did the work with great discipline. [10] The *mestri* decided the size of the frame and planks as dictated by his own memory. In fact there was no prepared chart or drawing. Experienced *mestri* or master carpenter after deciding the size of the vessel to be built cut the planks as required depending on the plan he had in his memory (Figure 4).

Irippu (seat)

Wooden seat upon which keel of the ship was to be made, was prepared. This should be strong enough to support the entire weight of the vessel. It was made of two wooden *makkanis* (big wooden pieces) on two sides and then keel was laid.

Keel (*eravu* or *pandi* or *patan***)** and keelson, the stem and stem posts, the lower ribs, the side-planks permanently below the water level, the cross beams, the masts and spars are the important parts for which the greatest care was given to maintain the quality of timber.

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[9] V.Kunhali, "Timber Industry related to Shipbuilding in Kerala" in G.Victor Rajamanickam & Y. Subbarayalu, eds, *History of Traditional Navigation*,Thanjavur,1988, pp.159-60

[10] The word '*mestiri'* takes it origin from the Portuguese word *mestre*, meaning master.

Selection of planks for the upper side above water-level, the inner decks, cabins and platforms permitted some flexibility.

Keel

Keel (*pandi*) is the foundation or backbone of a ship. It is the most important part of the vessel which gives strength and stability to it acting as the backbone, besides being the single massive timber without curve. The length of the keel is the same as that of the vessel. A keel of 110 feet has 16 inch width and thickness. Keel is prepared first. The preference of the timber is for *Karimaruthu* (*Terminalia Crenulata*). Usually the length of the keel was limited to 90 ft. It is rather difficult to get one piece of timber of this size without physical defects. Therefore, the carpenters take extra care to choose the best and suitable piece.

Keel laying was an important function and was done on an auspicious day chosen in the light of the advice of *kanakkan,* or astrologer. Coconuts were broken to ward off evil spirits. Betel leaves and nuts were distributed to the guests who were invited to witness the ceremony.

Two beams known as *Aniyam* (stern) and *Amaram* (stem) posts were joined on both ends. The stern post was connected in such a way that the angle against the water surface was greater than the angle between the stern post and the water surface when the ship was launched. Two or three timber pieces of the same specie and quality are used by joining the planks together. The keel planks are joined by interfingering tongue and groove scarf joining and fastened with wooden pegs. Joints in the keel are fastened by *pantham*- a resin of C*anarium sprictum*. The keel was covered by a beam. The shape of the beam depended on the shape of the bottom for the ship. [11] The carpenters fixed a plank called *ottupalaka* on either side of the keel. The position of *ottupalaka* towards *aniyam* and *amaram* is 0º and in the middle 45º C. Before fixing the *ottupalaka*, on the keel, the carpenters kept cotton immersing in a gum mixture of *pantham, Punna* oil and neem oil for waterproofing. *Ben teak* (*Lagerstroemia lanceolota*) having the tendency of swelling in the water and thereby making the keel water tight was used for keel. [12] *Kappal Sastram* recommends *Vembu, Ilupai, Punnai* and *Naval* as the ideal timber *for keel,* while *Karimaruthu, sirutekku, Sirunangu, Ayini,*

[11] Some ships are of flat bottom, others V bottom and still others round bottom bull.
[12] A.P.Greeshmalatha and G.Victor Rajamanickam, "The Ship-building Technology: As practised in Beypore, Kerala," in K.S.Mathew, *Ship-building and Navigation in the Indian Ocean Region, A.D. 1400-1800,* Delhi, 1997, p. 50

Karunelli, *Kongu* and *Venga*i are suggested in the *Kulatturayyan Kappal pattu.*[13] The general trend was to use *Karimaruthu* and in its absence *Punnai, Ilupai*, and seldom *seerani* (*Puvarasu*) or *Vembu.*

Hull

Hull of a ship consisted of keel and ribs covered by planks. The hull could be of different shape like flat bottom, V bottom and round bottom. Once the keel was fixed, the ribs (*manikal*) were prepared. It was a leg-like support fixed on the keel. A vessel of 110 feet required 50 *manikkal* on each side. The length in the middle was 31 feet reducing towards either side while the length in the sides was only two feet. The width of the ribs was ten inches and eight inches in thickness. The distance between two ribs was three inches. A *mattam* or model was prepared before shaping the ribs. Ribs were usually made of joining two pieces. *Manikkal* (ribs) or *Mallakkals* (side legs) were placed at a reasonable distance taking into account the size of the vessel. These *mattakals* were fitted on two sides in a pair. Different types of legs were used for various purposes such as, a) *otharkal*, leg to tie the stay bar, b) *buoykkal* –leg to tie the anchor in the stern c) *pathikal*- to spread the *panthal* or cover as roof. d) *peelikkal*-used for additional sails. The *manikkal* and planks were fastened together by coir. In the past, sewn boats were made in India. They are usually called *masulas*[14]. After fixing the ribs on either side, ten planks of four inches' width were placed to strengthen the ribs.

[13] B.Arunachalam, Timber Traditions in Indian Boat Technology, in K.S.Mathew, *Ship-building and Navigation in the Indian Ocean Region, A.D. 1400-1800*, Delhi, 1997, p.15

[14] For details on sewn boats, ref. Eric Kentley, "The Sewn Boats of India's East Coast" in Himanshu Prabha Ray and Jean-François Salles, eds., *Tradition and Archaeology : Early Maritime Contacts in the Indian Ocean*, Delhi, 1996, pp. 247-260

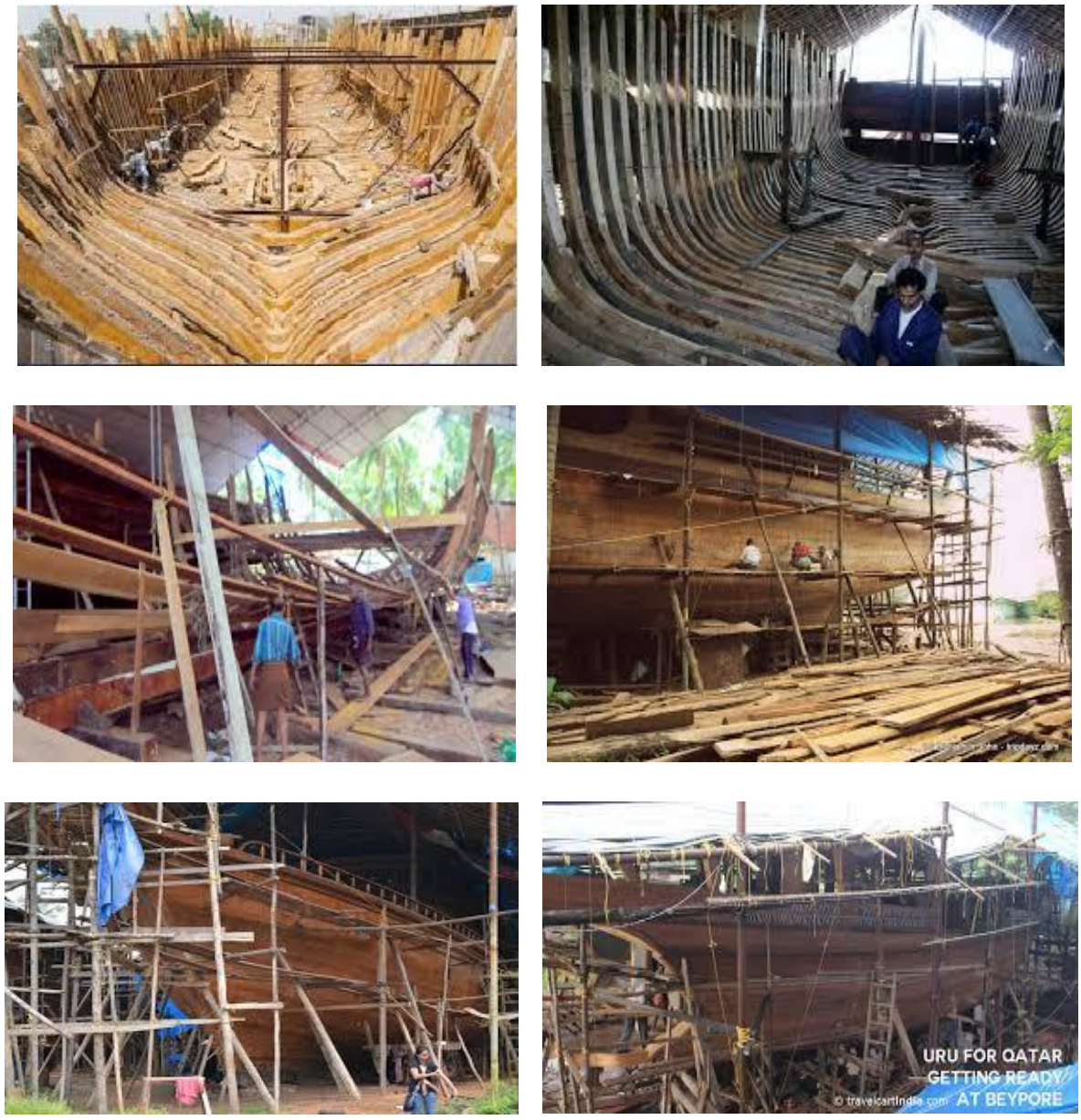

Figure 4: Various Stages of Shipbuilding

Outer Planking or *Kakaorayam Cherkkal*

The carpenters made 'V' shape on one plank and to that they inserted the other piece. The 'V' shape was called *kakaorayam* since it looked like the open beak of a crow. Bending of the timber according to the requirements for building of ships was done by the use of *mara enna (*oil extracted from trees*). Vep* (neem) oil or *cheeni* oil was applied on the planks. Then they were heated up mildly. There was another method for the same. The planks were besmeared with a lair of mud found on the river banks. Mud of this type was greasy and paste-like with some special properties. The moisture from the mud was allowed to be

absorbed. The planks were kept as flat on two wooden logs at the ends. Then the plank was heated till the slush gave out steam. The steam entered on the body of the planks and made them elastic. The planks became pliable. One end of the plank was then inserted into a long vertical slit cut in a thick wooden stump. The other end was fastened by strong rope lashed to a big tree. The rope and the plank were pulled according to the desired curve. The slanting position of the middle pole helped in bending the plank to the required shape of the hull.

Stern (Aniyam) & Stem (Amaram)

Aniyam or *tharchila* in Malayalam language was the extreme front of a ship. Its size depended on the shape of the ship usually having seven inches' slant. A vessel of 110 feet had an *amaram* of 35 feet height and an *aniyam* of 24 feet. They were fixed before the ribs were finally placed. *Amaram* was at the extreme back of a boat. It was controlled by a sculler or *Amarakkaran.*

Cukkan (rudder)

It was fixed in *amaram* with the help of bronze ring in such a way that it can move in any direction. *Cukkan* was used to control the direction of the vessel by steering it. It had the height of the stern. Its width increased towards bottom.

Sail (Paya).

Sails were made of thick cotton fabric. Usually three sails of 150 m, 200 m and 40m are used in some types of vessels. The big sail was fixed in front. The sail cloth called locally in Malabar as *Payathuni* was stitched and prepared in different sizes according to the types of sail such as triangular, mizzen, lateen, square etc. Ludovico di Varthema says: "the sails of these ships are made of cotton, and at the foot of the said sails they carry another sail, and they spread this when they are sailing in order to catch more wind, so that they carry two sails where we carry one"[15]

Mast (Kombu or Paymaram)

The height of the mast depended on the size of the ship. It was erected on the keel base, where a whole called *pandi kuzhi* was designed for it. The sail cloth was fastened on it. Mast was fixed on a pace which was 1/3 of the keel length. Ships used to have one, two or three masts. If the ship had only one mast, it was fixed at the centre.

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[15] Ludovico di Varthema, *The Itinerary of Ludovico di Varthema of Bologna from 1502 to 1508*, London, 1928, p. 62

Two Masts or *Kombu* of 60 feet and 45 feet in length were used in vessels known as *Uru.* A mast of 60 feet required 1.8 feet circumference while that of 45 feet needed 1.4 foot width. *Punna* was usually chosen for mast. Yard known as *pariman* on the Malabar coast was used for tying the sail. It used to be 128 feet long. It was made of *punna* tree. Pulley (*kappi* in the local language) was used to spread the sail. *Kappi* was usually made of jack tree.

Use of Nails for Shipbuilding

It was generally held that Indian shipwrights did not use nails to join the planks of a ship in the period before the arrival of the Portuguese. Wooden pegs and coir were used lavishly in joining and tightening the planks. Ludovico di Varthema mentions that an immense quantity of iron nails was used in shipbuilding in Calicut in the early decade of the sixteenth century: "And when they build the said vessels they do not put any oakum between one plank and another in any way whatever, but they join the planks so well that they keep out the water most excellently. And then they lay on pitch outside, and put an immense quantity of iron nails".[16] Duarte Barbosa who was in India since 1503 while speaking about shipbuilding in Calicut before the arrival of the Portuguese firmly asserts that the ships were built without any iron nails. He adds: "…the whole of the sheathing was sewn with thread, and all upper works differed much from the fashion of ours, they had no decks".[17] In fact there were old directives not to use iron nails on the ship since rock formations in the sea have magnetic areas which may cause difficulties for navigation.

Anchor (*Nankooram*)

Granite stone carved specially for the purpose in a square shape with a sharp edged wooden piece in the middle tied with coir *(kal*) was used in Malabar as anchor. It was fixed to the bottom of the seas when thrown from the ship. Marble pieces were used as anchors for the vessels built in Calicut. Anchors of this type eight palms long and two palms broad and thick were tied to the vessel through two large ropes.[18] Anchor rope was made of coconut fibre. It was 6" to 7" thick and was called *alath* or *vadam*. This was needed for operating the anchor.

Coating and Outer Treatments

Water proofing was done after completing the planking. Cotton treated by specially made mixture of *Punna* oil and *Pandam* was inserted between the gaps of the planks. Fish oil or any vegetable oil was applied up to the water level for seasoning the vessel. Another

[16] Ludovico di Varthema, *op.cit*, p.62
[17] Duarte Barbosa, *op.cit*. vol.2, p.76
[18] Varthema, *op.cit*. p.62

mixture called *cherivi* with lime and *Punna* oil was also applied. This mixture protected the vessel from sea-worms. The Portuguese writers of the sixteenth century mention some materials used for the treatment of the vessel. They were *Galgata* and *Saragusta* which were made indigenously.

***Galagata (gualagualla*)** or bitumen

It was made of three materials, namely virgin lime, oil(fish oil) and linen. If fish oil was not available, gingili oil or any other oil was used.[19] This sealant served mainly as a protection against shipworm, which could not penetrate from outside, for, their teeth were dulled by lime. [20]

Saragusta

It was made of four materials, namely, lime, *allcatrão de breu*, fish oil, linen.[21] The material prepared out of this was used in India to treat the seams of ships.[22]

Caulking *(Panthavum Paruthiyum)*

Kalpath was the term used for caulking a ship. It was also known as *Panthavum Paruthiyum* in view of the articles used for caulking. *Pantham*, a resin taken from certain species of tree was essential for *chopra* or to embalm the ships to protect them from worms and to prevent leakage. "*Paruthi"* meant cotton. Usually *Punnakka Enna* (oil of *Punna* or pine tree) along with cotton and coconut fibre (*chakiri*) was used. Cotton and coconut fibre were soaked in the oil of *Punna* and applied to the chinks and strongly hammered. Some scholars are of the opinion that the *Kalpath* was not at all needed for the ships made on the Malabar coast. Because, the Indian shipwrights carved each piece of timber according to the shape of the hull suggested to them .Each plank was filled to its neighbouring piece until a perfect joint was effected. Therefore, the waterproofing required for the vessels made in Europe was superfluous. [23] Leakage takes place on account of improper joining of planks for the hull.

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[19]Adelino de Almeida Calado, *Livro que trata das cousas da India e do Japão: edição critica do codice Quinhentista 5/381da Biblioteca Municipal de Elvas* , Coimbra, 1957, pp.67-8
[20] Fernando Oliveira, *Livro da Fabrica das Naus*, Lisboa, 1991, p. 153
[21] Adelino de Almeida Calado, *op.cit* , p. 69

[22] Fernando Oliveira, *op.cit*, p.153.
[23] K.N. Chaudhuri, *Trade and Civilisation in the Indian Ocean: An Economic History from the Rise of Islam to 1750*, New Delhi, 1985,pp.151-52

Chopra (Embalming of the ship)

After caulking had been done inside and outside, *chopra* or embalming of the ship was done. It was applied from the bottom to the water line with a white composition. This mixture was made from the *Pantham* (resin), *Dammar,* fish oil, and burned lime (*Chunna*). All these items were boiled and carried upward in a wide sweep on either bow. Above this, a coat of paint was applied which separated the pitched bottom from the sides. *Chopra* protected the wood from termite, prevented leakage, tightened the caulking materials into the chinks, prevented the ship from decaying and gave a fresh appearance to the ship. *Chopra* coating was done once in three months.

Launching of a ship

Launching the ship (Figure 5) was a happy ceremony for the owner, merchants, passengers, shipbuilders, labourers and the crew. The owner for whom the ship has been built invited his friends and relatives to grace the auspicious moment of the first launching of the ship. All the guests brought a coconut each and stood in a row in front of the vessel. They went around the vessel by knocking the coconut on the hulls and side planks. Then they broke the coconut on a stone to ward off evil spirit. *Ganapathipooja* was performed under the leadership of the *mestri*. The guests used to give some presents to the *mestri*. The owner of the ship gave a *Mothirakkani Veshti* to the *mestri* and cloths and money to other workers.

Dhawaring[24] technique was used in launching the ship. According to this method, green coconut leaves were spread on the sand where the vessel was located. Pieces of round coconut timber were placed on the leaves as rollers. The rollers did not sink on the sand due to coconut leaves. Supports were placed on sides to avoid the ship from turning sidewise. Huge ship weighing hundreds of tonnes was pushed by using a pulley mechanism called *dhawar*. The ship was made to move slowly on the rollers to the sea.

Dhawar consisted of removable stand with two pieces of huge wooden rollers. There were two movable thick and long posts called "*kai"* in the middle of the rollers. A big beam was placed horizontally in between the wooden rollers. This was called *Pakku.* A *kamba* (big rope) was connected with *kappi* (pulley). One end of the rope was tied to the stern of the ship. When the workers turned the wooden "*kais*" in a circle, the rope tightened with the pulley and the ship moved on the rollers to the sea without applying energy manually. A small *dhawar* was used in the stem of the ship to lift the anchor.

[24] *Dhawar* is an Arabic term meaning " go around "

Dhawar was operated for launching the ship as well as drawing the ship on to the coast by Mappila *Khalasis.*

Figure 5: Launching of the Vessel

Tonnage of Ships

Pliny gives some information about the tonnage of ships in the Indian Ocean. According to him, Indian vessels had a tonnage of 3,000 *amphorae,* the *amphora* being regarded as weighing about a fortieth of a ton.[25]The tonnage of the ships varied from three hundred to four hundred butts as observed by Ludovico di Varthema.[26] In the days of prosperity i.e. before the arrival of the Portuguese, the shipyard at Calicut built keeled ships of one thousand to one thousand two hundred *bhares'* tonnage.[27]

Indigenous cargo ships plying by the Malabar coast were sometimes of six hundred tons. A contemporary Portuguese chronicler makes mention of a ship belonging to Mammale Marakkar and Cherina Marakkar of Cochin which carried seven elephants from Ceylon and three hundred armed men on board. This ship was on its way from Cochin via Calicut to Gujarat around 1500. It was of six hundred tons[28]. We have reference to another huge ship, *Meri* by name plying between the Malabar coast and Mocha. It carried many families of the

[25] Radha Kumud Mookerji, *Indian Shipping: A History of the Sea-borne Trade and Maritime Activity of the Indias from the Earliest Times*, Delhi, 1999, pp.103-04
[26] Varthema, *op.cit*, p.62
[27] Duarte Barbosa, *op.cit*., vol. 2, p.76.
[28] João de Barros, *Da Asia*, *Decada* I, Lisboa, 1778, p. 425; Castanheda speaks of a ship belonging to a merchant of Cochin called Patemarakkar which carried an elephant and three hundred men of arms among other things. This was captured by the men of Pedro Álvares Cabral as desired by the Zamorin in 1500.. Ref.Fernão Lopes de Castanheda, *História do Descobrimento e Conquista da India pelos Portugueses*, Livro I, Coimbra, 1924, pp.83-85. Gaspar Correa on the other hand refers to a ship belonging to a merchant of Cochin which carried an elephant and other commodities to Gujarat via Calicut. This was a huge ship . It was captured by the men of Álvares Cabral as the Zamorin wanted to get the elephant carried on board the ship. Ref. Gaspar Correa, *Lendas da India*, tomo I, Coimbra, 1922, pp 196-203.

Muslims from Calicut bound for Mocha. It had besides, 260 soldiers on board in addition to the mariners and rich cargo. It was sighted near Mount Eli.[29] These two incidents give an idea of the tonnage of the ships plying by the Malabar Coast in the first decade of the sixteenth century.

Types of Ships

Several types of vessels were found in Calicut during the period before the arrival of the Portuguese. *Sambuk, paraos* (*prahu) almadia* and *chaturi*[30] were some of them.

Ludovico di Varthema of Bologna who was in Calicut in the early part of the first decade of the sixteenth century writes:

> "As to the names of their ships, some are called *sambuchi* [Sambuk] and these are flat-bottomed. Some others which are made like ours that is in the bottom they call *capel (kapal).* Some other small ships are called *parao (prahu*, prow), and they are boats of ten paces each, and are all of one piece, and go with oars made of cane, and the mast also is made of cane. There is another kind of small bark called *almadia* (*al-ma'adiya*, ferry-boat), which is all of one piece. There is also another kind of vessel which goes with a sail and oars. These are all made of one piece, of the length of twelve or thirteen paces each. The opening is so narrow that one man cannot sit by the side of the other, but one is obliged to go before the other. They are sharp at both ends. These ships are called *chaturi* [*shakhtur*], and go either with a sail or oars more swiftly than any galley, *fusta* [foist], or brigantine. There are corsairs of the sea, and these *chaturi* are made at an island which is near, called Porcai [Porrakad]."[31]

Based on the mode of construction, vessels were classified as a) *Kattamaram*, b) dug-outs, and c) plank-built. *Kattamaram* was built of three or four logs tied together. Dug-outs were cut out from a single trunk usually from mango tree. This was similar or identical to *monoxylon* dug out from the trunk of a tree. Dug-outs ranged from one man *toni* to eight men crew of *odams*. *Colonidphonta* was a large ocean- going ship. Batil, or Batel, boom, kotia, paravu or Patavu were some of the other types of vessels built in Calicut.

In fine it may be concluded that the Indian shipwrights had reached a high level of sophistication in shipbuilding and had taken into account the temperature of the water in which the ships plied, the formation of shoals, volume of commodities to be transported and

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[29]. João de Barros, *Da Asia, Decada* I, Part 2, Lisboa, 1777, pp. 29-38
[30] Varthema, *op.cit*, pp. 62-63
[31] Varthema, *ibid*., pp.62-63

so on. It is true that they did not compose any manual for shipbuilding and the knowledge they obtained through transmission from generation to generation was prodigious. The European mariners who doubled the Cape of Good Hope and entered the monsoon battered Indian Ocean regions adopted many of the techniques used by the Indian shipwrights. Hence we feel proud of our maritime heritage.