Chapter Four

Technology of Navigation

India is surrounded by sea from three sides. It enjoys a coastline of more than 6300 kilometers. Impact of the Indian Ocean on Indian history has been neglected in the first half of the twentieth century. It was believed that the Indian Ocean was a barrier to outside world. It provided protection to India and only the Europeans could overcome this obstruction to colonise India. With the passage of time, the historians have come across numerous contemporary sources which point to well developed navigational methods employed by the Indian Ocean sailors. The sailors employed complex calculations of the stars to tack their path in the Indian Ocean. They possessed the knowledge of sea routes and the change of monsoons. They were familiar with craft of building a variety of ships, boats and anchors. They were also equipped to deal with natural hazards on the sea.

Since antiquity, the sea has attracted human attention. Its vastness and strength resounds in myths, legends and folk tales. Even in the Hindu scriptures, the worldly life has been compared to a sea (of existence, that is bhavsagar), which one has to cross to attain salvation. How sea haunted human memory could be best described in the words of Amr:

"The sea is a boundless expanse, whereon great ships look tiny specks; nought but the heavens above and water beneath; when calm, the sailor's heart is broken; when tempestuous, his sense reel. Trust it little, fear it much. Man at sea is an insect on splinter, now engulfed, now scared to death."¹

¹ G.F. Hourani, *Arab Seafaring in the Indian Ocean in Ancient and Medieval Times*, pp. 54-55.
Nature has, however, bestowed man with indomitable will. He was always out overcoming the challenges and to assert his supremacy. But why did man step unto the sea? It is a hard question to answer. Probably scarcity of food forced him to search for the same in water. Once he found that seas were enriched with life to satisfy his hunger, there was no going back. It was also possible that he would have used sea coasts as a guide when migrating from one place to another. Sea coasts presented less challenge than deserts or thick jungles infested with wild animals. Coastal navigation would have taken birth as a result, because it was less dangerous and tiring. And where did the first man sail deep into the sea? The place seems to be the Arabian coasts, because deserts would have taught man how to navigate with the help of stars. Secondly, the Arabian coasts were comparatively rich in vegetation than the interior and the coastal navigation would have been more like a necessity there. The knowledge of navigating deep into the sea was applied to sail to Indian and African coasts, rich in vegetation and other necessities of daily use.

Around the first century AD., we have concrete evidence that sailors were navigating the sea with the help of monsoons. Hiplus discovered southwest monsoons in 45 AD and Egyptian ships started sailing directly to India. Egyptians could sail rapidly to Indian coasts with the help of southwest monsoons. The Arabs were also sailing to India with the help of northeast monsoons. Bitter rivalry existed between the Romans and Persians over their control over maritime trade in the Indian Ocean. The Romans even instigated Abyssinia against the Persians to have a footing in sea trade with India.²

As discussed earlier the Islamic expansion and revival of the Red Sea trade increased mercantile activities in the Indian Ocean. Science of navigation became complex and advanced. Sailors displayed professional competence in their knowledge of the sea. We have the valuable account of a reputed sailor Ibn Majid who has described in detail the science of navigation and what it takes to

² Procopius quoted in G.F. Hourani, op. cit., p. 43.
be a good muallam (captain). He advised that a navigator should be proficient in twelve principle of sailing. These were:

1. Manazil (lunar mansions)
2. Akhnan (rhumbs)
3. Diyars (routes)
4. Qiyas (star altitude measurement)
5. Isharat (signs)
6. Hulul al shams wa’l-qamar (revolution of the sun and moon)
7. Aryah wa’l-mawasim (winds).
8. Mawasim al bahr (seasons of monsoons)
9. Alat al safina (instruments of ships)
10. Siyasat (relations with the crew and passenger)

Diyar or dira was a route followed by ships from one port to another.³ One finds other words like al majra (compass bearing) and tariq (an individual path of a ship). Diyars were the established routes in the Indian Ocean and ships always followed them. Diversion from diyar could bring a lot of trouble. Ships thus could change their individual path (tariq) but diyar was never overlooked. Three types of routes were prevalent in the Indian Ocean shipping. According to Ibn Majid these were:

1. Dirat al mul (coastal sailing) required keen sight, a knowledge of the coast and isharats (signs).⁴ Coastal sailing was done in almost all sectors of the Indian Ocean. It also enabled sailors to collect merchandize from less important ports to the chief trading emporiums. Ships did coastal trading from Africa to Aden, from the Persian Gulf to Sind, from Gujarat to Malabar, Bengal to Coromandal and in the Malacca straits. Ships had to take much caution in coastal sailing. River deltas, tidal bores and coral reefs proved treacherous and fatal for ships. Sailors looked for every sign (isharat) to make their voyage successful. Many a time the

³ Ibn Majid Ahmad, p. 282.
⁴ Ibid., p. 274.
dangers were also recorded in folktales and legends and thus guided new sailors on the same route.

2. Dirat al matlaq was a deep sea sailing. Ships took direct route between two points or coasts. Ships sailed directly from Aden to Cambay. Ships also sailed direct from Bengal to southeast Asian countries. The ships did not change their course during its entire voyage. Still, it required knowledge of bearing (it decides the exact angular direction/position of the ship with reference to the two known points) apart from keen sight. Knowledge of coasts and isharat also proved helpful.

3 Dirat ai iqtida, or matlaq, was the third type of navigation, which required great skills. The ship took route between two bearings and changed course when out of sight of land. It required knowledge of qiyas (measurement of one latitude) with all the above mentioned capabilities of the sailor.

By the fifteenth century, internationally acknowledged routes were established in the Indian Ocean. These routes were further interconnected with short feeder routes that made it possible to transport a product made in China to the markets of Arabia and Cairo. Ships coasted from east Africa to Aden and Gujarat; from Aden or Jeddah to Gujarat and to Malabar; from Aden to Hormuz; from Hormuz to Sind, Gujarat and Malabar; from Gujarat to Malabar and other ports of western coast like Chaul; from Malabar to Malacca and Canton; from Bengal to Malacca and Java and from the Coromandel to Bengal and Malacca.

An inevitable part of diyar was the understanding of isharat on trading routes. A muallam was expected to have a keen observation and suitable understanding of isharats. If a sailor was well versed in the science of navigation, he could always ascertain his way through various signs noticeable in the sea and around it. Landmarks, winds, colouration of water and tides were the

5 Ibn Majid Ahmad, pp. 275-276.
inevitable guides for a good captain. The sailors used the sighting of Girnar mountains to make their way into the Gulf of Cambay. Mount Delly served the same purpose in Malabar. Tides and currents could also help sailors to locate their position. One could know that the ship was approaching Sacotra from strong easterly currents.\textsuperscript{6} Tides of the Gulf of Cambay were also very famous.\textsuperscript{7} First sign of approaching the coasts of Bengal was strong currents.\textsuperscript{8} Sailors also collected samples from the sea bottom to ascertain their location. Ibn Majid remarks that one could tell from the specimen of sea bottom whether he was towards Arabian or Sudanese ports in the Red Sea. The bottom of the Red Sea towards Arabia was a mixture of stones and sand, whereas Sudanese coasts had only sand.\textsuperscript{9} Vegetation and sea life also guided sailors in the Indian Ocean. Sulaiman observes that Nipah palm 'may be seen floating in sea between the Nicobar and the Siamese coast and they look like small boats.'\textsuperscript{10} Presence of sea snakes was also said to provide guidance to sailors. Sulaiman records the presence of sea snakes in the Indian west coast from 5° -10°. They were found only 8 \textit{zams} from the coast of Gujarat and 16 \textit{zams} from Konkan.\textsuperscript{11} Birds like \textit{Umm, Sananim, Munj} and \textit{Kuraik} (not identifiable) also helped sailors to ascertain their immediate location.\textsuperscript{12}

\textit{Qiyas} was the science of measuring stellar altitude. The altitude of stars was measured in \textit{Isba}. \textit{Isba} was divided into \textit{zam} and each \textit{zam} represented...
The routes followed by the Europeans

Land sightings which served as bearing points

1. Ras Asir (Cape Guardafui), 2. Socotra, 3. Ras al-Hadd
4. Pemba, 5. Seychelles, 6. Girnar,
7. Laccadives, 8. Maldives 9. Ponto de Galle,

The main sea-lanes in the Indian Ocean

three hours of sailing. One *isba* constituted one day of sailing. It was considered that one day's sailing towards north would raise the Pole Star 1 *isba* from the horizon. There were many other stars that could help the sailors, but the Pole Star always remained the guiding star for many in the sea and deserts. Sighting and study of the Pole Star reduced several problems of the sailors. Sailors used *loh* to measure the altitude of stars. G.F. Tibbet remarks:

"Sidi Celeb had a system of nine tablets each with a string through them all. The nine tablets each had a different width to correspond with different angular altitudes on the horizon. The smallest measured an angle of 4 *isba* and the largest 12 *isba*, the other seven measuring the intervening *isba*’s. The smallest one was divided by three groves (*sikan*) into four equal *isba*’ divisions. Thus a complete range of division from 1 *isba* to 12 was given......the smallest *loh* (of 4 *isba*) covered exactly the distance between A Aurigae (*Aiyuq*) and B Aurigae (*dhubbann al aiyuq*) which were regarded as 4 *isbas* apart. The measurement of 4 *isba* is actually a complete hand of four fingers held at arms length was known as *dhubbann* and stars received its name from this measurement. *Suhail* (Canopus) had its *dhuban*.”\(^{13}\)

Sailors had to take some precautions while measuring the altitude of the stars; otherwise they could land up in great trouble. Difference between the correct and wrong readings of the star meant a difference between life and death. Sulaiman advises that good weather, accurate observation of instruments and double checking of the observations with the one made earlier should be taken into consideration by an experienced *muallam* (the captain).\(^{14}\)

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\(^{13}\) Ibn Majid Ahmad, p. 316.

\(^{14}\) Ibid., p. 319.
Rhumbs or akhnan was the division of horizon. It was divided into 32 divisions on the compass-card termed as aknan da’irat al-ibra. The Arabs called these 32 rhumbs after the name of prominent stars that rose and set approximately on these rhumbs. It is a controversial question whether or not sailors in the Indian Ocean were able to navigate during day time. Nowhere in any reference or navigational method, one comes across a method of navigating with the help of sun. Sailors were comfortable with the calculation of stars. Conti remarks that natives of India steered their vessel by the stars of the southern hemisphere.\(^\text{15}\) Did that amount to helplessness of the Indian Ocean sailors to navigate the sea in daylight? Tibbets, on the contrary, opines that no doubt the latitude was taken at night, yet isharat (signs) with whom they were so familiar would have helped them to follow the bearing during daytime.\(^\text{16}\)

Of the instruments employed while sailing, compass, in the form of floating needles, might have been very useful, but Ibn Majid finds one major defect in it.\(^\text{17}\) He called it al-samka which probably came from Sanskrit sammuka. It meant ‘to swing to and fro.’ The floating needle might never point to the true north. Referring to the weakness of compass, Sulaiman gave a full commentary in the fourth chapter of his Tuftat:

"Corruption of route by errors due to the displacement of the compass card (taqbil al-daira al-qutb) for it becomes displaced at certain hours (times?), because it is badly balanced on its pivot in the wrong place (thaqal fil-daira wa’l-butlan qubbatala) or because it is some time since the needle has seen lodestone or because of the cold, hence causing this error which usually

\(^\text{15}\) Nicolo Conti, pp. 26-27.

\(^\text{16}\) Ibn Majid Ahmad, p. 272.

\(^\text{17}\) Earth is a magnet with a north south field and it causes the freely moving magnetic needle of the compass to align itself with the field, Britannannica: Ready Reference Encyclopedia, Vol. 3, p. 21.
Navigational Theory

Picture of Arab Rhumb (32 Points) as depicted in
G.T. Tibbets, Arab Navigation in the Indian Ocean
before the Coming of the Portuguese, p. 297.
shows as a slight displacement towards the west. Error may also be caused by the compass-box not being level or by confusion of the signs used for bearing due to variation occurring at night, but this (last?) is all due to the weakness of helmsmen’s knowledge.\textsuperscript{18}

Another important instrument in the ship was \textit{khasba}, which was used to measure altitude of the stars. The captain had to be well versed about the working of sails, rudder and steering oar. Lowering and floating of sail in particular weather (like in stormy season) could be very crucial.

\textit{Siyasat} (politics) was considered another basic art, in which a sailor had to be proficient. A \textit{muallam} (captain) dealt with two kinds of people, namely the merchants and the crew. Efficiency and control over the crew was a necessity for any successful voyage. \textit{Muallam} was expected to be steady, quick decisioned, non committal, gentle in speech and god-fearing. He was expected to establish cordial relations with the merchants. He was required to listen to the complaints of merchants. He could not backbite one before another. He could also not tolerate any kind of nuisance and disobedience from anyone on the ship. Great amount of cooperation was needed while encountering a trouble on the sea.

The study of monsoons was another important branch of navigational science. Upto the arrival of steam engines, sailing depended entirely on the pattern of winds. The very word monsoon originated from an Arabic word \textit{mawsim} (a fixed time). The Arabs did not use it for signifying the duration of

\textsuperscript{18} Tibbets opines that the sailors were confused about the magnetic variations of the compass. As late as 1832 AD, the pilots in the Red Sea carried two compass, one pointing to the Pole Star and one oblique ‘\textit{dira farqadiya}’ to allow for magnetic variations. G.T. Tibbets, \textit{Arab Navigation in the Indian Ocean before the Coming of the Portuguese}, p. 293.
wind's season, but only for sailing dates.\textsuperscript{19} For example they had \textit{mawsim al zafari} or \textit{futuh mawsimal bahr al hindi} (season for sailing to India).\textsuperscript{20} 

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\caption{KAMAL \hspace{1cm} CHINESE FLOATING COMPASS} 
\end{figure}

Sailing in the Indian Ocean was fixed as per the calendars of two dominant patterns of monsoons. These were southwest and northeast. Southwest began in late March and continued upto September or the first week of October.\textsuperscript{21} Northeast started from October and continued upto February and early March. The tenth century began to witness several changes in the patterns of navigation. Direct sailing from the Persian Gulf to China was introduced. With the passage of time, the Indian Ocean was divided into two zones. Participation of the Chinese in the eastern waters made it a zone of \textit{junks}, whereas \textit{dhows} plied in the western sector. These changes reduced the time of sailing due to shortened distance. The ships could come back in one year instead of two. To make things more tangible, one could take into account the calendar season drafted by

\begin{footnotesize}
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\item \textsuperscript{19} Ibn Majid Ahmad, p. 360.
\item \textsuperscript{20} Ibid., pp. 360-361.
\item \textsuperscript{21} Ibid., p. 368.
\end{itemize}
\end{footnotesize}
Hourani for the ships sailing from the Persian Gulf to China and compare it with the sailing seasons of later times. According to Hourani, the ships *enroute* to China would sail up to Malabar from the Persian Gulf in September taking northeast monsoons. December would be spent in Malabar due to cyclones in the Bay of Bengal. In January, the ships would continue with northeast monsoons across Malacca Straits. Southern monsoons were used to sail further up to China. After summer in China, the ships would set for their return journey in northeast monsoons. They would reach Malacca Straits in October and December. The Bay of Bengal would be crossed in January and ships would reach Raysut till February or March so as to sail into Persian Gulf with the southwest monsoons. It took one and a half year for a ship to complete the whole journey. Things changed rapidly after the twelfth century. Now, the ships could leave for India in September and come back within the same year.

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**MOONSOONS TABLE IN THE INDIAN OCEAN**

*Source: Nabataea.com*

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22 G.F. Hourani, op. cit., pp. 74-75.
Southwest monsoons were the time when the ships left for Indian coasts. They were unable to sail throughout the southwest because the sea became turbulent from June to August and the ports of western India were closed for sailing. Sailing restarted only when the sea became safe once again in September. Hiplus discovered southwest in 45 AD and the Arabs knew it as Rih al Kaws. They divided it into two parts. The first one upto June was called Mawsim al Kaws. The ships sailing from the Red Sea in this season had to strictly follow the time table or else they ran a great risk in their delay. The second part after August was known as Dammani and ships preferred to sail into that season when the currents were steady. Northeast, known to the Arabs as the Rih Azyab or Rih al Saba, was less rough than southwest. Ships could sail from Malacca to even Jeddah with the help of the northeast as it was open to sailing throughout the season. It was a time for ships to sail in the westward direction.

As mentioned above, the sailing pattern underwent considerable changes after the twelfth century. The long voyages from the Persian Gulf to China were discarded in favour of shorter ones upto Malabar. The Sungs began to take a keen interest in the trading empire of the Indian Ocean. Their ships were formerly not very huge and sailed only upto southeast Asia. Now they arrived on the scene with hugely built multi sail junks. These junks provided shelter against the pirates of southeast Asia, and they were also designed for comfort. They were decked and provided separate rooms to the merchants. Soon these junks were sailing to Malabar and Bengal. The Arabs recorded the presence of junks as far as Calicut and Quilon. Eastern waters from Malabar to China came under the sway of Chinese junks and dhows were confined to the western sectors. Ibn Battuta observed at the harbour of Calicut that the Chinese Sea was navigated

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23 Ibn Majid Ahmad, p. 368.

The pattern of emporia trade in the Indian Ocean: the triple segmentation, c. 1000-1500 (each circle represents the quarterly shift of the monsoon). Adapted from K.N Chaudhuri, *Trade and Civilisation in the Indian Ocean*, p. 41.
only by the Chinese ships (junks). Though Marco Polo sailed directly from China to the Persian Gulf, yet it must have been a rare phenomenon. Around the last decade of thirteenth century, John of Montecorvino refers to two lengthy sea-voyages from Hormuz to Canton. Both kinds of shipping had their own advantages suitable to the water they were sailing, but we shall discuss these in detail under the construction of ships.

Hazards

We have studied how adept medieval sailors were in navigational technology. They employed different methods to reach their destinations safely. Still numerous hazards awaited the unwary. The nature had its own ways to make human beings feel her might. Sailors were like 'an insect on splinter, now engulfed, now scared to death.' Storms, cyclones, silting, strong currents, reefs and shoals could easily result in ship wreckage. Man had no control over them. He could only respect these phenomena and avoid sailing during such an unfavourable scenario. Apart from nature, pirates, ignorance, unfit ships and delay in sailing could result in untold misery and losses on the sea.

The Indian Ocean was infested with pirates in different sectors. Since antiquity, some communities settled around coasts and employed their knowledge of sea for plunder and piracy. Pliny alludes to the menace of piracy in the Indian Ocean and how ships used to carry archers on board. Similarly, the Periplus finds infestation of pirates along the Arabian coasts, southern Konkan.

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27 R. N. Saletore, Indian Pirates: From the Earliest Times to the Present Day, p. 16.
and northern parts of Malabar. Menace of piracy continued to threaten flow of maritime trade up to the modern times. Travellers in medieval period also witnessed piratical activities. Alberuni, Idrisi, Duarte Barbosa, Marco Polo, Ibn Battuta, Masudi, Nkitin and Tome Pires refer to piratical activities in the Indian Ocean.

Bawarjis were the most dreaded pirates in Sind and Gujarat. Their ships sailed as far as Sacotra. Their threat had forced the Sassanids to block the Persian Gulf with stones. Bawarjis got their names from their ships called Baira. These were small but swift. The invasion of Muhammad bin Qasim was directed against these pirates of Sind, who had even plundered the ships carrying gifts for the Caliph. They were also instrumental in the decline of the port of Somanatha. Konkan and northern Malabar were also infested with pirates. Due to shortage of resources and cultivable land, the sea provided a better option to the indigenous population. The flow of ships up and down from Gujarat to Malabar was an added incentive. Indian pirates were predominant even in the waters of Maldives. Situation was further complicated with the participation of small principalities in piratical activities. Speaking of Hinnawar, Duarte Barbosa refers to its pirates, Timoja and Raogy, who conspired with the king and did piracy. They shared their plunder with the ruler to obtain favours. Similarly the ruler of Fakanar had a commander named Lula, a Muslim, who plundered ships. Native boats chased the ships, which were not willing to sail to their ports. Captured ships were forced to embark on harbour and pay double the custom duties.

29 W. R. Schoff, *The Periplus of the Erythraean Sea*, p. 44.

30 Rashiduddin in *The History of India as Told by its Own Historians*, Vol. I, p. 65.


32 Ibid., pp. 186-187.
Pirates in the Indian Ocean were skilled in their violent vocation. They left nothing with the merchants. They forced the merchants to swallow a stuff called Tamarindi mixed in sea-water. It produced violent purging and merchants vomited precious things which they had swallowed realizing the danger of pirates. These pirates were skilled sailors and very well organized in their endeavours. We have an interesting testimony about the methods of Indian pirates from Marco Polo.

"From the kingdom of Melibar and Gujarat, there go for every year more than a hundred corsair vessels on cruise. These pirates take their wives and children, and stay out the whole summer. Their method is to join in fleets of 20 or 30 of these pirates vessels together, and then they form what they call a sea cordon that is they drop off till there is an interval of 5 or 6 miles between ships and a ship, so that they cover something like an hundred miles of sea, and no merchant can escape them. For when any one corsair sight a vessel, a signal was made by fire or smoke, and then whole of them make for this and seized the merchants and plunder them. Their aim was plunder only and they refrained from killing people. Perhaps only if they left the merchants alive, they would dare to come and try their luck again in Indian waters. They however obtained everything possible from the merchants."  

These pirates did not kill merchants. The motive behind this was not any compassion or mercy, but mere economic factors. Piracy was a livelihood for these pirates and they did not want merchants to be scared away from the Indian

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waters. They would on the contrary say and wish: 'Go along with you and get more gains and that mayhap will fall to us also.'

Pirates were skilled sailors. They were active in the sea over a long period of time. The entire community shared the spoils. They were familiar with the sea and their knowledge must have been transmitted to the younger generation. It would have been interesting if we had come across any evidence pointing towards their participation in maritime trade as sailors or captains. They could prove to be an asset, but one does not come across any such example in India. Duarte Barbosa alludes to fishing communities of Malabar that also sometimes worked on ships. Malacca involved dreaded pirates Celates in its maritime world. They were employed to ward off piratical activities and to further the economic interests of Malacca at sea. Indian states however failed to utilize the services of pirates to their full advantage. States of Hinnawar and Fakanar conspired with pirates to collect the spoils of the sea, but the practice was followed on a limited scale. Besides, this approach failed to attract sea-merchants. Rather, it alienated them.

The sailors took a number of precautions against the menace of piracy. Pliny, the elder, remarks that the ships carried archers to ward off the pirates in the Indian Ocean. In medieval times, the ships employed Abyssinians who were famous for their war-skills. Ibn Battuta found fifty archers and fifty Abyssinians on a ship named al Jakar from Perim. According to him, Abyssinian warriors were the lords of the Arabian Sea and 'infidels (here it stands for pirates who are termed as infidels) avoided attacking ships carrying them.' V.K. Jain argues that Indian ships did not concentrate on war material and hence lacked

36 R.N. Saletore, op. cit., p. 16.
skills to counter the threat of pirates. However, there were several references of Indians who engaged the enemies on the sea. Ibn Battuta encountered sixteen warships on his voyage from Pattan to Quilon. Malik Tujjar captured the Indian villages of pirates and chastised them. The sultan of Ma'abar ordered the formation of an army to safeguard his ships on the sea. The state of Sandapur had war-ships which could throw catapults. They even employed the ships called *ukairi*, roofed ships, and *taridatan*, with open stern to ease the movement of mounted horses in and out of the ships. Ibn Battuta accompanied the son of Ibrahim (governor of Sind) on an *al-ukari* that resembled a kind of *ghurab* (literal meaning crow). It was a long pointed and low war ship. It was covered with a roof during wars so that rowers remained safe from arrows and stones.

Turning to the eastern sectors of the Indian Ocean, the Malacca Straits were infested with the Celates, but the local rulers involved them in empire building. The arrival of huge *junks* further strengthened the mercantile community. The pirates were helpless against *junks* due to their huge structures. Chinese ships employed around 400 warriors like archers, shield bearers and cross bearers to safeguard their ships. Sheer numbers of occupants on the ship

38 V.K.Jain, op. cit., p. 89.
41 Arya Chakravati of Ceylon wanted to plunder the ships but the ruler of M'abar gave timely orders to protect his ships bound for Yemen. Ibn Battuta, (Mahdi Husain), pp. 217-218.
42 Ibn Battuta, (Mahdi Husain), p. 196.
43 Ibid., p. 176.
45 V.K. Jain, *Trade and Traders in Western India (AD 1000- 1300)*, p. 89.
made piracy a hard option for pirates. However, the pirates were a big menace for coastal ships. The merchants continued to face the threats of the pirates up to the modern times and the European were also not immune from them.

Rulers sometimes posed grave threat to mercantile activities. We have discussed how some of them indulged in piratical attacks to extract booty. Personal rivalries among the rulers could sometimes ruin a trading venture. There is no reference that rulers forced the merchants to operate in their area only. It was a later innovation of the Europeans. The rulers, however, demanded gifts and sometimes even confiscated the belongings of the merchants. Stefano faced a lot of trouble at the hands of rulers in Sumatra. Ibn Battuta tells us how Nizamuddin, a brother and enemy of the Sultan Qutbuddin Tahmatan (of Hormuz), intercepted merchants from India and Sind and caused great devastation. Revolt of General Huang Chao (879 AD) had resulted in the massacre of many sea merchants in Canton. The merchants countered such a scenario by diverting their merchandize to some safe principalities.

The Indian Ocean was also beset with many natural hazards. Storms, cyclones, reefs and sitting posed potent threat to the ships. Only a seasoned navigator could encounter these diverse challenges. The ships utilized the southwest to sail towards east but the southwest was traditionally very strong. The sea was rough and boisterous during this season. The sailing was tough for the dhows. Their frail stitched construction made things even more difficult. Marco Polo observes that sailors always remained in the pool of water bailing it out into the sea. Many ships were destroyed in the sea storms.\(^{49}\) If the ships

\(^{46}\) Stefano, p. 5.


completed their journey, it was with great difficulty and with only ‘God’s
guidance.’ The shoals and delta formed near the confluence of the river also
posed great problems. Ships faced the most daunting task while entering such
confluences from the high sea. Confluence of the Ganges in the Bay of Bengal
made currents strong enough to destroy any ship coming to Bengal.

Different sectors of the Indian Ocean required local expertise. Duarte
Barbosa found the tides of Gandhar very treacherous and ships hiring local
 navigators to guide them safely to the port. Ships also preferred local
 navigators to navigate through the Gulf of Cambay. Ibn Battuta records a similar
scenario in south India. When the ships intended to sail to Maldives, it was
necessary for them to have a local pilot. Ibn Battuta was stranded in Maldives
for nine days in the absence of a good pilot to navigate their ships to Ceylon.
Difference between a skilled team of crew and inexperienced one was a matter
of life and death. Ibn Battuta attributes the destruction of his ship in the Bay of
Bengal to an inexperienced captain. Pilots were available throughout the Indian
Ocean who offered their services in lieu of money. The port of Marataban was
dangerous for the ships. The ships had professional navigators who, if paid
handsomely, guaranteed safe sailing. Some ships employed pilots from Obeda
and Babelmandel. They were proficient in sailing through the Red Sea and were
available for this purpose only. Buzurg narrates two episodes that were well

51 Duarte Barbosa, Vol. I, pp.138-139.
52 Ibn Battuta, (Mahdi Husain), p. 197.
53 Ibid., p. 217.
54 Ibid., p. 225.
known among the sailors. These experiences depict what difference a knowledgeable pilot and an incompetent one made in the sea journey. The following story revolves around the famous shipmaster Abharah. A reputed shipmaster, he started his career as a shepherd, but went on to become a fisherman, a sailor and lastly the captain of a ship, which sailed upto China. How he saved a ship enroute to China, was related by Captain Shahriyar and recorded by Buzurg:57

"I was sailing from Siraf to China, and was between al-Sinaf and China in the region of Sandal Fulat, an island at the entrance of China, i.e. the sea of China, when the wind dropped to a calm and the sea became still: we let out the anchors and rested there for a couple of days. On the third day we sighted at a distance something on the sea. I let down the dingy into the sea with four sailors and ordered them, 'Make for that black object. And see what it is'. So they went out and returned and we asked, 'what is it?' and they said, 'Captain Abharah in his canoe with a water skin.' I replied, 'Why did you not bring him?' They said, 'We tried; but he said, 'I shall enter your ship on condition that I become the captain in command of vessel and am paid good to the value of 1000 dinars at Siraf prices. Otherwise I shall not enter.' When we heard this report, we were struck by his words. I went down with some others from the ship to where he was being tossed up and down by the waves; we hailed him and begged him to come up with us. But he said, 'Your situation is worse than mine, I am safer than you. But you shall go up if you pay me goods to the value of 1000 dinars at Siraf prices, and give me command of ship.' Then we said,' This ship holds a great quantity of goods

and valuables and many people, and it would do us no harm to have the advice of Abharah for 1000 dinars.'

So he came up into the ship with his canoe and his water-skin. As soon as he was aboard he said, 'Deliver me the 1000 dinars' worth of goods'; and we delivered them. Then, when he had put them in safe place, he addressed the captain, 'Sit aside!' and the captain moved from his station. Then he said to us, 'It is your duty to carry orders thoroughly while there remains a chance.' We said we shall do?' He said, 'Throw out all heavy cargo,' so we threw out about half the ships freight, or more. Next, 'Cut the larger mast (al-daqaal al-akbar),\textsuperscript{}' and we cut it and threw it overboard. In the morning he ordered us to take up the anchors and let the ship drift, which we did; then to cut the cable of the large anchor, which we did also, leaving it in sea. After that he ordered us to do the same with the other anchors and continued until we had thrown six anchors into the sea. On the third day, a cloud rose up like a lighthouse, and dissolved again into the sea; then the typhoon was upon us. And if we had not jettisoned the cargo and cut the mast we should have been sunk by the first wave that struck us. The typhoon lasted three days and three nights with the ship tossing up and down without anchor or sail, drifting we knew not whither. On the fourth day, the wind began to abate; then it died down altogether and sea was fair at the end of the day. From the morning of the fifth day, the sea was good and the wind were favourable (mastaqimah); we erected the mast, hoisted the sails and went out on our way.

On their return journey, Abharah ordered the members of crew to fetch anchor from certain reefs. This was the place where they had encountered the storm. The crew was amazed to find the anchors of the ship on these reefs and wanted to know from Abharah how did he know about these anchors. Abharah replied.
Yes, I shall explain. When I found you in this place, it was exactly the thirteenth day of the moon, at the same time of high tides. But, the water had already ebbed considerably, and you were between the reefs and the islands. So I ordered you to throw out the heavy cargo, and you did so. I then thought about the anchors, and realized that we should not need them urgently in China and that the value of an equal weight of the remaining cargo was double the value of anchors; so I threw them out as well because it was absolutely necessary to lighten the ship. The three anchors remained visible above the reefs and the island, while the other sank under the water. ‘But,’ we asked, ‘what indication did you have of this ebb and typhoon?’ He answered, ‘I and others before me have had experience of this sea, and we have discovered that exactly on the thirteenth day of every moon there is a large ebb which uncovers these reefs. Moreover, at the time of this ebb there is a violent typhoon, which arises from the depth of the ocean. The ship on which I was, had been wrecked on the crest of one of these reefs, because the ebb had caught me while I was lying at the anchor for the night over the reef; but I saved myself in that canoe. And, if you had stayed where you then were, you would not have remained on the sea more than an hour without the ship being grounded, before the typhoon, because you were over the island; and if you had run aground on it you would have been wrecked.”

Buzurg also narrates the story of a famous shipwreck under captain Ahmad. In contrast to the episode of Abharah, here is the tale of a captain who was unable to understand the gravity of the danger and suffered heavy loss of lives and cargo.

‘Three ships sailed off from Siraf. The vessels were well known to sea and the captains were respected. After a journey of eleven

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months they sighted the land of Sandan. It was a quick journey. But the luck went against them. Shortly a gale got up and carried them away. The sailors suggested to Ahmad to throw away the cargo but Ahmad refused. The crew started to bail out the keel. The crew once again requested the captain to throw away the cargo. The merchants also decided not to hold him responsible for the loss. But Ahmad remained adamant. The ship continued to suffer for next six days and when the order was given to throw away the cargo, it was too late. The water had heavily increased the weight of cargo and it could not be thrown. Rescue boats were floated and thirty-three men embarked. Ahmad refused to embark and decided to remain with the ship. Ships were ultimately lost.

Buzurg assures the readers that it was a very famous story that was told in those days. It was a great lesson for the sailors as to how they should be able to arrive at decisions quickly at sea. Delay could cause huge damage. Those three ships carried 1200 persons and great amount of cargoes. Had Ahmad decided well in time, the people on board might have been saved. However, due to delay only thirty men were saved. Towards the end, Buzurg remarks that the loss of three ships with cargo, sailors and captain contributed to the decline of Siraf and Saymur (it might signify unavailability of good sailors and captains in Siraf and Saymur over a certain period of time).

Ships also faced grave problems while entering the high seas and vice versa. The frailty of ships made it vulnerable to the coastal rollers. S.D. Goitein argues that most of the ships-wrecks occurred shortly after starting sailing or just before the ships' arrival in the ports. 59

At this juncture, it would be appropriate to have some understanding of the sailing classes. Most of the studies in maritime trade in the Indian Ocean have

concentrated primarily on the merchants and chief sailors. Ships also utilised services of people without whom the ships would never have sailed. They worked day and night on oars and performed numerous petty tasks. Abul Fazl refers to twelve categories of crew on board. They were nakhoda, muallam, tandil, mate, surhang, storekeeper, purser, gunner, lookouts and common seaman.\textsuperscript{60} Nakhodas and muallams might have some capital in hand to participate in trading ventures, but it would have been impossible for other members of the crew to generate capital.\textsuperscript{61} They were content to offer their services in lieu of money. Hinduism prohibited a sea voyage to dwijas. Still theoretically the sailors could be recruited from the lower social strata. The scenario changed when Islam offered them a better status and more mobility. Some foreign accounts also testify the presence of Indian sailors and captains in various nations. When the Portuguese invaded Malaaca, there were ‘many sea junks and Gujarat ships which were ready to fight; because there was in Malacca a captain from Gujarat who was working for war.’\textsuperscript{62} Indian Mappilas, Chettis and Siddis all went on to become expert navigators. In southeast Asia, Tome Pires tells us about dreaded pirates Celates who helped the sultan to lay the foundation of Malacca empire. They were also instrumental in the emergence of Srivijaya. The Sultan recruited them as nobles and they contributed a lot in strengthening the maritime network of Malacca.\textsuperscript{63}

\begin{itemize}
\item \textsuperscript{60} K.N. Chaudhuri, \textit{Trade and Civilisation in the India Ocean: An Economic History from the Rise of Islam to 1750}, p. 125.
\item \textsuperscript{61} Ashin Das Gupta suggests that the active workers during the sailing were sarang and tindal. In reality, they navigated the ships. The captain was there to regulate their affairs only. He did not get much opportunity to sail the ship himself. Ashin Das Gupta, ‘India and the Indian Ocean, c.1500-1800: The Story’, in \textit{The World of the Indian Ocean Merchants 1500-1800, Collected Essays of Ashin Das Gupta}, compiled by Uma Das Gupta, p. 25.
\item \textsuperscript{62} Tome Pires, Vol. II, p. 279.
\item \textsuperscript{63} Ibid., pp. 234-235.
\end{itemize}
Shipbuilding

Shipbuilding was an important branch of navigational sciences. Only well constructed vessels could help sea merchants to earn profits in distant lands. The lives and capital of the merchants and sailors depended upon how good a vessel was. Only the efficiency, sturdiness and suitability of the ships could ensure the safety of persons on board in turbulent sea. Thus, the shipbuilding industry also required indepth study to understand the requirements of the mercantile classes and the nature of maritime trade. The designs and material employed in ships could help us understand the routes and difficulties faced by the ships in a particular sea. Red sea was full of treacherous reefs and it was always advisable to sail in small crafts. Junks avoided the Arabian Sea because of its shallowness. The design of ships could also sometimes enable us to understand the religious beliefs of sailing communities. Ships also threw considerable light on the cultural traits of the sailors.

It is not known how and when man first thought of constructing the ship. How he calculated risks and the design of his sailing vessel. Perhaps he was tempted to take to water when he saw a log of wood floating in the water. Wooden logs might have been given new shapes to provide stability to boats. These were the boats of rudimentary type. It might have resembled modern canoe still used by fishing communities around the Indian Ocean. Our object here is not to study the ships for their own sake. Our prime consideration is towards huge sea going vessels that dramatically altered the picture of maritime trade after the eleventh century. These ships sailed like mountains with wings upon the sea.\textsuperscript{64} They crossed the deep sea and withstood violent storms and protected its inmates and merchandize. The navigational skills required for

\textsuperscript{64} Wassaf in \textit{The History of India as Told by its Own Historians}, Vol. III, p. 30.
sailing these ships was an art in itself and needed years of learning and experience.

Shipbuilding industry has a long history in India. People of the Harrapan civilization knew the art of shipbuilding. They had the famous port of Lothal and ships did coastal trading up to Mesopotamia. S. R. Rao remarks that Khambayat (Cambay) must have been a port in the Harrapan times. Alexander also got a large fleet of ships constructed in Punjab. He even sent a branch of his army via the sea route. The Mauryans commanded a strong navy. They appointed a special officer called navadhayaksha (incharge of navy) to look into the affairs of navy. Skilled ship-builders were directly employed by the government and ships were leased out to merchants. Ashoka sent many embassies to various countries to spread the gospel of Budhism. These embassies crossed seas to reach Ceylon and southeast Asian countries. However, it is not known whether or not the ships, employed by these embassies, were state owned. Pliny remarks that the Maurayan ships were around 3000 ampharae (one ampharae being around 1/40 tons). Thus these ships were carrying the loads of around 75 tons. These ships were also sharp ended so that they could steer both sides in small channels. Emergence of the Roman Empire and its expansion into Egypt proved to be a boon for the Indian Ocean trade and its shipping industry. Hipalus discovered monsoons and ships could sail directly from the Red Sea to India. The Stavahanas, Kushanas and Guptas witnessed considerable expansion in maritime trade. The Arabs and Persians were sailing up to China in the ninth century.

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68 Pliny quoted in Radha Kumud Mookerji, op. cit., p. 72.
69 Ibid.
century. The absence of teak in western Asia must have necessitated the construction of dhows (for such a long voyage) in western India i.e. Konkan and Malabar. Conquest of Srivijaya (1025 AD) by the Cholas also attests to well-developed shipping industry in south India. Indian merchants started expanding their activities to the Persian Gulf, Red Sea and southeast Asia. Increased mobility further helped the expansion of shipbuilding traditions in the Indian Ocean.

Shipbuilding tradition around the Indian Ocean underwent several changes after the eleventh century. Commodities were restructured and staples became an important part. The merchandize grew in size and ships followed the trend by increasing their size. New communities like the Chinese and Indian converts to Islam started playing an important role and their influence was noted in all spheres. Ships in the Indian Ocean could be classified into two broad categories namely junks and dhows. Almost all the contemporary sources refer to the differences that existed between these two types of ships. Western sector of the Indian Ocean was dominated by dhows. Junks on the other hand, were the ships originating from China. They controlled the eastern sector of the Indian Ocean. South India, being the area of transshipment, experienced the impact of both categories. Eastern and western sectors showed different interests due to their locations and requirements. Konkan became famous for dhow building. Teak found there was used in almost all the dhows plying in western sector of the Indian Ocean. On the other hand, Bengal and Quilon in Malabar region became the centre of junk building. Simon Digby opines that technology of constructing junks filtered down from China to Bengal, so that the latter was constructing junks around the fifteenth century.70

Yuktikalpatru, an important treatise of the eleventh century throws light on Indian shipbuilding tradition sans technical specifications. According to this work,

ships could be divided into two major categories namely samanya and visesha. Ships like mantra and samany were measured to be around 120 cubits in length and 60 cubits in breadth and height. Kshunra on the other hand was a small ship measuring around 16 cubits in length and 4 cubits in breadth and height. This text also illustrates another aspect of Indian shipping. It records that the Indian ships were provided with cabins. Sarvamandir had cabins from one end to another end. Madhyamandir and agrahamandir had cabins only in the middle and front respectively. Indian ships were also multi-mast sailed. Teak was favoured for its flexibility and resistance in sea-water. However, still it is not known whether or not these ships constituted traffic in the deep sea. Ibn Battuta also records wooden cabins in the middle of the ships. But these ships were used mainly for river transporation. The governor used these ships for patrolling his country i.e. Sind. In his account, Ibn Battuta records:

"The jurist Alau al-Mulk had amongst his vessels one called by the name of ahwara, somewhat like a tarida in our country, but broader and shorter. In the centre of it there was a cabin to which one climbed up by steps, and on the top of this there was a place prepared for the governor to sit in. His suite sat in front of him and the mamluks stood to right and left, while the crew of about forty men rowed. Accompanying the ahawra were four vessels to right and left, two of which carried the governor's 'honour', i.e. standard, kettledrums, trumpets, bugles and red pipes (that is ghaitas)."

71 Brajesh Krishna, op. cit., p. 53.
72 Ibid., p. 54.
73 Tarida in Mediterranean usage was a vessel for the transport of horses and heavy goods. Ibn Battuta, (H.A.R. Gibb), Vol. III, p. 601 (fn. 23).
Nowhere in other contemporary sources, Indian ships with multi-sail and decks have been observed. As stated above, the Indian Ocean trade was mainly carried out into two kinds of ships namely **junks** and **dhow**s.

**Junks**

Originally, **junks** came from China and they sailed upto southeast Asia prior to the eleventh century. The emergence of the Sungs and subsequent transfer of their capital Hangchow towards the southern areas encouraged direct Chinese participation in the maritime trade of the Indian Ocean. They sailed upto Calicut. Wassaf compares their ships, namely **junks** with mountains sailing with wings on water.\(^75\) **Junk** building tradition originated in China but, with the passage of time, it filtered down to other countries in southeast Asia and India. These ships were multi-masted and carried square bamboo sails and single central rudder. H. Warington Smith considered **junk** the most efficient ship of its times. He remarks:

> "As an engine for carrying man and his commerce upon the high and stormy seas as well as on the vast inland waterways, it is doubtful if any class of vessel is more suited or better adapted to its purpose than the Chinese or Indian **junk**, and it is certain that for flatness of sails and handiness, the Chinese rig is unsurpassed."\(^76\)

Conti observed that Indians built ‘ships larger than ours capable of containing two thousand butts and with five sails with as many as masts. The lower part was constructed with fabricated planks to withstand the force of tempest to which they are much exposed.’\(^77\) Java was also constructing **junks**

\(^75\) Wassaf in *The History of India as Told by its Own Historians*, Vol. III, p. 30.

\(^76\) H. Warington Smith quoted in wikipedia.org/wiki/Chinese-junk, p. 2.

\(^77\) Nicolo Conti, p. 27.
after the twelfth century. **Junks** were constructed in both Bengal and Calicut around fifteenth century.

**Junks** could be divided into three broad categories. **Zau** and **kanklam** were middle and small sized junks respectively. However, these were not deep sea going vessels.78 The large vessels sailing in deep ocean were called **junks**. These were designed for sturdiness and comfort. They boasted of immense size. G.F. Hudson attributes their large size to the changing structure of commodities. Silk technology was smuggled out to Syria. China no longer held monopoly over silk. Chinese porcelain at the same time was in great rage. Porcelain was a heavy product and needed space.79 Changed eating habits and inclusion of spices and grains in sea trade also necessitated the increased size of **junks**. They also provided security from the pirates. Sheer size of **junks** and the large number of inmates was sufficient to wards off pirates. Marco Polo echoed similar sentiments when he records that well manned and armed ships with huge size were difficult to plunder.80 The author of Pingzho Ke Tan attributes different reasons for the big size of **junks**. He admits that the sheer size of junks discouraged pirates. But he candidly remarks that **junks** were made big enough to carry the insatiable demand of gifts and tributes to foreign lands.

These ships had a single deck and many cabins. These cabins had their own attached bathrooms. Ibn Battuta complained that he was not given a good cabin in the **junk** at Calicut. These ships were multi-masted. Many sails were fitted in such ships. The sails were raised and lowered as per the requirement. Traditionally the sails were of bamboo. But, it is not authentically known whether Indian **junks** employed traditional bamboo or cotton cloths. It is a common belief that the sailing classes tended to be extremely superstitious and generally

78 Ibn Battuta, (Mahdi Husain), p. 190.
A junk of the Sung Period

Source: wikimedia.org

A junk of the Yuan Period

Source: wikimedia.org
resisted diversion from traditional methods in ordinary circumstances. Besides, both bamboo and cotton were available in India in plenty.

The construction of junks was such that they required strong planks to build the super structure. The planks of the ships were not pitched. On the contrary, the shipbuilders employed different techniques. According to Marco Polo, the shipbuilders daubed the sides. They took some lime and chopped hemp and kneaded these together with certain wood oil. When the hems were thoroughly amalgamated, they held like glues. With these mixtures, they painted their ships. This technique strengthened the planks of the junks. Plankings of the junks were done after every long journey.\textsuperscript{81} Conti remarks that the planks of the ships were planked thrice. Second plank was constructed over the first and the third over the second. Only then, the ships were taken for a long journey.\textsuperscript{82} In case of leakage in the plank, the mariners at once ascertained the location of the damage. They emptied the cargo from that compartment and shifted it to the adjoining ones. Then they repaired the leakage. Conti observes one important phenomenon in junks. The junks in India were so built in compartment that ‘should one part be shattered, the other portion remaining entire may accomplish the voyage.’\textsuperscript{83} Ibn Battuta provides a vivid description of the structure of junks. In his words:

“Two wooden walls are built connected by extremely strong beams, which are fastened throughout their length and breadth by means of thick nails. The length of such a nail is three cubits. When the two wooden walls are joined together by the beams.... the lower deck is built on them and these are launched in sea.....the beams and wooden walls which jointly touch the

\textsuperscript{81} Marco Polo, Vol. II, p. 250.

\textsuperscript{82} Nicolo Conti, p. 27.

\textsuperscript{83} Ibid.
water enable the people to descend to it, and wash and satisfy need. By the side of these beams, there are oars, which are as large as ships mast, and each one of these are ten to fifteen men come together; and they row standing at their feet. Four decks are constructed on the ships, which contain apartments, cabins and rooms for the use of the merchants. And cabins in ship contain lavatories and have a door which can be bolted by the occupants who may take with him his female slaves.84

The Chinese innovated new techniques to make their junks sturdier. After thirteenth century, the rudders of the junks were made with holes in them (fenestrated rudders). It lessens the force applied on maneuvering these huge ships.85 The Chinese also improved the designs of their sails. They made the sails with several battens that provided shape and design. Now each batten had a cord attached to its edge. With the help of these battens and their cords, the sails could easily be adjusted to accommodate various wind strengths. This technique made sails more resistant to wear and tear because repair could be done be replacing any particular batten. Besides, the sails on junks could be 'moved inward, towards the long axis of the ship, allowing these junks to sail into the wind.'86

Junks faced one great shortcoming. Wake suggests that the Chinese pine and ceder was not durable. It was not strong enough to prevent ships ‘against prolonged immersion in the tropical waters of the south Chinese sea and the Indian Ocean….against wood boring and sea worms. Navigators therefore took recourse to fastening an extra layer of planking to hull after accomplishing each

84 Ibn Battuta, (Mahdi Husain), pp.190-191.

85 The Europeans adopted the technique of ‘fenestrated rudders’ in 1901 AD to decrease the vulnerability of torpedo boat’s rudder when manoeuvring at high speed. wikipedia.org/wiki/Chinese-junk, p. 2.

86 Ibid., p. 1.
long voyage. But after three layers of planking the ships became unworthy for long voyage and 'thus withdrawn from the run to India.'

**Junks** required thorough preparation before actually starting the voyage. These were provided with tenders and small boats (normally ten). These small boats helped in laying the anchors, catching fish (for food) and bringing supplies overboard. These boats also towed the big ship in close winds. When the ship was in full swing these boats were slung to the sides of the main ship. Marco Polo provides vivid description of these small boats and their services to the main ship. In his words:

"...every great ship has certain large barks or tenders attached to it; these are large enough to carry 1000 baskets of pepper and carry 50 or 60 mariners apiece [some of them 80 to 100] and they are likewise moved by oars; they assist the great ship by towing her, at such time as her sweeps are in use [or even when she is under sail, if the wind be somewhat on the beam; not if the wind be astern, for then the sails of the big ship would take the wind out of those of the tenders, and she would run them down]. Each ship has two [or three] of these barks, but one is bigger than the others. There are also some ten [small] boats for the services of each great ship, to lay out the anchors, catch the fish, bring supplies aboard, and the like. When the ship is under sail she carries these boats slung to her sides. And the large tenders have their boats in like manner."

**Junks** also required a virtual army of sailors and guards on board. There were around 300 to 400 mariners in a single junk. Around fifty to hundred sailors

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were required to tow the ship with oars if the wind was not enough. Ibn Battuta concludes that *junks* had around 600 sailors and 400 warriors to ward off the pirates. *Junks* could carry considerable amount of cargo. A big sea going *junk* could carry between fifteen hundred to nineteen hundred tonnes. 89

**Dhows**

The term *dhow*, a corrupt form of *daw*, was originally drawn from Somali rather than Arabic. The travellers however applied this term to all the ships constructed after the fashion of Arabia. *Dhows* were smaller in stark contrast to the huge Chinese *junks*. At the same time, they were more suitable in the rough shallow waters of the Arabian Sea. They plied between Aden and Malabar after the eleventh century. They were single masted. They had lateen sail that was well suited to catch the wind. However, it was not truly triangular in shape. These for and aft sails, or more correctly the settee sails ‘had a luff at the fore part in proportion to the leech of roughly 1-6 in the main sail.’ 90 It could catch more wind in return. Unlike the Chinese *junks*, sails on *dhows* could not be reefed. However, the sailors lowered the sails in the face of strong winds, and even carried small sails with them. Captain Colomb observed, ‘There is no arrangement for reefing in bad weather and every sea-going *dhow* carries two

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89 Marco Polo’s remark that the junks could carry 5000 to 6000 baskets of pepper has given birth to a hot debate regarding the capacity of junks. Simon Digby calculated junks to be 720 tonnes if one *carica* or bag was of 120 kilograms as in Venice. But, if it was measured in reckoning of the weights prevalent in the Indian Ocean than it must have been 1462 tonnes. For details see Simon Digby, ‘The Maritime Trade of India’, in Tapan Raychaudhari and Irfan Habib, eds., op. cit., pp. 129-129; C. Wake concluded that one basket of Marco Polo was standard Mediterranean *sporta* of pepper weighing 225 kg and thus the junks carried the capacity of 1520 tonnes to 1860 tonnes. For details see C. Wake, op. cit., pp. 74-80.

90 [www.nabataea.net/ships.html](http://www.nabataea.net/ships.html), p. 4.
yards and two sails, one large, as described, for daylight and fine weather, the 
other small, for night and foul weather.\textsuperscript{91} In the earlier times, the sails in the 
beginning, sails were made of coconut and palm leaves, but in medieval times, 
cotton was used in the making of these sails.\textsuperscript{92} Hourani attributes the discovery 
of lateen to the Arabs because in the interiors of India, where there was less 
foreign contact, square sails continued to dominate the local ships.\textsuperscript{93} Even the 
Chinese used square sails on their \textit{junks}. The Mediterranean ships also used 
square sails till their contact with Muslim armies. \textit{Dhows} with setteen sails kept 
closer to the wind and hence better suited to manoeuvre and tack the narrow 
waters.\textsuperscript{94} The masts of the \textit{dho\textsc{ws}} were tall and Buzurg mentioned a mast of 
seventy-six feet.\textsuperscript{95} However, the tall mast must have made tacking risky and 
\textit{dho\textsc{ws}} usually employed the wearing method. When steering a course into the 
wind, the \textit{dho\textsc{ws}} would prefer to wear around, that was, to change tacks by 
going round stern to wind. Tacking involved bringing the bow around into the 
wind. The Arab vessels were built with small rudders. It was difficult to bring the 
bow across the wind in case of strong winds. Wearing around meant losing way. 
But it was easier, to wear, to take the line of less resistance. When wearing, the

\textsuperscript{91} G.F. Hourani, op. cit., p. 100. 

\textsuperscript{92} Reefing is a technique in which the area of sails catching strong wind was 
reduced. www.nabataea.net/ships.html, p. 4. 

\textsuperscript{93} In the Ajanta paintings and Pallava coins ships were depicted with square 
sails, though with the passage of time these were replaced with lateen sails. For 
details see G.F. Hourani, op. cit., pp. 100-105. 

\textsuperscript{94} Lateen was very important to \textit{dho\textsc{ws}}. Lateen or fore and aft sail made \textit{dho\textsc{ws}} 
catch the wind more effectively. www.nabataea.net/ships.html, p. 6. 

\textsuperscript{95} Ibn Shariyar Buzurg, \textit{Kitab Ajaib al-Hind}, Eng. tr., G.S.P. Freeman-Grenville, 
\textit{The Book of the Wonders of India, Mainland, Sea, and Islands}, p. 87.
yard must be transferred to the other side of the mast. However, the wind aided this manoeuver, whereas when tacking the wind tended to hinder it.\footnote{136}

The structure of the \textit{dhow}s was very simple because there was no deck and sailors had to keep on bailing the water out of the ship. These ships were also unique for their stitched structures. There is a vigorous debate as to why Indians did not employ iron nails when they had seen their use in Chinese \textit{junks}. Almost all the contemporary travellers refer to the strange practice of stitching of the ships (\textit{dhow}s). Referring to a \textit{dhow}, Odoric remarks, “in this country men make use of a kind of vessel which they call \textit{jase}, which is fastened only with the stitching of twine.”\footnote{Friar Odoric, (\textit{Cathay and the Way Thither}), Vol. II, pp.113-114.} Marco Polo observes:

“\textbf{The ships are wretched affairs and many of them get lost; for they have no iron fastening and are only stitched together with twine made from the husk of Indian nuts. They beat this husk until it becomes like horsehair, and from that they spine twine and with this stitch the planks of the ships together. It keeps well and is not corroded by the sea-water, but it will not stand well in storm. The ships are not pitched but rubbed with fish oil. They have one mast one sail, and one rudder, and have no decks, but only a cover spread over the cargoes. This cover consists of hides, and on the top of these hides, they put the horse, which they take to India for sale. They have no iron to make nails of, and for this reason they use only wooden treenails in their shipbuilding, and then stitch the plank with twine as I have told you. Hence, tis’ perilous business to go on a voyage in one of those ships, and many of them are lost, for in that Sea of India the storms are often terrible.}”\footnote{Marco Polo, Vol. I, p. 108.}
It was believed that iron might make ships vulnerable to the magnetic power underneath the sea. Marco Polo remarks that the ships were stitched because the wood was not strong and flexible enough to be worked upon with nail. It was also suggested that the iron was vulnerable to corrosion in the Arabian Sea. Masudi explains, "Now this kind of structure (stitching) is not used except in the Indian Ocean; for the ships of the Mediterranean and those of the Arabs have nails. Whereas in the ships on the Indian Ocean, the nails grow soft and weak in the sea; and therefore the people on its shores have taken to threading cords of fibre instead, and these are coated with grease and tar." Iron fasted ships were also said to be more prone to disaster in case they ran into coral reefs. Hourani contradicts all these arguments. According to him, the salinity of the Indian Ocean was not much in comparison to Mediterranean. Teak used in the Indian Ocean was more flexible and strong than any wood. It was well suited for ironwork as proved in later times. For more details see G.F. Hourani, op. cit., pp. 95-96.

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99 Hourani contradicts all these arguments. According to him, the salinity of the Indian Ocean was not much in comparison to Mediterranean. Teak used in the Indian Ocean was more flexible and strong than any wood. It was well suited for ironwork as proved in later times. For more details see G.F. Hourani, op. cit., pp. 95-96.
stitched ships. Superstitions also ruled the sailing communities and only strong economic consideration forced them to part with their traditional techniques. Besides, Ibn Battuta suggests that a stitched ship provided more resilience to the ship because these ropes did not get rusted. The flexibility of the rope sewing would have enabled the sailors to ride the heavy surf of many roadsteads with more success. Nevertheless, in the face of strong European competition, the rope-sewn ships were replaced with iron nailed ones in the sixteenth century. In 1507 AD, an Arab merchant in Gujarat ordered the construction of ships built on a Spanish model (that indicated the inclusion of iron nails).

Dhows were caulked with wood or mixture of pitch (rasin) and whale oil. Idrisi remarks, "They catch the smallest (whale) which they took in cauldrons so that their flesh melts and change into thick liquid. This oily substance is renowned in al Yaman, Aden, the coasts of Fars, Uman and the sea of India and China. The people of these region use this substance to block the holes in their ships." The smell of the whale oil must be very foul and one can understand the plight of Abdur Razzaq when he first boarded the ship. Like junks, the dhows also had smaller boats attached to them. These boats however were put on board. These boats, namely qarib and dunij, differed in their size only. The former could carry four men compared to fifteen by the latter. Dunij could also be

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100 Qaisar believes that iron nails increased the construction costs of the ships and it brought no significant increase in trade and profits. Thus the sailors felt no need to use iron nails in the construction of their ships. A.J. Qaisar, The Indian Response to European Technology and Culture AD 1498-1707, p. 25.


102 Caulking is the procedure to make joints leak proof by forcing oakum between the parts that are not tightly fitted. A.J. Qaisar, op. cit., pp. 20-21.

103 G.F. Hourani, op. cit., p. 97.

104 The smaller boats might also have slung to the sides of dhows like the modern life boats in the sea vessel.
An enlarged stamp (1937) from Aden Depicting dhow
Source: wikimedia.org
fitted with sail in emergencies. These boats also carried out daily chores like trading in coasts when the ship was stationed in the deep sea. These ships also towed the main ships in case of insufficient wind.

Dhows had single or double rudder in antiquity, but in the period under study, the stern rudder was commonly employed. Talking of the anchors (commonly referred to as langar, lanjer and bawa), the dhows employed anchors of rudimentary type. Lanjer with five garns (grapnels or arms) was used on the rocky sea bottom. The bawra was a heavy anchor with two garns with fluke at the end of the arms. This anchor was employed on sandy and muddy sea bottoms. These anchors could be anything from stone marbles to metals (mainly iron). However, the stone anchors were mostly favoured. Dhows usually had the capacity between 100 to 200 tonnes. These ships were packed to their limit with cargo, horses, merchants and sailors. Travelling in these ships was not as luxurious as in junks. These were overcrowded and one could just imagine the plight when Abdur Razzaq fainted on his first boarding of a dhow. He records, “I sojourned in this place for space of two months; and the governor sought all kinds of pretext to detain me; so that favourable time for departing by sea....was allowed to pass...As the men and horses could not be contained in the same vessels, they were distributed among several ships...As soon as I caught the smell of vessels, and all the terror of the sea presented themselves before me, I fell into so deep a swoon, that for the three days respiration alone indicate that life remained within me.”

105 Dionisius Albertus Agius, op. cit., p. 189.
106 Abdur Razzaq, p. 3.