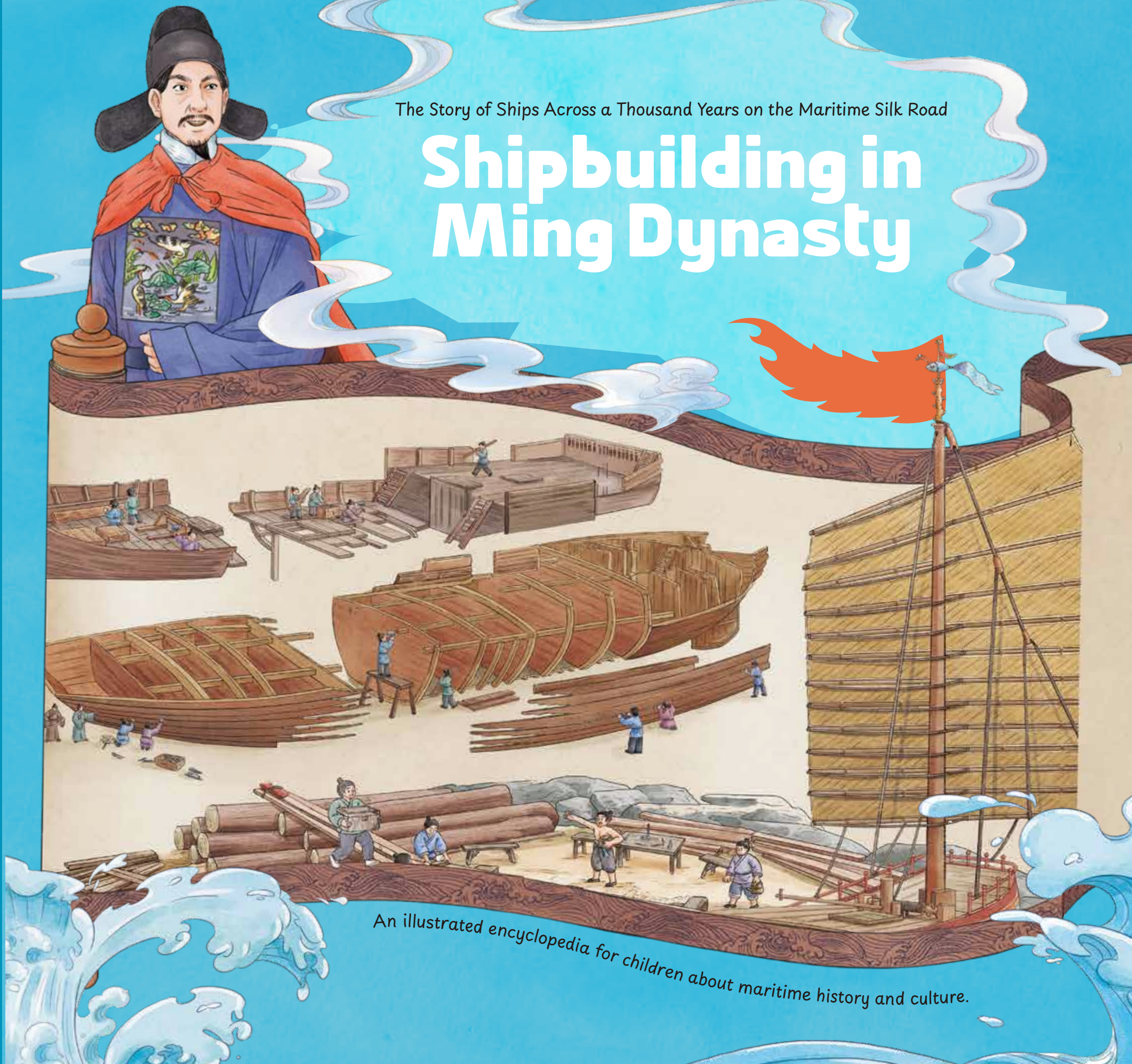
The Story of Ships Across a Thousand Years on the Maritime Silk Road

Shipbuilding in Ming Dynasty



An illustrated encyclopedia for children about maritime history and culture.

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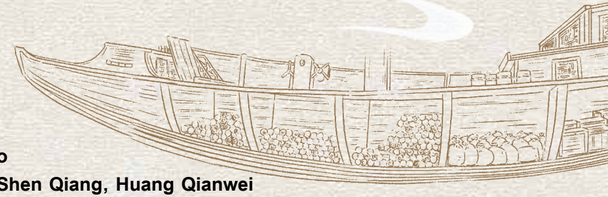

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Preface

Covering about 70 percent of the Earth's surface, the ocean is not only the cradle of life but also a vital channel through which civilizations have expanded and connected. China's relationship with the sea reaches far into antiquity. For thousands of years, its shipbuilding traditions have reflected remarkable ingenuity and legendary feats.

Let's travel back eight millennia to the rich wetlands of the lower Yangtze River—home to the unique Kuahuqiao culture. Among the fascinating relics left by this society, one discovery stands out: a perfectly preserved dugout canoe. This vessel represents one of the earliest examples of human maritime activity, silently witnessing our ancestors' curiosity and exploration of rivers, lakes, and seas.

From the Qin and Han dynasties onward, China's shipbuilding industry flourished. Advancements continued through the Sui, Tang, Song, and Yuan dynasties, reaching an apex during the Ming dynasty. By then, Chinese shipbuilding was globally unparalleled, supported by a rigorous and efficient administrative system. Techniques and craftsmanship achieved unprecedented sophistication. It was in this context that Zheng He set sail with his massive fleets, undertaking seven legendary voyages that left an enduring legacy in China's maritime history.

In honor of Zheng He's achievements and with approval from the State Council, the Ministry of Transport and the Shanghai Municipal Government established the China Maritime Museum—the country's first national museum dedicated to maritime heritage. Its mission is to celebrate China's maritime civilization, provide a platform for international exchange, support Shanghai's development as a global shipping hub, and inspire young people to engage with maritime culture. Here, visitors can trace the evolution of Chinese seafaring and navigational technology from ancient times to the present, witnessing the ongoing story of China's maritime development.

The year 2025 marks the 620th anniversary of Zheng He's voyage. To commemorate this milestone, A Children's Encyclopedia of the Thousand-Year History of the Maritime Silk Road was published. Consisting four volumes, this book series explores shipbuilding, investiture missions, navigation technology, and cross-cultural encounters. Through engaging narratives, it recounts how China—building on the legacy of the overland Silk Road—extended a hand of friendship across the seas, demonstrating leading maritime technology and an indomitable spirit of exploration. Each volume opens a window onto nautical wonders, inviting young readers to set sail through history.

Special thanks are due to the authors and illustrators whose vibrant storytelling brings these ancient adventures to life. We invite young readers to embark on this journey with open eyes and curious hearts.

May every child who opens these books become a little navigator—discovering wonders and joy along the way, gathering courage for life's journey, and sailing boldly into the world's vast horizons!

China Maritime Museum

A New Official Takes Office

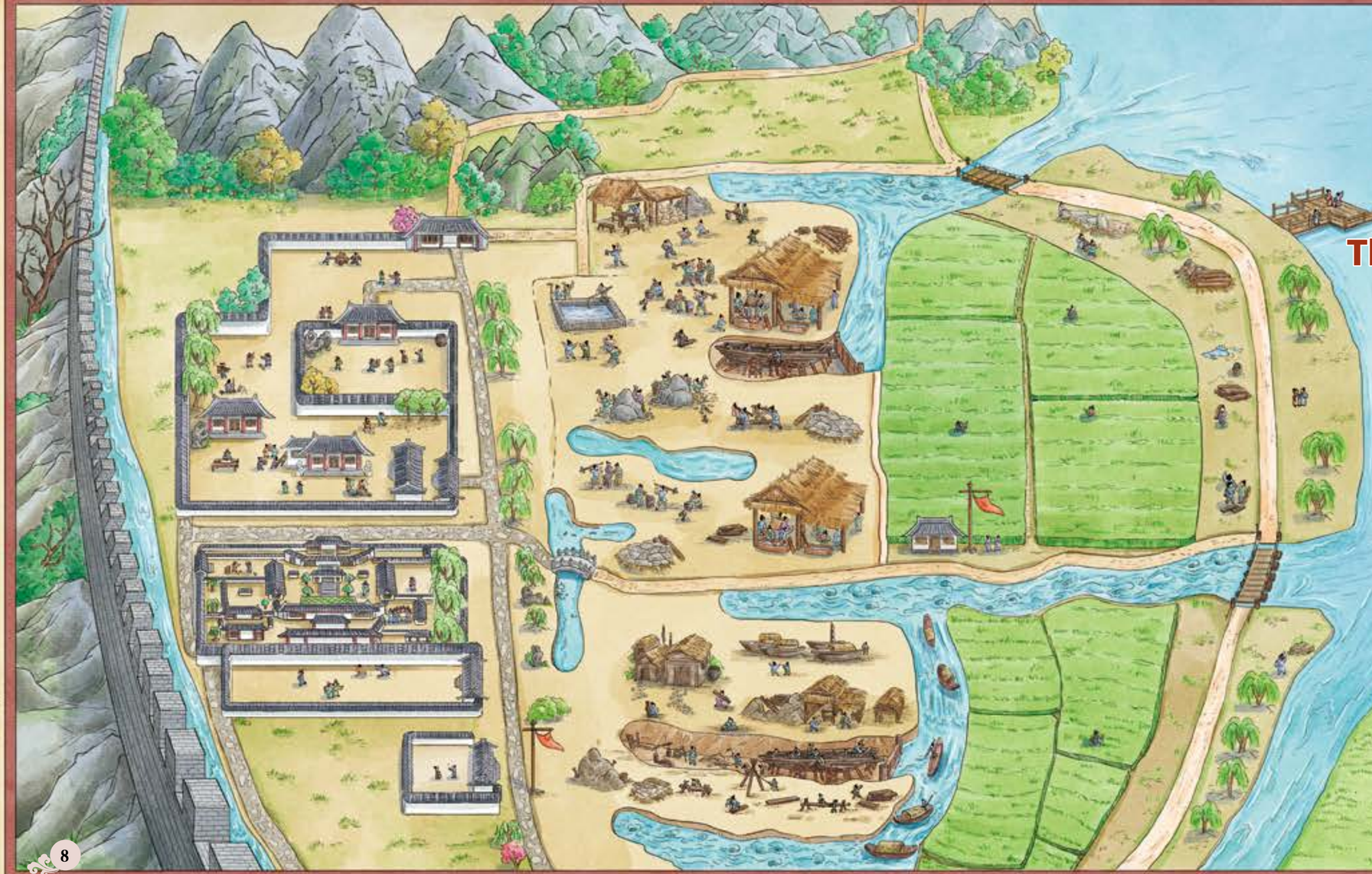
With spray rising from the river, an official boat with high sails glided slowly along the Qinhuai River toward Longjiang Pass. The new secretary in charge of the Longjiang Shipyard was coming to the Longjiang Shipyard (located in Gulou District, Nanjing today).

"Sir, there's Longjiang Pass ahead. The Longjiang Shipyard is just inside!"

Li Zhaoxiang (1512–1572 AD), courtesy name Yuantao, was from Songjiang Prefecture (today's Shanghai). In the 30th year of Jiajing (1551 AD) he was appointed as the Secretary of the Bureau of the Waterways in Nanjing, a sixth-rank official (a mid-level official) in charge of ship affairs at the Longjiang Shipyard.

Do You Know?

Ming China was a world leader in maritime technology and maritime trade. Nanjing was the nation's center for shipbuilding and naval administration. The huge treasure ships used by Zheng He, as well as imperial yellow barges, dispatch boats, and warships, were built and repaired in Nanjing's shipyards. The Ming government assigned officials specifically to supervise ship construction to ensure the efficiency and quality of shipbuilding. From the 2nd year of Hongzhi (1489 AD) to the 30th year of Jiajing (1551 AD), 12 officials ran the Longjiang Shipyard. And 10 of them were the palace graduates (Nominees who passed the highest-level Imperial Examinations (court exams) which shows how seriously the Ming government took the shipbuilding industry!



The Vast Longjiang Shipyard

Peering past Longjiang Pass, Li Zhaoxiang saw the shipyard rising like a grand city of ships.

Look — the shipyard's "brain" was laid out in neat order: the Supervisorates, the Ministry of Works Branch, the District Office, and the Regional Military Commission. Listen — the clanging of metal and the workers' calls came from the forging workshop (which made iron components for ships), the caulking workshop (which sealed seams so hulls would not leak), and other workshops. These were the shipyard's "magic workshops". A row of large docks stood ready, allowing many large ships to be built at the same time.

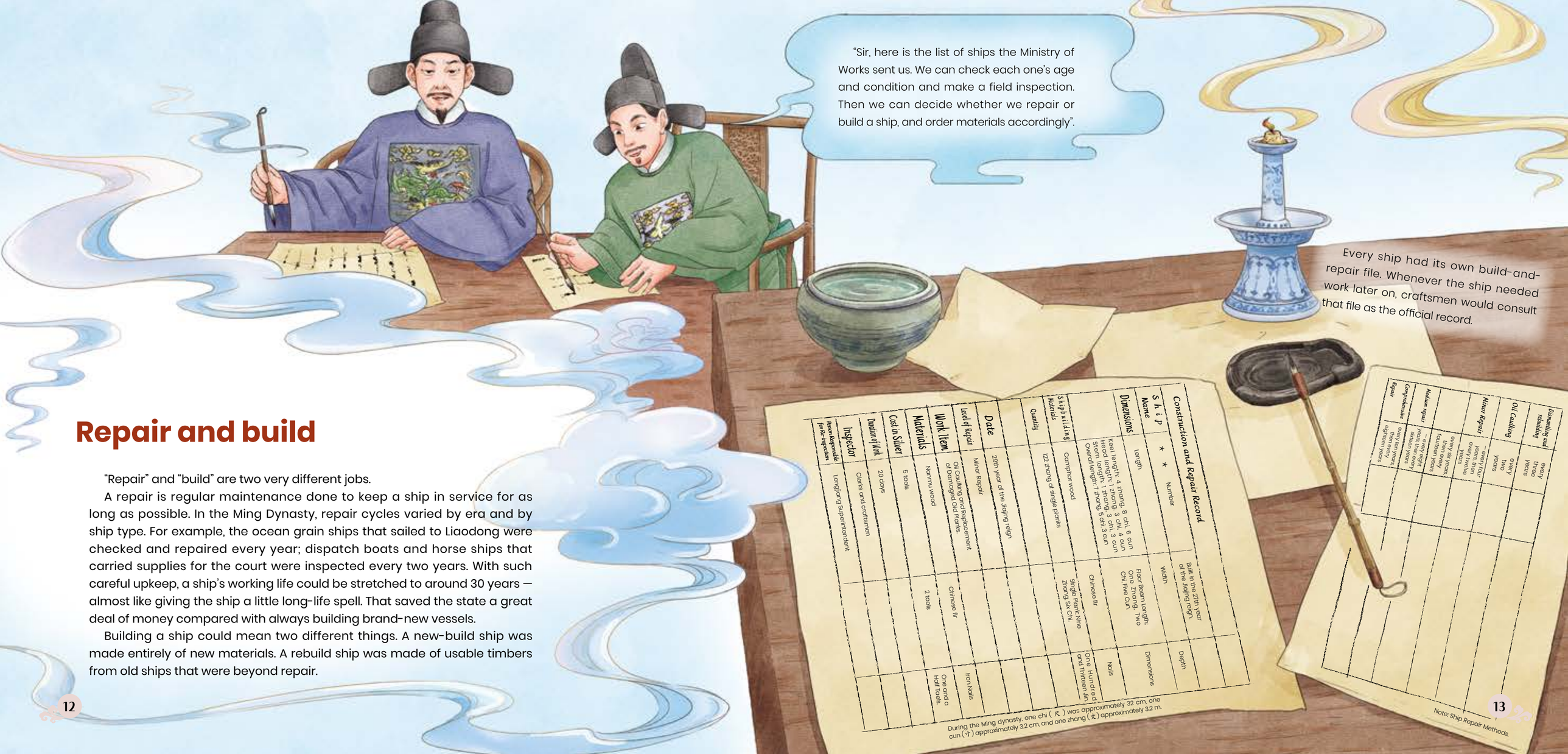
Do You Know?

Longjiang Shipyard was built in the Hongwu years and was the Ming dynasty's earliest state-run shipyard. It stretched nearly 1,200 meters from north to south and more than 400 meters from east to west, about 70% of the area of the Forbidden City. It was one of the largest shipyards in the world at that time. Over 400 households of craftsmen worked there. About every 10 households formed 1 unit called a jia (甲); ten jia formed a xiang (厢). The whole yard was divided into 4 xiang, and the craftsmen in each xiang had clear, specialized roles.

A Challenging Task

Li Zhaoxiang felt his blood run hot as he took in the hustle and bustle of Longjiang Shipyard. After a brief rest, aware of the heavy responsibility, he plunged straight into work.

In the main hall of the offices, Li cleared his throat and announced the Ministry of Works' orders: because tribute and grain transporting had grown in recent years, there simply weren't enough ships. This year the shipyard's orders to repair and build ships had doubled compared with last year! As soon as he said that, the officials began to discuss. Everyone knew this would not be an easy job.



Repair and build

"Repair" and "build" are two very different jobs.

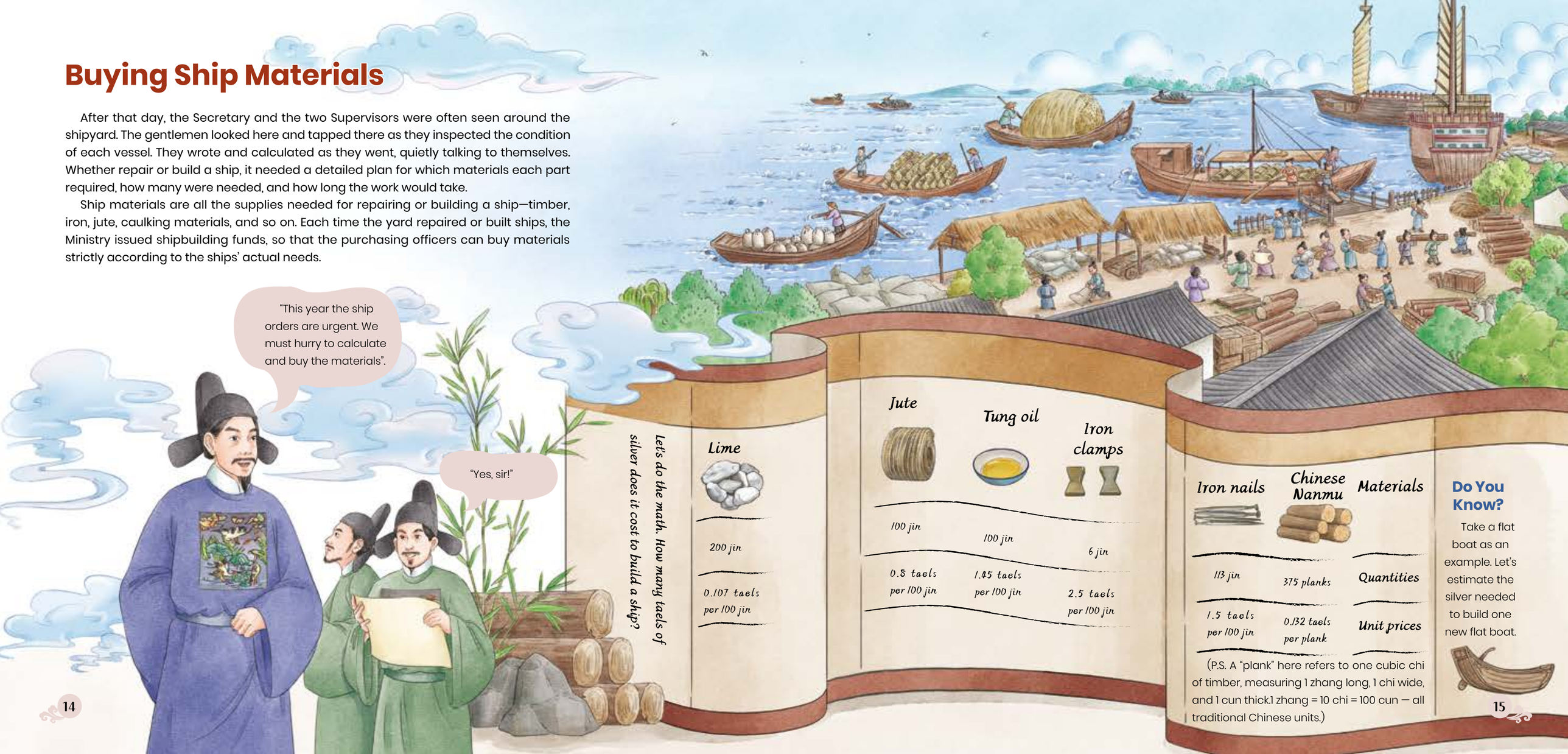
A repair is regular maintenance done to keep a ship in service for as long as possible. In the Ming Dynasty, repair cycles varied by era and by ship type. For example, the ocean grain ships that sailed to Liaodong were checked and repaired every year; dispatch boats and horse ships that carried supplies for the court were inspected every two years. With such careful upkeep, a ship's working life could be stretched to around 30 years — almost like giving the ship a little long-life spell. That saved the state a great deal of money compared with always building brand-new vessels.

Building a ship could mean two different things. A new-build ship was made entirely of new materials. A rebuild ship was made of usable timbers from old ships that were beyond repair.

Buying Ship Materials

After that day, the Secretary and the two Supervisors were often seen around the shipyard. The gentlemen looked here and tapped there as they inspected the condition of each vessel. They wrote and calculated as they went, quietly talking to themselves. Whether repair or build a ship, it needed a detailed plan for which materials each part required, how many were needed, and how long the work would take.

Ship materials are all the supplies needed for repairing or building a ship—timber, iron, jute, caulking materials, and so on. Each time the yard repaired or built ships, the Ministry issued shipbuilding funds, so that the purchasing officers can buy materials strictly according to the ships' actual needs.



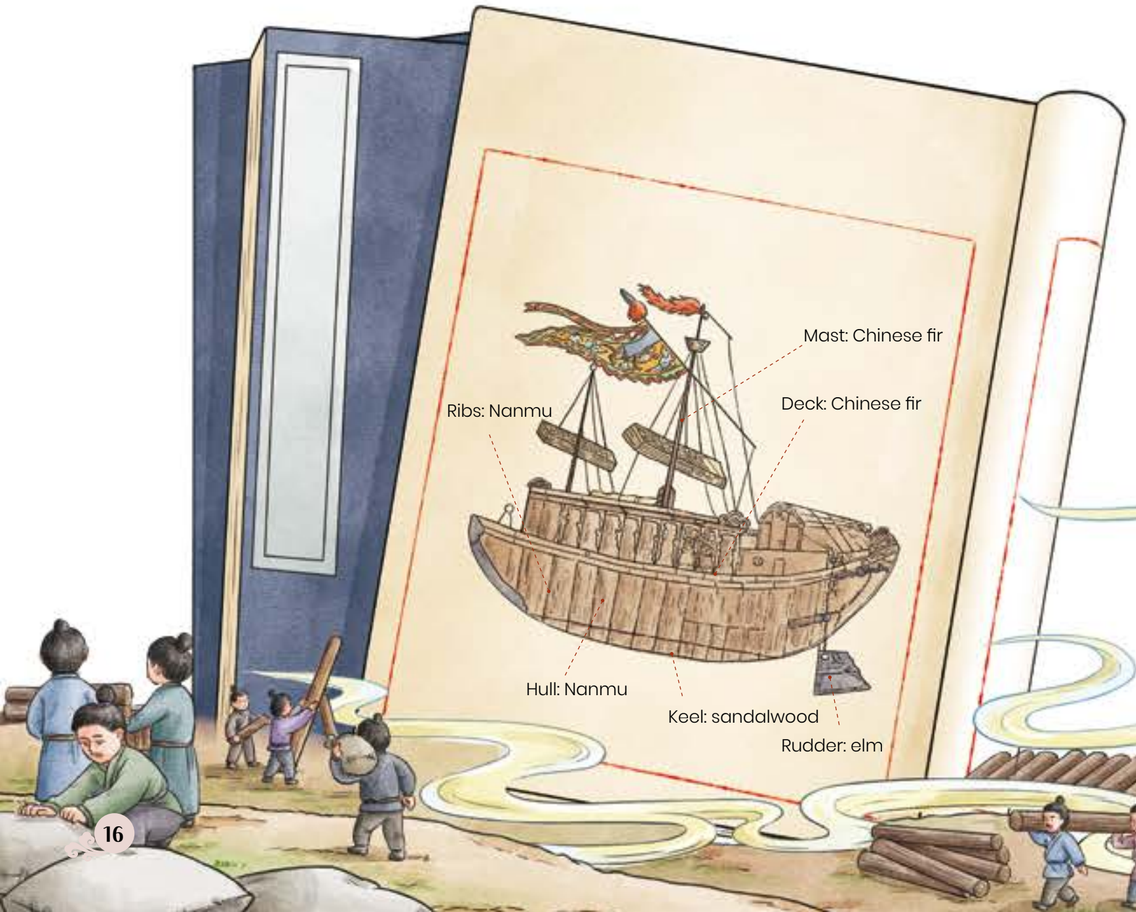
(P.S. A "plank" here refers to one cubic chi of timber, measuring 1 zhang long, 1 chi wide, and 1 cun thick.1 zhang = 10 chi = 100 cun — all traditional Chinese units.)

Do You Know?

Take a flat boat as an example. Let's estimate the silver needed to build one new flat boat.

Numbered Nanmu Logs

Among all shipbuilding materials, wood was by far the most in demand. The choice of timber determined how sturdy a ship would be, and different parts of a ship required different types of wood. For instance, Nanmu was often used for the hull, Chinese fir for the masts and decks. Large sea-going vessels of higher quality even used imported ironwood. Of course, there is not only one kind of material for each part. Thus, selecting, purchasing, and storing timber was one of the shipyard's most crucial tasks.



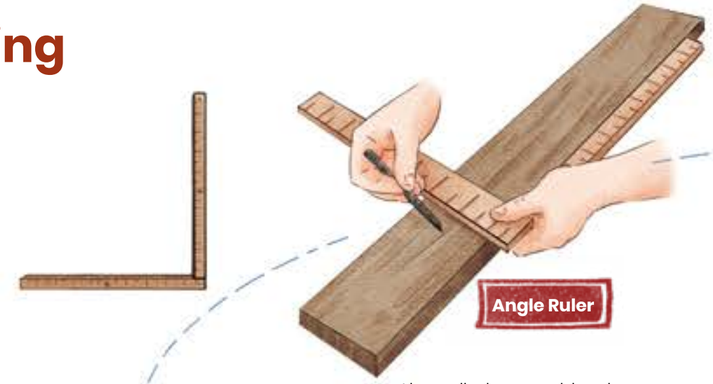
The most widely used Nanmu came mainly from Sichuan, Guizhou, and Huguang (present-day Hubei and Hunan). It was usually purchased in spring or autumn and stored for the year's upcoming shipbuilding. Timber merchants would bind the Nanmu logs into rafts and float them downstream into the Yangtze River, transporting them all the way to the shipyards of Nanjing. There, they were stored in designated timber yards such as the "Wood Receiving Yard" or the "Nanmu Dock".

Each Nanmu log bore its own unique number. The best logs were marked "No. 1" — they were the finest in both length and girth. The higher the number, the smaller or thinner the timber. One glance was enough to tell good from bad, making it easy to select the right Nanmu for shipbuilding.

Tools for shipbuilding

Once the ship materials had been procured and tallied with precision, Li Zhaoxiang turned his full attention to the actual repair and construction of the ships. As he walked through the shipyard, he saw axes flashing as wood chips flew with each heavy strike; chisels deftly carving fine patterns and fitting perfect mortise-and-tenon joints; and long two-handled saws sliding back and forth in rhythm, slicing timber neatly in two.

Looking at the busy craftsmen and their varied tools, Li could not help but exclaim, "Truly, 'a craftsman is only as good as his tools'!"



Angle Ruler

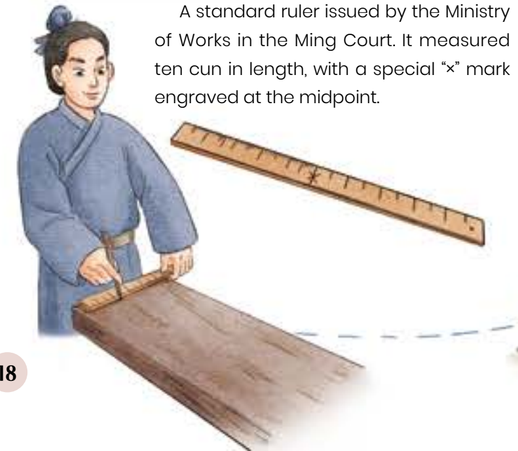
Also called a movable ruler, it was used for measuring angles or drawing slanted lines at specific degrees.

Ink Marker

A tool for drawing straight lines. Ink was poured into the ink box, and the cord inside was soaked with it. The line was stretched across the timber and snapped back to leave a perfectly straight ink mark.

Wooden Ruler

A standard ruler issued by the Ministry of Works in the Ming Court. It measured ten cun in length, with a special "×" mark engraved at the midpoint.



Axe

Before frame saws were invented, axes were the primary tool for cutting logs. A craftsman's years of experience were often judged by how long he had wielded his axe.

Frame Saw

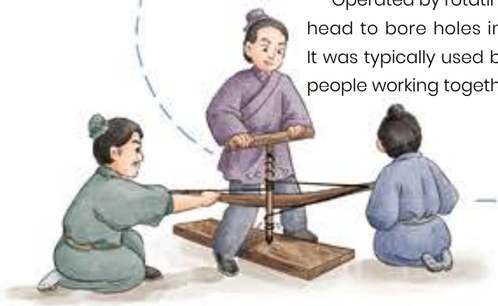
Used for sawing large logs, the frame saw appeared around the Tang–Song period (about 1200 years ago). It often required two or four people to pull it back and forth to cut through an entire log.

Hand Planer

Emerging during the Song–Yuan period (about 1000 years ago), the hand planer was used to smooth and level timber surfaces.

Hand Drill

Operated by rotating a drill head to bore holes in wood. It was typically used by three people working together.

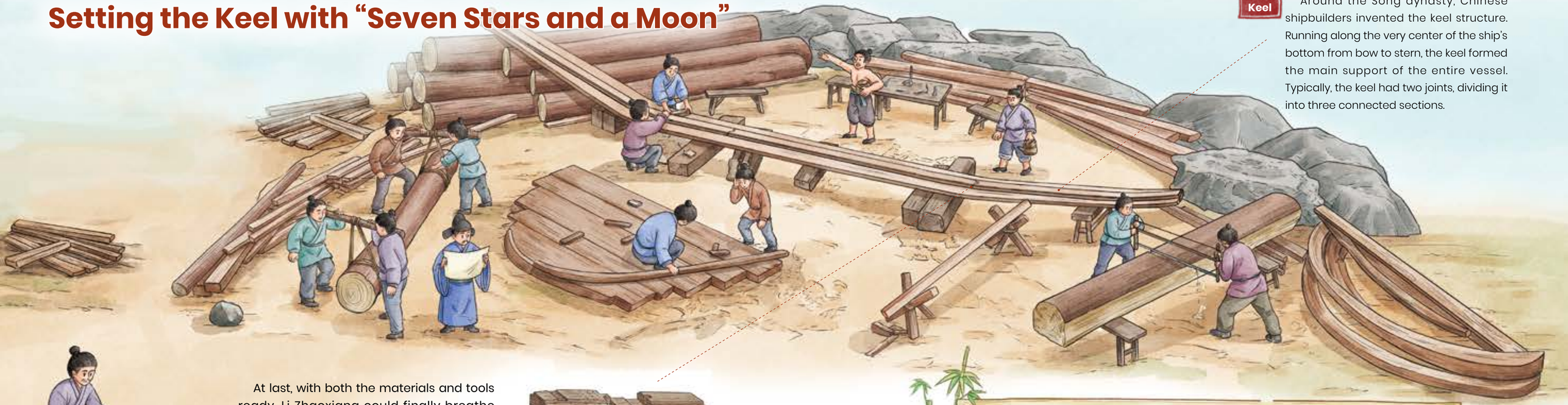


Chisel

Depending on the blade shape, there were flat, round, oblique, and square chisels. They were used for fine carving, cutting mortise holes, and hollowing grooves, often together with an axe or hammer.

Setting the Keel with "Seven Stars and a Moon"

Keel Around the Song dynasty, Chinese shipbuilders invented the keel structure. Running along the very center of the ship's bottom from bow to stern, the keel formed the main support of the entire vessel. Typically, the keel had two joints, dividing it into three connected sections.



At last, with both the materials and tools ready, Li Zhaoxiang could finally breathe a sigh of relief. Now came the main task: repairing and building the ships step by step. Compared with vessels that only needed repairs, Li was more focused on building new ships. Just like building a house, shipbuilding followed a strict sequence. And setting the keel was the very first and also the most crucial step. The keel was the ship's backbone. Only when the keel was firmly laid could the ship withstand fierce winds and towering waves.

Three segments of the keel were joined together using mortise-and-tenon joints, a technique dating back more than 7,000 years to the Neolithic period.

Do You Know? "Seven Stars and a Moon"

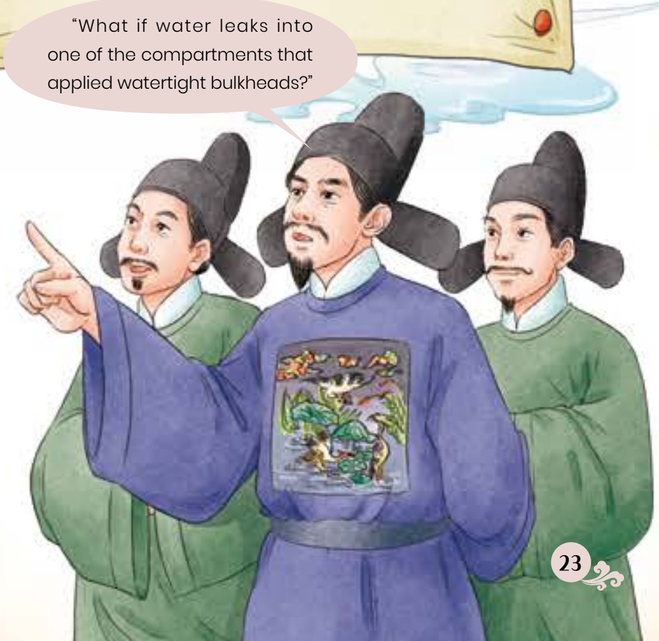
When fitting the keel's joints, craftsmen would carve several small holes called "longevity holes" into the two connection surfaces of the main keel. Inside these, they placed symbolic offerings such as copper coins, silver ingots, grains, or red cloth inscribed with "lucky dates" for building ships, praying for a safe voyage. Archaeologists once discovered in the keel of a Fu ship (Fujian-style ship) a bronze mirror and several copper coins arranged in the pattern of the Big Dipper, with the mirror representing the moon. This is a formation poetically known as Chinese "Seven Stars and a Moon".

World-Leading Watertight-bulkheads Technology

Once the keel was securely fixed, the craftsmen began installing the bottom planks on both sides of it. When the bottom reached a certain width, they started to set up the ribs according to the positions of each compartment. At this stage, the hull looked like the skeleton of a giant creature. Next, the craftsmen fitted the bulkhead boards tightly between the ribs. These panels divided the hull into separate, sealed compartments that did not connect with one another. Watching this, Li Zhaoxiang thought to himself, "So this is the famous watertight-bulkhead technology!"

Do You Know?
The Magic of Watertight Bulkheads

Watertight-bulkheads divided a ship into independent compartments, so that even if one section was damaged and flooded, the others remained dry and secure. This design also made cargo loading and unloading much more efficient, since different goods could be handled at the same time without interference. China had already begun using this ingenious technique as early as the Tang dynasty. Today, the Watertight-bulkhead Technology of **Fu Ships** has been inscribed on UNESCO's List of Intangible Cultural Heritage in Need of Urgent Safeguarding.



Inside-out assembly

Once the ship's strong "skeleton" was complete, the craftsmen moved on to fixing the side planks. They nailed the boards tightly to the watertight bulkhead with iron nails, so that the structure became solid and integrated as one. When the side planks reached the same height as the bulkheads, it was time to lay the deck.

The Deck

Early Chinese ships had no decks; they appeared no later than the Warring States period over 2000 years ago. The deck's center was built slightly higher than the sides, so rainwater could drain through small holes on the ship sides to the outside.

The Anchor

An anchor, usually made of iron or steel, was connected to the ship by a rope or chain. It had claws that gripped the seabed when dropped, keeping the ship from drifting with the wind or current. You see, isn't the shape anchor resembled a cat's paw? Now you know why the Chinese character for "anchor" (锚) came from "cat" (猫)!

"The nails commonly used in shipbuilding are generally shovel-shaped, also jujube pit-shaped".

Even dense, tightly hammered nails couldn't make a ship truly watertight. The real secret is the caulking technique. The special sealing compound was a mixture of hemp fibers, tung oil, and lime (or oyster shell ash). It was packed into the wider seams to keep the hull watertight. While a finer mix of tung oil and lime was used for smaller gaps and nail holes, also preventing the iron nails from rusting.

Functional Areas on Deck

By now, the main structure of the ship was nearly complete. Li Zhaoxiang strode up onto the deck. He asked the craftsmen how the different functional areas were being laid out, for the ship's upper cabins would soon be fitted and decorated. On long voyages, a ship had to be not only safe but also practical and well-equipped for daily living.

"It would be best if every cabin had a window to let in some light," Li thought to himself. But then he wondered—what should the windows be made of?

"The lower deck will be for resting, and the upper deck will hold a shrine for Mazu, the Goddess of the Sea".

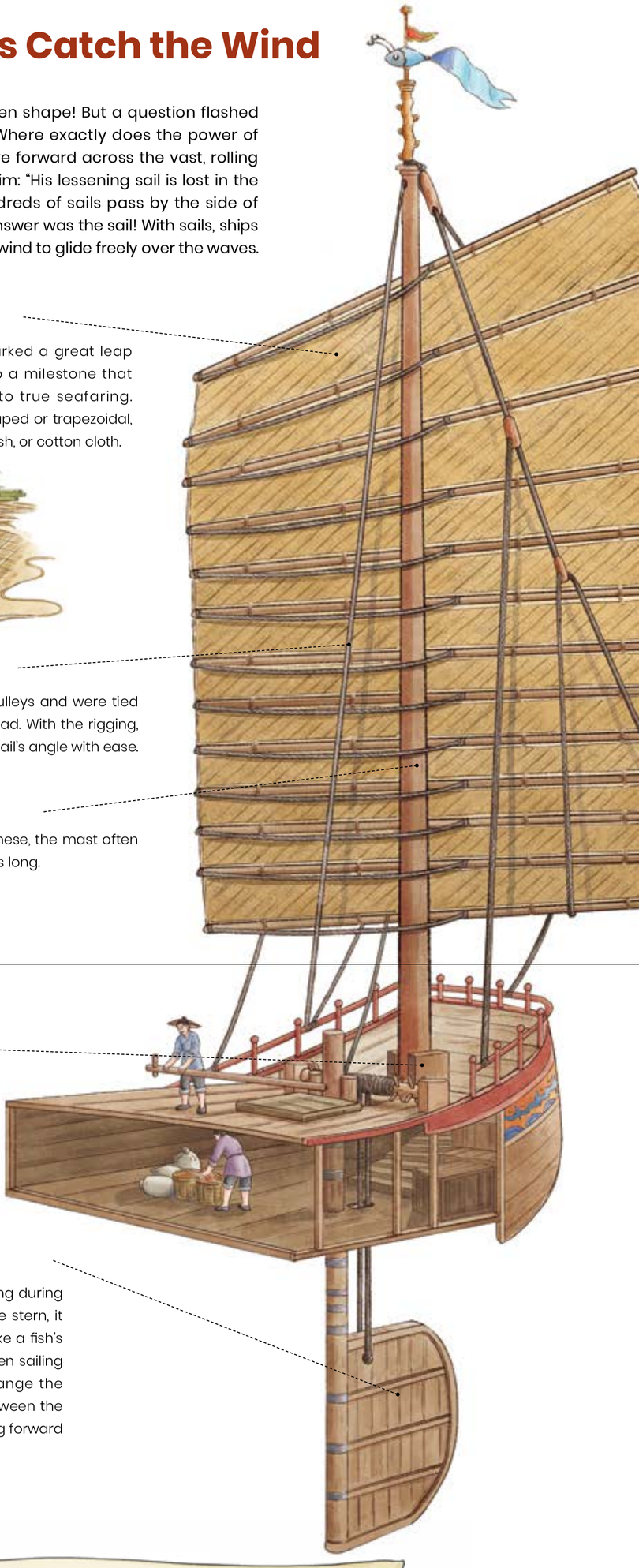
Do You Know?
"Glass Windows" Made from Shells

In the Ming dynasty, people made translucent window panes from clam shells. The window making process was intricate: craftsmen selected the flattest parts from large clam shells, cut them into neat squares, and polished them down to just 1 mm thick. The finished panes were then fitted into wooden lattice frames. These tiles — also called "clam-shell windows" or "oyster-shell windows" — kept out wind and rain while still letting in bright, gentle light, making them an ideal material for windows.

"This is the key area for steering. The rudder and the compass are both right here, which are of utmost importance to keep safe on the voyage".

Bamboo Sails Catch the Wind

Now the ship had finally taken shape! But a question flashed through Li Zhaoxiang's mind: Where exactly does the power of a ship come from when it move forward across the vast, rolling sea? Lines of poetry came to him: "His lessening sail is lost in the boundless blue sky;" and "Hundreds of sails pass by the side of sunken ship". Of course — the answer was the sail! With sails, ships could harness the power of the wind to glide freely over the waves.



The Sail

The invention of the sail marked a great leap in ancient navigation. It is also a milestone that transformed early boating into true seafaring. Chinese sails were often fan-shaped or trapezoidal, woven from bamboo mats, bulrush, or cotton cloth.

The Rigging

Ropes ran cleverly through pulleys and were tied securely to the yardarms overhead. With the rigging, even one sailor could adjust the sail's angle with ease.

The Mast

Also called qiang (樯) in Chinese, the mast often stood as tall as the ship's keel was long.

The Mast Clamp

Known as Luer, or simply "deer ears", the mast clamp connected the mast base to the mast step with mortise-and-tenon joints. It kept the mast from toppling and evenly distributed the weight of the mast and sail across the hull.

The Rudder

The rudder had already come into being during the Western Han Dynasty. Mounted at the stern, it is also called the stern rudder. It worked like a fish's tail, helping adjust the ship's direction. When sailing against or across the wind, it could change the direction of the hull to alter the angle between the sails and the wind, keeping the ship moving forward swiftly with the help of wind force.

Do You Know?

Besides sails, what other methods can be used to make a boat move forward? Oars: The earliest wooden oars in China appeared about 8,000 years ago. Sculls: A scull is a long wooden oar. In early times, sculls were mounted on the side of the boat. Later, they evolved to be placed at the stern, where they are moved from side to side, propelling the boat forward like a fish moving its tail and fins. Hauling Ropes: This is an ancient method of moving boats forward by pulling them with human power. In narrow rivers, fast-flowing waters, or areas with many reefs or shallow sections, hauling ropes were an important way to propel boats. Poles: Usually made of bamboo, poles are used in shallow waters or areas with many reefs. By pushing firmly against the riverbed, the boat can be moved forward. In emergencies, a pole can also be used to stop the boat quickly.

“Dressing” the Ship in Colorful Clothes

Finally, the grand vessel was completed! Now the craftsmen were dressing up the ship with colorful “clothes”: artisans brushed on layers of tung oil and bright paint, blending exquisite carvings and paintings into the ship’s design.

The yì bird was a legendary guardian of the waters in folk tales. It was often painted on the bow or stern to ward off sea monsters and evil spirits, as a prayer for a smooth voyage. Fierce tigers and lions, too, were painted mostly on the bow to ward off evil. Motifs like “The Rising Sun,” “Auspicious Wishes,” “Three Spears and a Vase,” and “The Eight Immortals Crossing the Sea” were also commonly used, each symbolizing good fortune and safe travels.

On the prow, craftsmen painted “dragon eyes” (sometimes called “big fish eyes”), for they believed they would help guide the direction, spot dangers below, and even find schools of fish or hidden reefs.

Checking and Setting Sail

When the ship was finished, Li Zhaoxiang and his team began the final inspections. Shipbuilding in the Ming Dynasty followed strict management and audit rules. Every ship type had set materials, fixed prices, and allotted work hours. Every piece of timber had to pass a careful check: a flaw in the wood — reject it! Off by half a cun in size — rework it! It was this millimeter-perfect attention to detail that made each ship strong and durable enough to brave the waves.

Inspecting the Ship

When building new ships, craftsmen had to control costs carefully by following the material and labor standards set for each ship type. When repairing, inspectors examined the old hull and allocated materials and labor according to the damage. Surveyors completed a ship inspection form documenting the ship's condition for later checks and records.

"Ship inspections are the basis for deciding whether to repair or to rebuild".

"Timber is graded in numbers. Every piece must be checked and given a number on site!"

Checking the Timber

For wooden ships, the timber was the most important material. Inspectors carefully looked for cracks, warping, or flattening on each beam. They tapped the wood with an axe and listen — a hollow or dull sound could mean rot inside. The size, defects, and other details of every timber piece were recorded in the registry.

"Three nails per chi, or 32cm, is the baseline!"

Checking the Nails

Nail inspection was a necessary part of acceptance. The rule of "Three nails per chi" meant that within 1 chi (a Ming chi is roughly 32 cm) there should be 3 nails — a standard for river boats under 30 meters in length. Larger seagoing vessels required "Five nails per chi". The bigger and stronger the ship needed to be, the more densely the nails were driven.

"Re-measure the ship with the Ministry's standard ruler — not a hair's breadth of difference is allowed!"

Checking the Fittings

Every ship's design and dimensions existed on a drawing before building began, with detailed notes on sizes and materials. Craftsmen had to follow these plans exactly. After each stage, inspectors measured the ship's shape and dimensions and tested the ship fittings' performance.

"Launch the ship, and set sail!" With that rousing call, the whole shipyard burst into life. The great vessel, the product of countless hours of skill and sweat, was about to claim its proudest moment.

"Open the gates——!" The dock sluices thundered open. River water rushed in; the hull cut through silver foam and rose, startling gulls all over the shore. In the end, with a mighty roar the bow broke the waves, the whole ship slid into the river like a dragon entering into water, sending up great sprays and white breakers as it sped into the Yangtze River.

Li Zhaoxiang continued his work at Longjiang Shipyard, also recorded its history, organization, and shipbuilding techniques in careful detail. His book — the Chronicle of Longjiang Shipyard — preserved a rich archive of Ming shipbuilding knowledge for later generations, opening a window into the deep secrets of the maritime craft of the past.

Types of Ships

The Ming dynasty was a high point for China's ancient shipbuilding and seafaring. Building on the achievements of the Song and Yuan, the Ming improved ship quality, produced many kinds of vessels in large numbers, and put each type to its own use — transporting grain, defending rivers and coasts, and even supporting Zheng He's voyages to the Western Seas.

Imperial yellow barges

Imperial yellow barges were only for the use of the imperial family. They were painted a rich yellow, the noble color for the emperor, to show imperial authority.

Dispatch boats and Horse Ships

Imperial yellow barges, dispatch boats, and horse ships were together known as "Gongfang" — the tribute ships that linked the southern and northern capitals of the Ming Empire.

Grain Ships

The main function of the grain transporting during the Ming Dynasty was to carry tax grain and supplies by water to feed the court, pay officials, and supply the army. Such grain shipments were vital to the stability of the state. In the Ming period, more than 14,000 grain ships were used every year.

Ocean Grain Ships

Ocean grain ships during the Ming Dynasty mainly included types called zuanfeng (means wind-drilling) and zheyang (means ocean-covering). 认为拼音加直译，外国儿童难以记住。建议直接描述功能，不需要给出拼音名称："wind-drilling" ships and "ocean-covering" ships。 They were used to carry grain and military supplies to Liaodong and the capital. Grain sent from Jiangnan to Liaodong usually set out from Liujiahe River (now Liuhe River) at Taicang, Suzhou. In spring and summer, they sailed north along the coast, returning in autumn and winter.

Warships

From the mid-Ming onward, coastal defense became urgent: wokou (Japanese pirates), other pirates, and even European military powers attacked the southeast coast of China. The Ming therefore developed warships and equipped them with powerful weapons such as Frankish cannons and other artillery.

Centipede-shaped ships

They were modeled after Portuguese galleys. Their many oars made them look like centipedes, hence the name. Once fitted with Frankish cannons, they could serve as warships too.

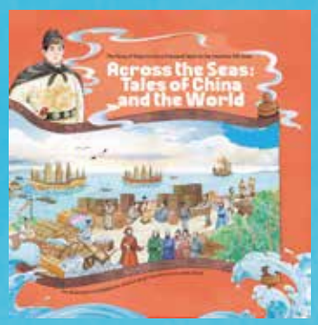
Sea-going vessels

Seagoing vessels were used for coastal defense, transport and diplomacy. The most famous of all Ming seagoing vessels were the giant treasure ships built for Zheng He's voyages. These treasure ships served as flagships for Zheng's fleet, carrying commanders, envoys, and foreign envoys.

By the time of Emperor Jiajing, Longjiang Shipyard no longer bustled with the same grandeur as in Yongle's time when Zheng He sailed, yet it still carried the major responsibility of building the Ming court's ships. Ming shipbuilding represented a peak in ancient China: its management was strict and organized; and its techniques, building on long tradition, made a great leap forward. The Ming not only pushed shipbuilding and navigation ahead at home, but also left an important mark on the world's maritime development.

Shipbuilding in Ming Dynasty

Promoting maritime culture and sharing Chinese civilization



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