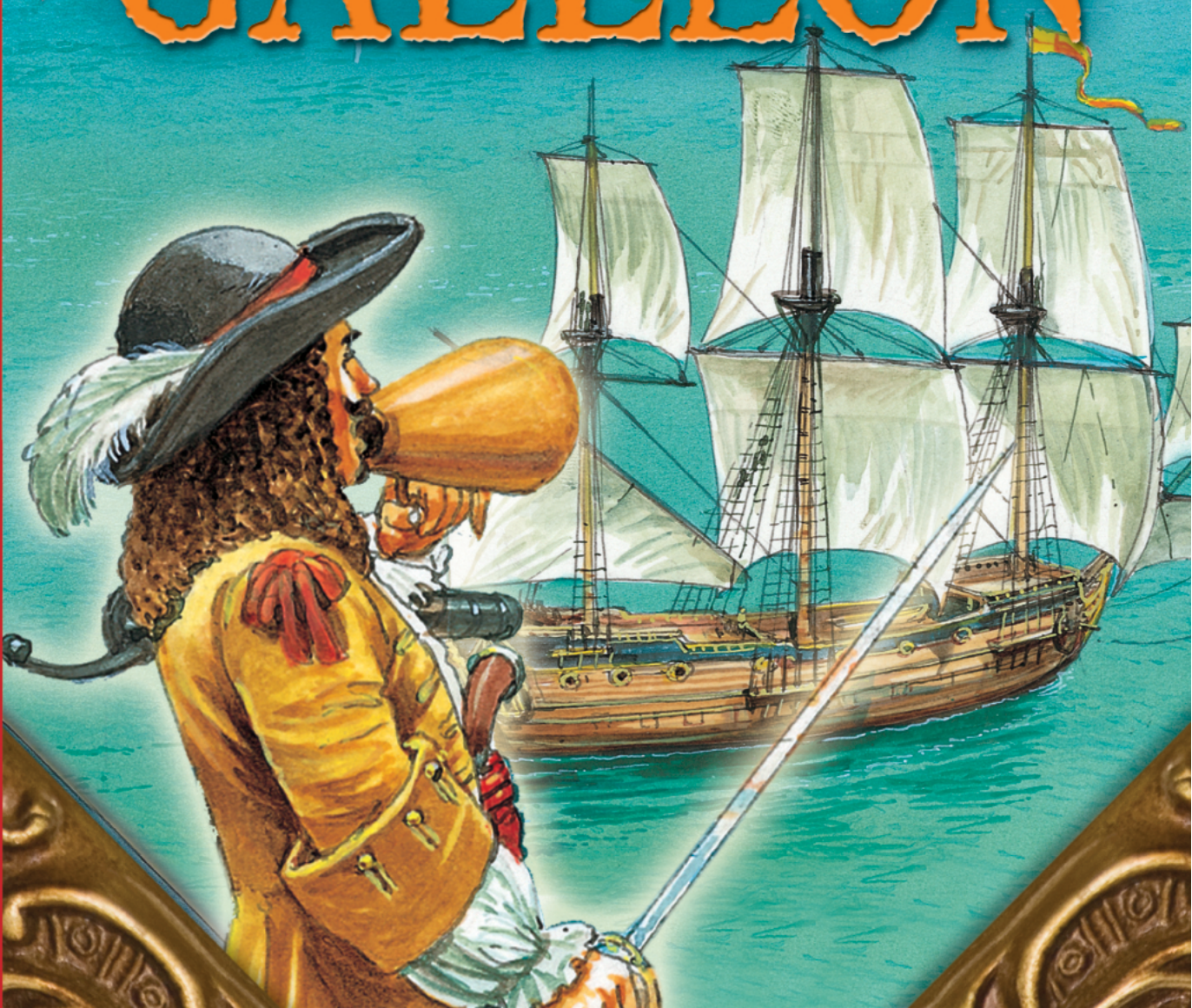


THE KNOWLEDGE

Voyage of a GALLEON



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GALLEON





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GALLEON

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Introduction

The year is 1680 and you have been summoned by the King of Spain. Every year, he sends out a fleet of galleons to Spain's new colonies in the Americas. Here the ships load up with gold, silver and other treasures to bring back to Europe, where they are sold for huge profit. Your task is to command a galleon, and ensure its safe passage across the Atlantic Ocean and back. How do you accomplish this?

First, you should familiarize yourself with the history of the Spanish explorers in the Americas. Next, you must read up about the history of ships so you are familiar with up-to-date construction techniques. Then it is time to prepare for your voyage. You will need to commission a new ship, prepare a reliable crew and load the ship ready for departure. Finally, you are ready to set sail. Be sure you are aware of the latest navigation techniques, establish rules for how the ship is to be maintained at sea, and prepare yourself for how you will deal with a possible attack by pirates.



1. The Americas

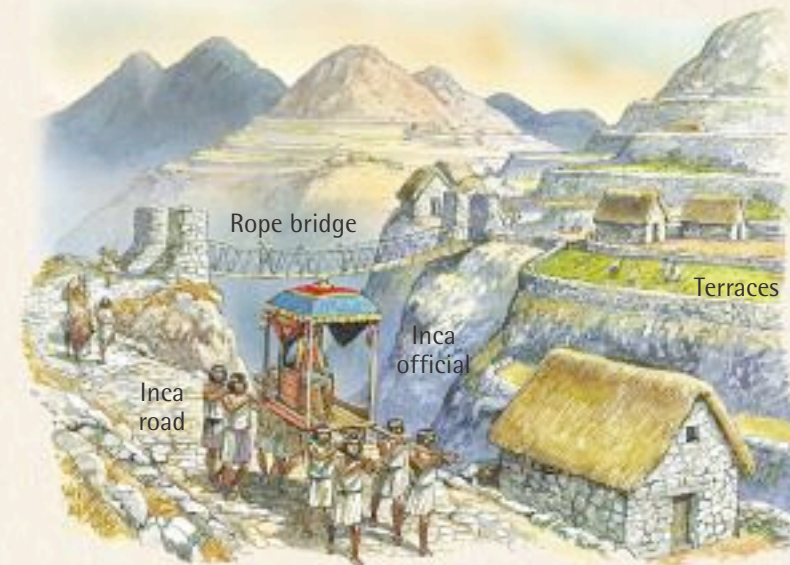
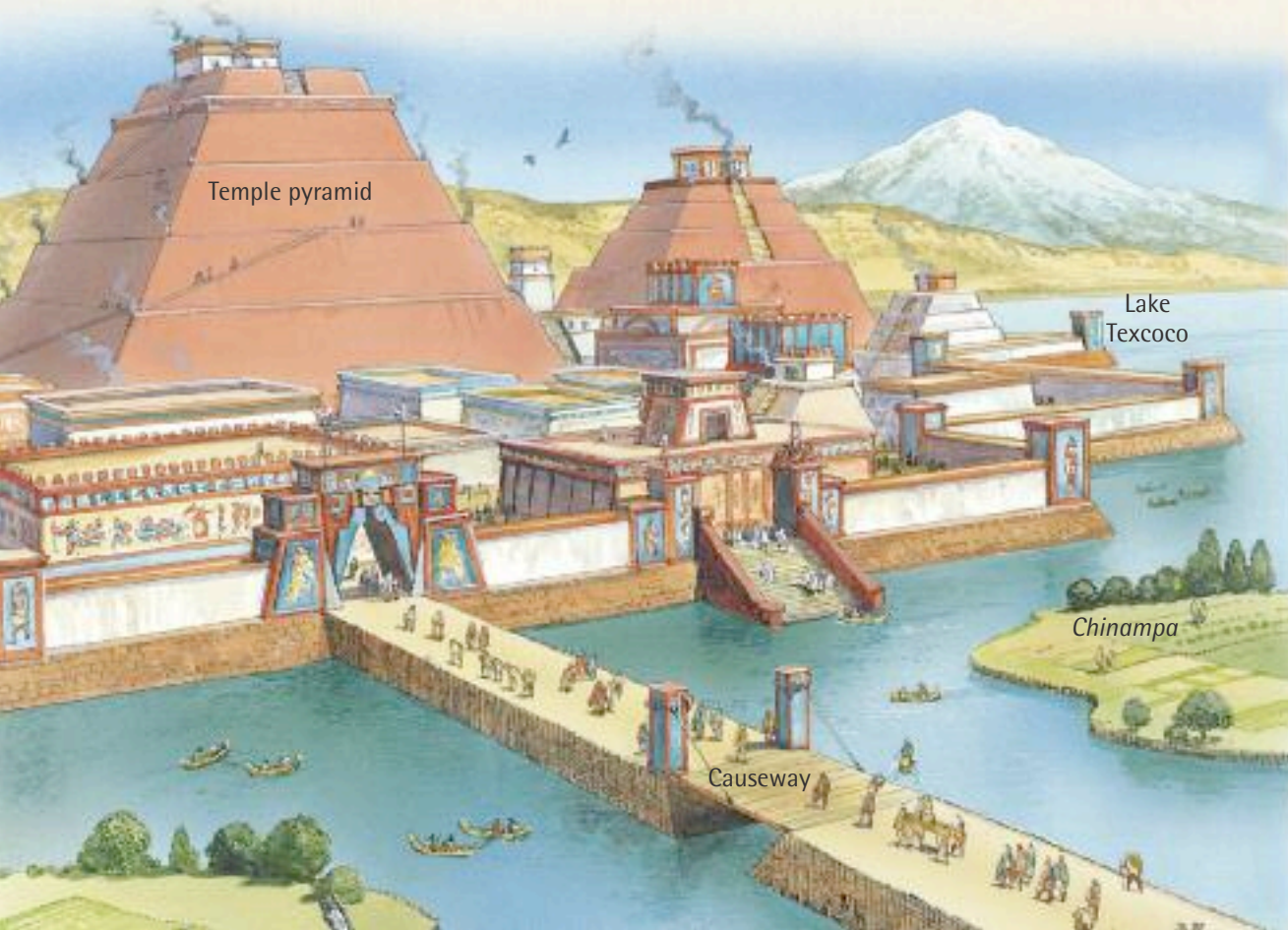
The Aztecs

▼ The island city of Tenochtitlán was once one of the largest cities in the world with a population of about 200,000 people. It was connected to the main-land by causeways to the north, south and west. The city itself had a network of canals.

Its temples were built in the shape of stepped pyramids, some as high as 45 m. Around the city were the *chinampas*, so-called "floating gardens". Made from plant beds fixed to the shallow lake bottom, these islands were used to grow crops.

WHO LIVED IN THE AMERICAS before the Spanish "discovered" the continent? And how did the Spanish go about conquering these people?

The dominant power in Mexico was the Aztec Empire, founded by the Mexica people. The Mexica arrived in central Mexico in 1248 and made alliances with their neighbours. By the 1420s, they had conquered an empire. Their capital, Tenochtitlán, was founded on an island in Lake Texcoco in 1325. The Aztecs could be ruthless warriors and followed a cruel religion, sacrificing humans to appease the gods. But they were also a civilized people who insisted on high standards in education, medicine and sanitation.



The Incas

The greatest empire in South America before the Spanish arrived was that of the Incas. The Incas were originally chiefs of a small area in Peru around their capital, Cusco. Having fought and raided neighbouring villages, they had, by about 1200 AD, become the most powerful people in the region. The Inca emperors (below) claimed they were descended from the Sun, and that this gave them the right to rule over others.

From 1438, the Incas began to conquer surrounding territories. Pachacuti and later, his son, Tupa Inca, led their armies against forces trying to invade their own lands, then attacked their rivals to the north and south. By 1493, the Incas ruled over 10 million subjects in a 4000-kilometres stretch of the Andes Mountains. To help govern their vast territory, they built a system of roads which led out in all directions from Cusco.



◀ Here, a high-ranking official is being carried in a litter. The road system through the mountainous empire was constructed with great skill. The builders often had to cut into the rockface, or build steps in steep sections. To cross gorges, they hung rope bridges.



▲ The building of terraces, which allowed steep slopes to be farmed, and stone walls, in which huge, irregularly-shaped blocks were interlocked with great precision, both demonstrated the supreme craftsmanship of the Incas.



▲ The Incas used a *quipu*, plied strands of llama hair with knots, to perform simple arithmetic.

▼ The three ships under Columbus's command were the caravels, *Niña* and *Pinta* and his flagship, the *Santa Maria*.



▼ Columbus first made land-fall on the island he named San Salvador ("Holy Saviour"). He went on to explore Cuba and Hispaniola.



The Spanish in America

Hundreds of years after the Vikings first explored the coast of Canada, Europeans once again arrived in the Americas in 1492.

The Genoese mariner, Christopher Columbus, set sail from Spain in search of a route to Asia. Believing, as many navigators did, that the world was round, he reasoned that the Far East could be reached more easily by sailing west across the Atlantic than by taking the hazardous route east around Africa. He had initially asked King John II of Portugal to fund the expedition, but the king refused him the money. King Ferdinand and Queen Isabella of Spain were keener and agreed to sponsor him. No one in Europe knew the Americas existed, so it came as a great surprise and disappointment to Columbus when he could find no trace of the great Asian cities he had expected to see when he eventually reached land.



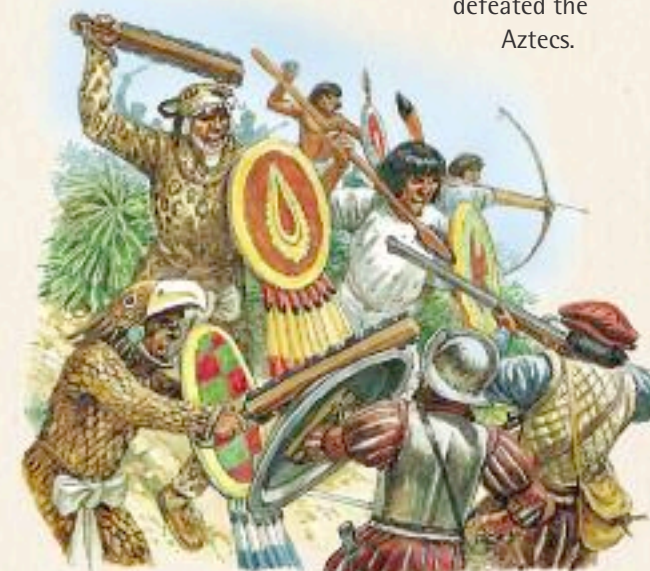
◀ On his way to the Aztec capital, Cortés made an alliance with Tlaxcala, a region hostile to the Aztecs. Along with a large force of Tlaxcalan warriors, he travelled on to Tenochtitlán. Here, he and his translator Marina were greeted with great ceremony by the Aztec emperor himself, Moctezuma. Cortés later took Moctezuma hostage and demanded a huge ransom for his release.

The Conquistadores

Columbus made three later voyages to the Americas, taking him to the coast of mainland Central and South America. While he still thought he had discovered Asia, other explorers were not convinced. Amerigo Vespucci's exploration of the east coast of South America seemed to confirm the lands were part of a new continent, which was named "America" after him. The Spanish crown now backed further expeditions to explore and conquer new territories.

The first campaigns were led by the *conquistadores*, soldiers and adventurers in search of riches and fame. Hernán Cortés landed on the coast of Mexico in 1519. He was eager to find the fabulous Aztec Empire, of which he had heard so much. Leading a small band of Spanish soldiers and a large force of native warriors who despised their Aztec overlords, he marched to the capital and captured it in 1521.

▼ Cowed at first by the Spanish, the Aztecs later fought back against the invaders. Initially they succeeded in driving them out of Tenochtitlán. But Cortés returned to lay the city under siege. Cannon, horse cavalry, starvation and disease eventually defeated the Aztecs.





▲ Nearly all the Inca gold seized by the Spanish was melted down. But a few pieces, like this figurine, survived.

► On hearing a signal from their leader, Pizarro's horsemen charged from hiding places surrounding the Inca forces and slaughtered them.

Defeated by disease

Spanish military power was too much for the native Americans, but a far greater peril they faced was disease. They had no resistance to the European diseases of smallpox and measles. By the end of the 16th century, the native population had declined by 93%.

Defeating the Incas

A small band of Spanish soldiers under the command of Francisco Pizarro arrived in Inca territory in 1532. Pizarro was in search of an empire rumoured to be rich with silver and gold. He found a land riven by civil war and ravaged by an epidemic of smallpox – a disease introduced to the Americas by the Spanish themselves. Leading a force of just 177 men, Pizarro crossed the Andes to confront the Inca emperor Atahualpa and his army of 80,000 men in Cajamarca. With their horses (which the Inca forces had never seen before) and superior weaponry – guns, steel armour and swords – the Spanish soldiers held the advantage, despite being vastly outnumbered.



The Spanish won the battle easily and captured Atahualpa. Although they demanded, and received, a ransom of more than 20 tonnes of gold and silver for his release, the Spaniards decided to execute their noble prisoner. Pizarro and another *conquistador*, Hernando de Soto, then set off for the Inca capital, Cusco, which they captured in November 1533. The Spanish installed a new "puppet" ruler, Manco Inca, and set about plundering the empire of all its treasures. Inca warriors kept up resistance, but the Inca Empire finally fell in 1572.

Treasure from the Americas

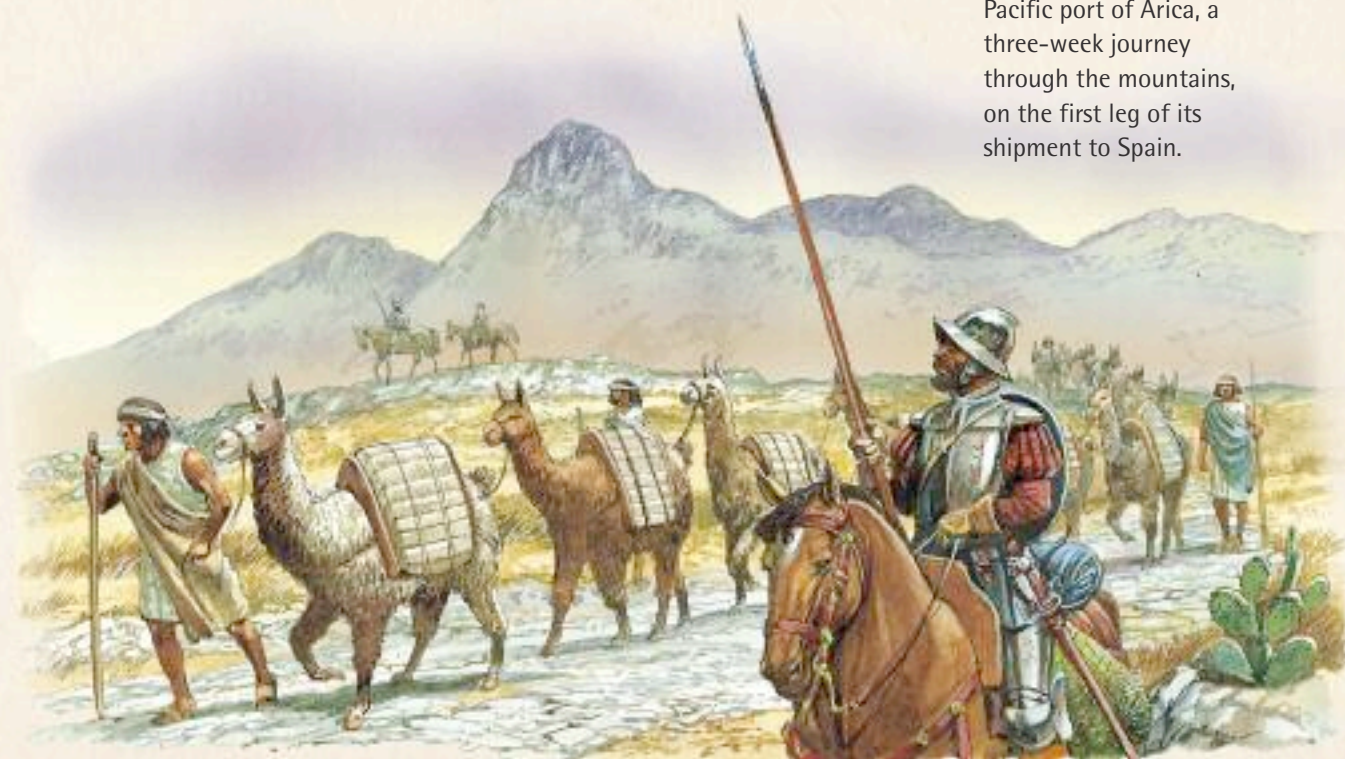
The *conquistadores* had travelled to the American continent in search of riches. Following the fall of the Aztec and Inca empires, they went in search of the Seven Cities of Gold in North America and El Dorado in South America – both mythical places. The Spanish adventurers found little gold, but did discover the silver mines of Zacatecas in Mexico, and, in 1545, the richest of them all, Potosí, in the Andes south of Peru.

The silver came from rich ores inside the Cerro Rico ("The Rich Mountain"). The mining town of Potosí soon grew up in the neighbourhood and grew to be one of the largest cities in the Americas. Some 45,000 tonnes of silver was mined between 1546 and the end of the 17th century. The mine labourers, originally native Americans, and later African slaves, died in their thousands due to the extremely poor working conditions and to poisoning by mercury, a substance used in the process of separating silver from the natural ore.

▼ Most silver and gold was shipped in the form of large ingots, but around 20% was made into coins. The ingots, or bars, were stamped with both a unique serial number and a mark to indicate that the 20% royal tax (*quinto*) had been paid.



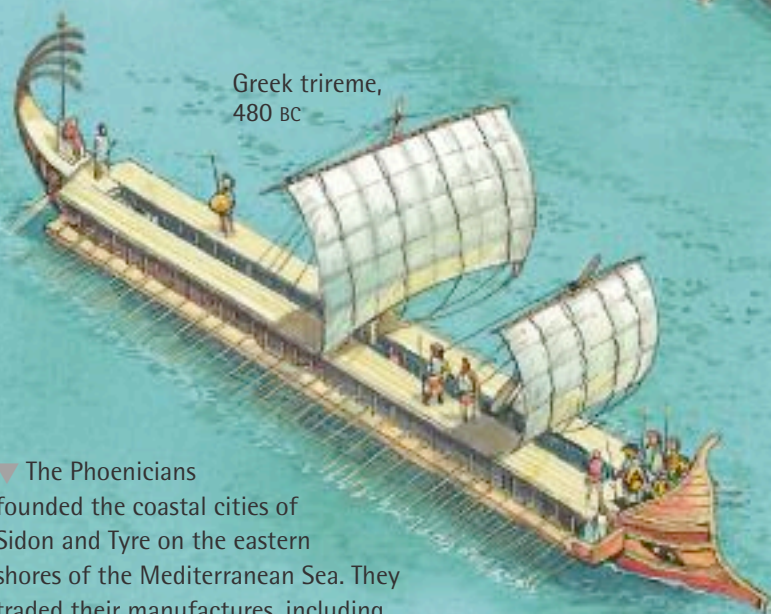
▼ Under the eye of a Spanish soldier, a train of llamas transport silver from Potosí to the Pacific port of Arica, a three-week journey through the mountains, on the first leg of its shipment to Spain.



2. The story of ships

IT IS IMPORTANT to learn about the history of ships, in order to understand why the galleon is built the way she is. The first boats were made thousands of years ago from logs, reeds or animal skins. These early craft were propelled by oars or paddles. The first sailing boats had single masts with square sails fixed to them. Over the centuries, boatbuilders arranged the sails, called its rig, in ways designed to catch the wind more efficiently. Ships, large vessels, could now sail in large rivers and seas.

▼ Warships needed oars to provide extra speed and manoeuvrability. Oared ships, called galleys, were used by the Greeks in war. Greek triremes were rowed by three banks of oarsman, and fitted with a ram and steering oar.



Greek trireme, 480 BC

▼ The Phoenicians founded the coastal cities of Sidon and Tyre on the eastern shores of the Mediterranean Sea. They traded their manufactures, including glassware and dyes, for linen, oil, ivory and other goods with cities around the Mediterranean coast. The Phoenicians relied on their sturdy seagoing cargo ships, called hippos, and their own expert seamanship.



Phoenician hippo, 800 BC

Egyptian warship, 1400 BC



▲ By about 3400 BC, the first sailing ships were in use on the River Nile in Egypt. The hulls of the earliest ships were made of papyrus reeds bundled together. Later, wood from acacia or sycamore trees was used, although only short lengths could be cut from these timbers. From 2900 BC, Egyptian merchants began to import cedar, a wood from which much longer planks could be sawn. Later Egyptian vessels were built with keels and a ribbed frame, copying the designs of merchant ships from Minoan Crete. Warships of this construction sailed under the command of Pharaoh Ramesses III in about 1400 BC.

Roman cargo ship, AD 200



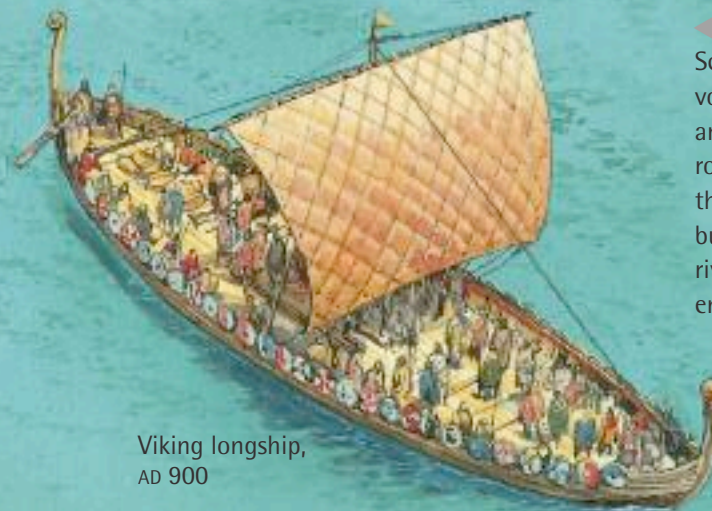
▲ Greek power in the Mediterranean was later challenged by Carthage, a Phoenician colony in North Africa. Carthaginian galleys, called quinqueremes, outclassed the Greek triremes until they were themselves defeated by Roman galleys of a similar design during the Punic Wars (264-241 BC). Roman cargo ships also borrowed some features from earlier Phoenician vessels. The Romans added high sterns, more sophisticated rigging and a small sail at the bow, a spritsail, to improve manoeuvrability.



14th-century cog

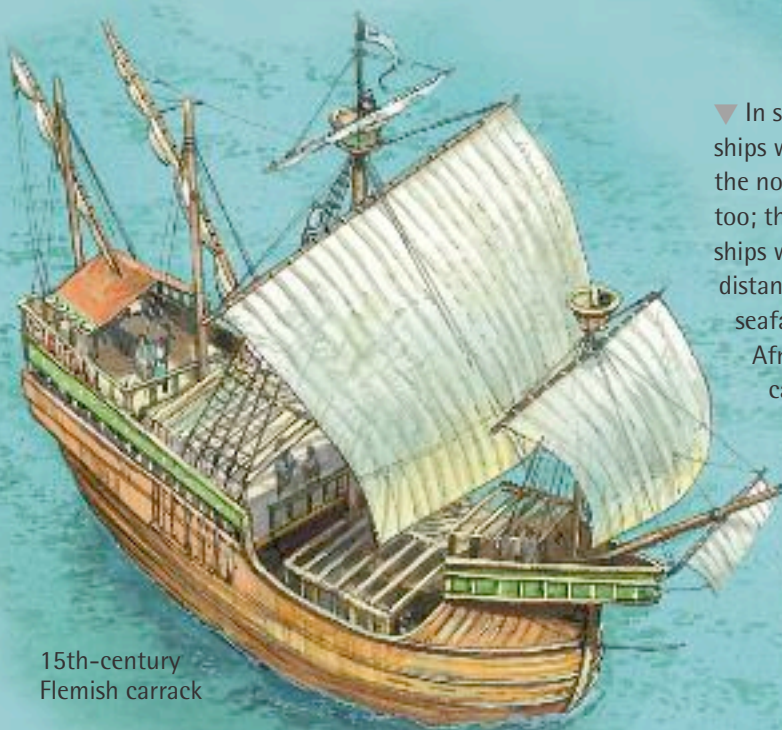
◀ From about AD 800, Norsemen from Scandinavia, the Vikings, began to make voyages across the North Sea to raid coastal areas of Britain and Ireland. They also sailed round the coasts of France and Spain to reach the Mediterranean. The hulls of their longships, built from overlapping planks ("clinker-built") rivetted to frames, were strong and flexible enough for long sea journeys. The ships were also slender and shallow in shape — ideal for making journeys up inlets under oar. Viking ships travelled to Iceland and Greenland, eventually reaching North America in about AD 985.

Viking longship, AD 900



The rise of the galleon

By the 15th century, many ships had a mixture of rigs: square-rigged sails on some masts and fore-and-aft sails, set parallel to the sides of the vessel, on others. In the early 16th century, Spain needed a new kind of warship to protect its vessels bringing back treasures from its American territories. It would combine the size, sailing rig and fore- and aftcastle design of the *nao* with the sleekness, speed and manoeuvrability of the caravel.



15th-century
Flemish carrack

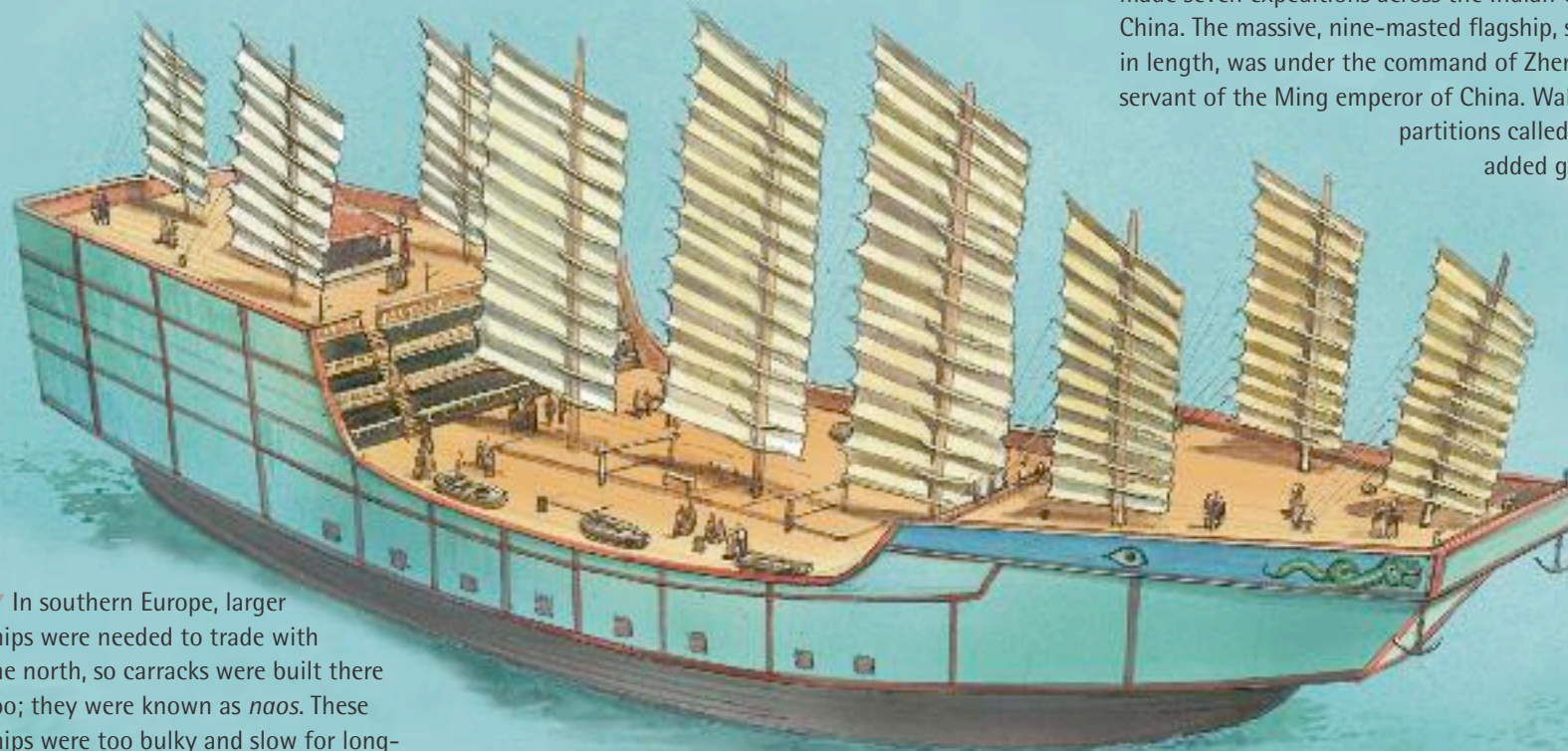
▲ As trade between northern and southern Europe expanded, so the designers of ships began to exchange ideas and methods. Instead of clinker-built hulls, northern builders now began to adopt the southern "carvel" method, in which planks were fitted edge to edge on to a frame. This allowed them to construct larger hulls. They also added extra masts and lateen, or triangular, sails, enabling their ships to make better use of the wind. The deep hull, high fore and aft castles, and stern-mounted rudder were all kept. The result was the first full-rigged sailing ship: the carrack.

▼ In southern Europe, larger ships were needed to trade with the north, so carracks were built there too; they were known as *naos*. These ships were too bulky and slow for long-distance voyages, so when Portuguese seafarers began to explore the coast of Africa they chose lateen-sailed caravels — smaller, more streamlined vessels based on the design of Arab fishing boats.



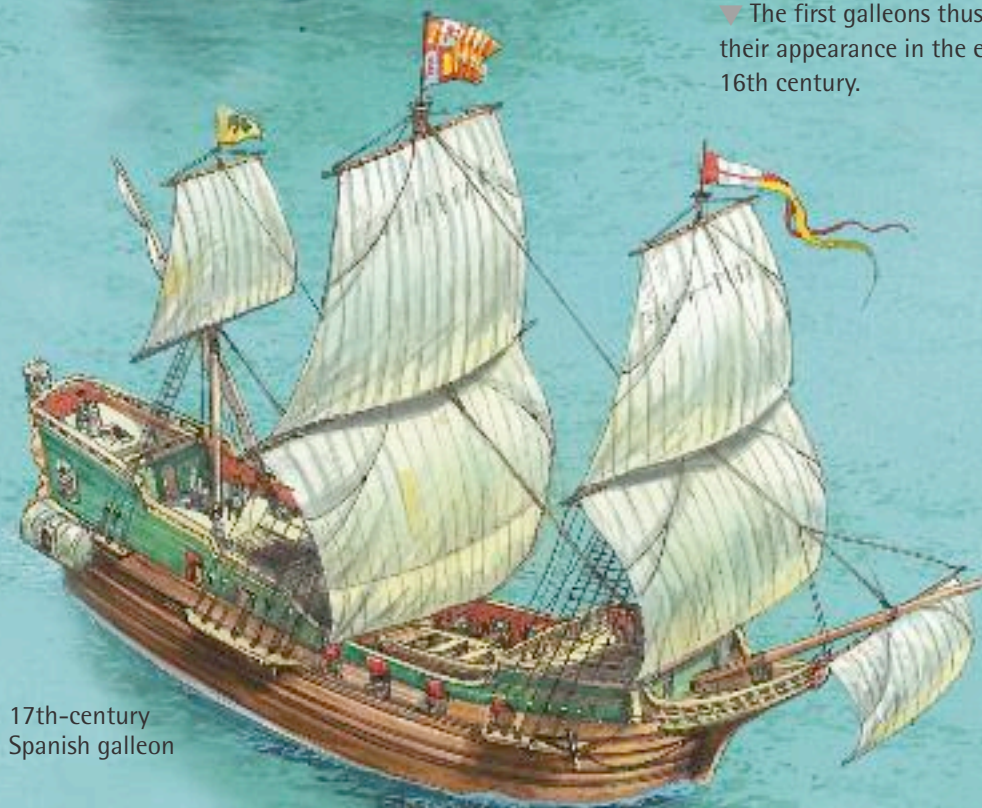
15th-century
Portuguese
caravel

15th-century
Chinese junk



▼ Between 1405 and 1433 a fleet of ships, called junks, made seven expeditions across the Indian Ocean from China. The massive, nine-masted flagship, said to be 152 m in length, was under the command of Zheng He, a trusted servant of the Ming emperor of China. Wall-like internal partitions called bulkheads added great strength to the hull.

▼ The first galleons thus made their appearance in the early 16th century.



17th-century
Spanish galleon



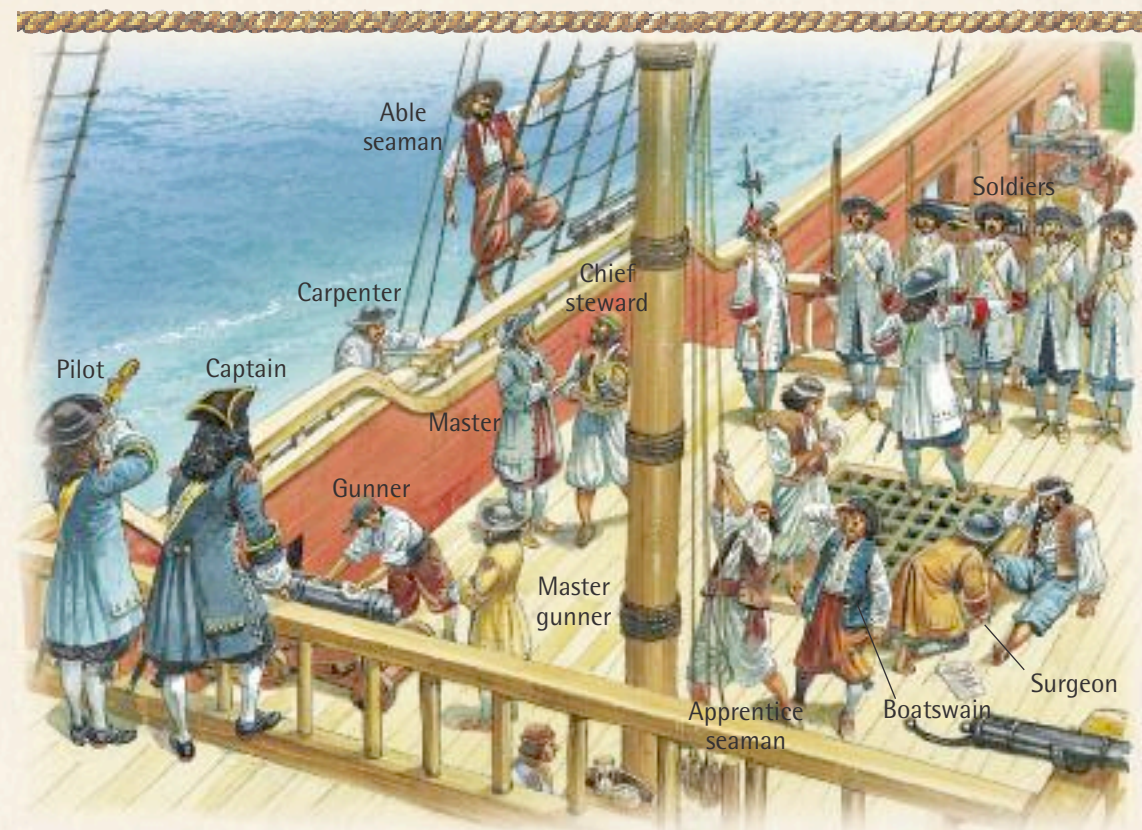
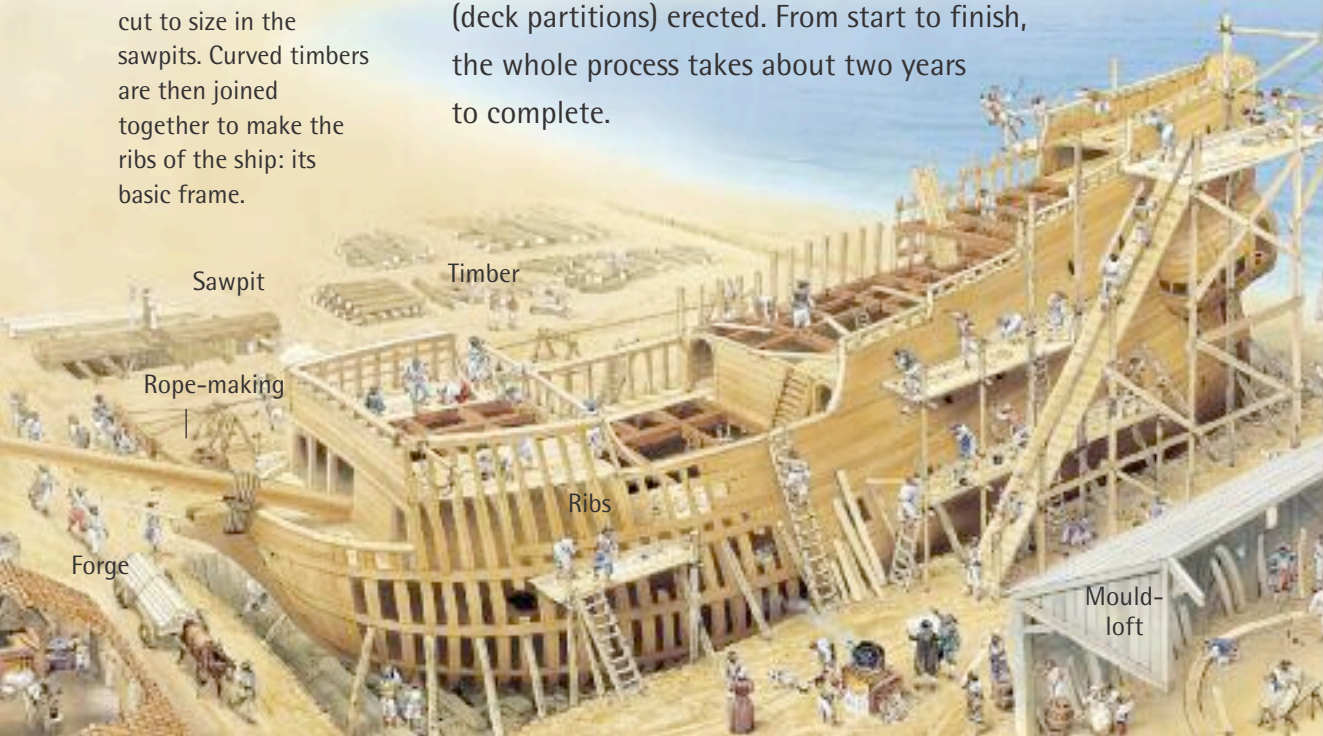
▲ Trenail mooters fix planks of wood to the frames with wooden pins (trenails) to form the outside of the hull. Caulkers hammer rope fibres into the gaps between the planks. The fibres are coated with hot tar, or pitch, to waterproof them.

▼ A galleon is being constructed in this shipyard. In the mould-loft, carpenters mark out shapes on pieces of timber which are then cut to size in the sawpits. Curved timbers are then joined together to make the ribs of the ship: its basic frame.

3. Prepare a voyage

BEFORE LEAVING for the Americas, a ship must be built and a crew assembled. The galleon is built at a shipyard in northern Spain, close to the port of Bilbao. Nearby grow forests of Bilbao oak, from which the ship's timbers will be made. The surrounding region is also the centre of artillery production, and the port has links with sources of pine (for masts) and other materials such as canvas, rope and pitch from other parts of Europe.

First of all, timbers are delivered to the yard. The keel is laid out on the ground (the *astillero*), then curved pieces forming the bow and stern are fixed to it. Next, a series of ribs is attached to the keel, forming the basic frame. They make a U-shape in the central part of the galleon (amidships) and a Y-shape at the stern. The design must follow government regulations. The internal decks are then laid out, and supports for the masts added. Planks are fixed to the decks and the outside of the hull. The masts are then lowered into place, a rudder slung into position, and the bulkheads (deck partitions) erected. From start to finish, the whole process takes about two years to complete.



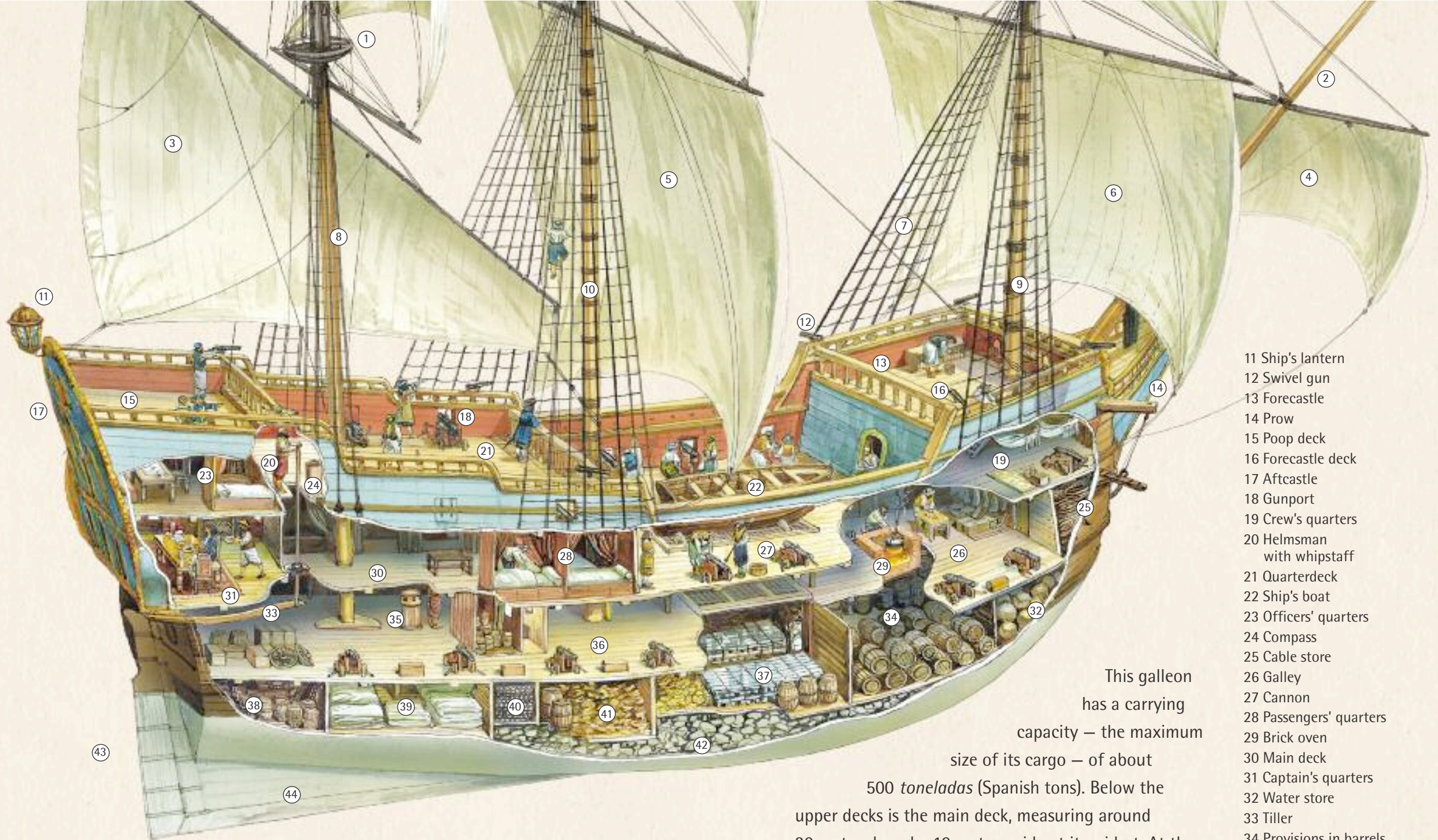
Assemble a crew

The men aboard the galleon comprise the sailors, numbering about 80, and soldiers, about 125. In overall command is the *capitán* (captain). He is a soldier rather than a sailor; the commander of the ship's sailing crew is the *maestre* (master). He is responsible for sailing the galleon, for keeping it seaworthy and for ensuring it has adequate supplies.

The *maestre* is assisted by several officers, including the *piloto* (pilot), responsible for navigation, the *contramaestre* (boatswain, or bosun), who looks after the rigging and ensures the ship runs smoothly, the *despensero* (chief steward), in charge of food and drink, and the *codestable* (master gunner) who supervises the ship's guns. There are also officers who play no part in the running of the ship, including a chaplain, a surgeon and government officials who oversee the cargo.

The crew

The ship's crew comprises, in descending order of rank, *marineros* (able seamen), *grumetes* (apprentice seamen) and *pajes* (ship's boys). The ship's boys perform menial tasks such as scrubbing the decks and serving meals. In addition there are the *maestranza*, specialist craftsmen, including carpenters, coopers and caulkers, and the *artilleros*, gunners, who operate the ship's guns. The soldiers are infantrymen whose purpose is to defend the ship from attackers.



- 1 Crow's nest
- 2 Bowsprit
- 3 Mizzen sail
- 4 Spritsail
- 5 Mainsail
- 6 Foresail
- 7 Shrouds
- 8 Mizzen mast
- 9 Foremast
- 10 Mainmast

Inside the galleon

The galleon was originally built as a warship, to escort the convoys of cargo vessels sailing between Spain and the Americas. From about 1600, all treasure from the New World – including gold bars, silver ingots and coins – has been transported in the royal galleons.

This galleon has a carrying capacity – the maximum size of its cargo – of about 500 *toneladas* (Spanish tons). Below the upper decks is the main deck, measuring around 30 metres long by 10 metres wide at its widest. At the stern end are the captain's quarters. Below the main deck is the lower deck or gundeck. A galleon of this size carries about 24 cannon. The holds, containing the ship's stores and its cargo, lie beneath the lower deck. At the very bottom of the ship are the bilges packed with heavy stones, called ballast, to help keep the ship upright in the water.

- 11 Ship's lantern
- 12 Swivel gun
- 13 Forecastle
- 14 Prow
- 15 Poop deck
- 16 Forecastle deck
- 17 Aftcastle
- 18 Gunport
- 19 Crew's quarters
- 20 Helmsman with whipstaff
- 21 Quarterdeck
- 22 Ship's boat
- 23 Officers' quarters
- 24 Compass
- 25 Cable store
- 26 Galley
- 27 Cannon
- 28 Passengers' quarters
- 29 Brick oven
- 30 Main deck
- 31 Captain's quarters
- 32 Water store
- 33 Tiller
- 34 Provisions in barrels
- 35 Capstan
- 36 Lower deck or gun deck
- 37 Treasure hold
- 38 Water in barrels
- 39 Sail hold
- 40 Powder and shot store
- 41 Dry provision store
- 42 Bilges with ballast
- 43 Rudder
- 44 Keel



FLORIDA
GULF OF MEXICO

ATLANTIC OCEAN



The *Flota de Indias* takes advantage of prevailing winds across the Atlantic. The outward route from Spain runs southwest to the Canaries before crossing the Atlantic. The return route picks up the fast-flowing Gulf Stream current back to Europe.

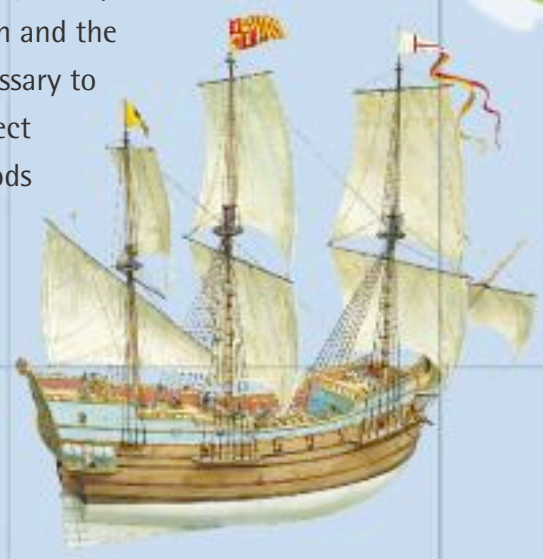
The *Nueva España Flota* makes the three-week journey to Havana from Veracruz each spring. Here the ships undergo repairs and take on cargoes of tobacco and sugar before setting sail for Spain.

Zacatecas
Veracruz
Acapulco
from the Philippines

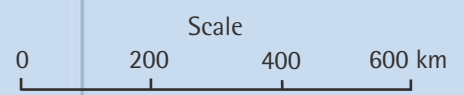
Every year, the *Manila Galleons* brings luxury goods from East Asia to Acapulco. From here, the goods are transported across Mexico to Veracruz and loaded aboard the *Nueva España Flota* bound for Spain.

Planning a route

This is a map of routes taken by the Spanish Treasure Fleet, between Spain and the Americas. The plans are necessary to ensure ships arrive in ports at the correct times to collect treasure and other goods from Mexico, South America, and Spanish traders in the Far East.



- Flota de Indias
- Tierra Firme Flota
- Nueva España Flota
- Overland routes
- Manila Galleons
- South Seas fleet



PACIFIC OCEAN

Mule trains carry silver mined in Potosi to the coast, from where it is shipped north.

CARIBBEAN SEA

SOUTH AMERICA

ANDES

Each year, the Treasure Fleet sails in convoy to the Americas to collect treasures from Spain's new colonies there. The *Flota de Indias* is made up of the *Nueva España Flota* and the *Tierra Firme Flota*. The first fleet sails in April to Veracruz in Mexico, while the second sets out in August for the port of Cartagena. Another fleet, the *Manila Galleons*, crosses the Pacific from the Philippines bringing goods from China and Japan to Acapulco. From here, mule trains ship the goods overland to Veracruz. The *Nueva España Flota* collects this and silver from the Zacatecas mines and overwinters in Veracruz. Meanwhile, the *Tierra Firme Flota* travels on to Porto Bello to collect silver mined in South America, returning to Cartagena, where it spends the winter. Both fleets meet up in Havana in the spring to embark on the voyage home to Spain.

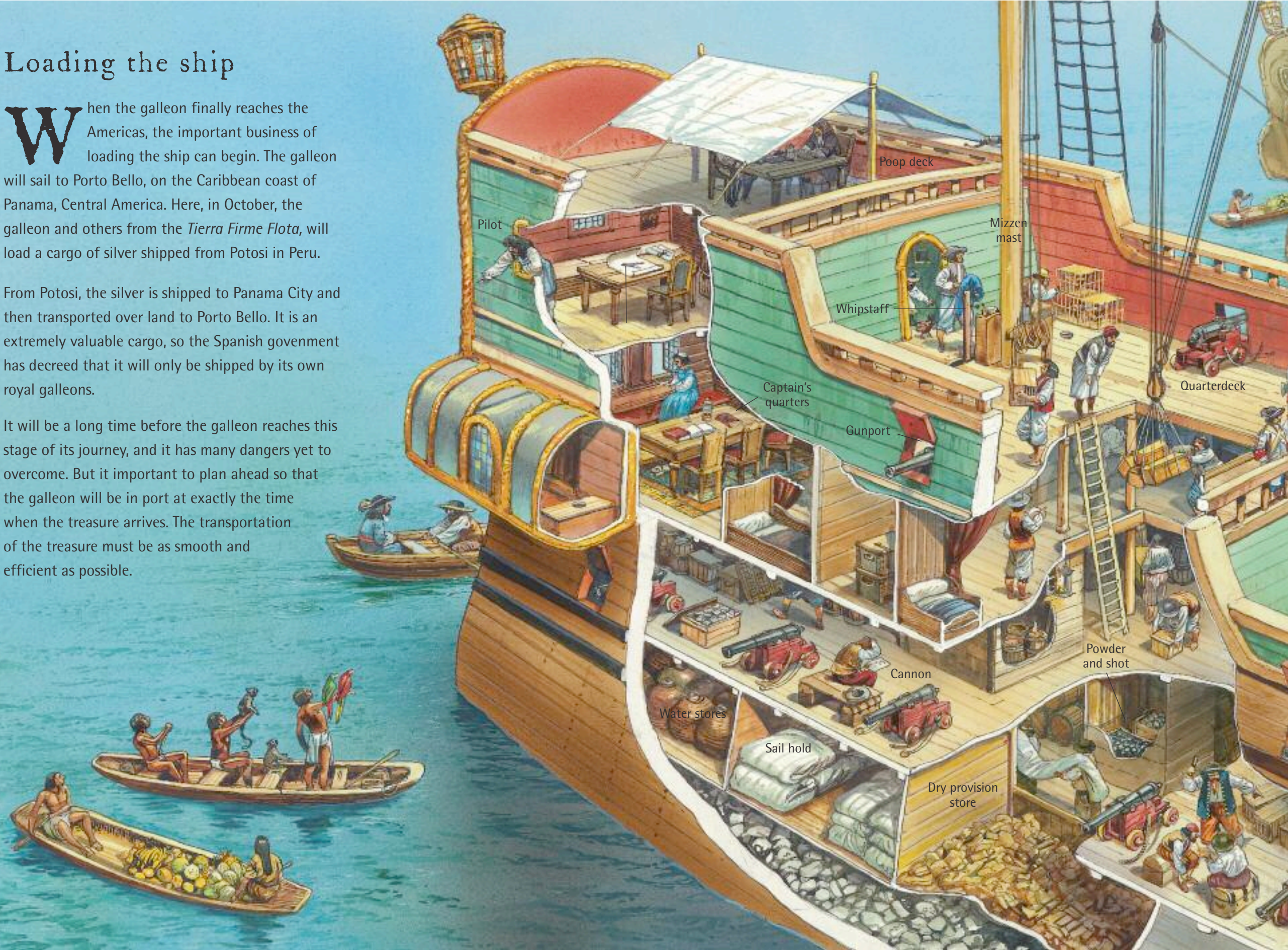
Guayaquil
from Potosi

Loading the ship

When the galleon finally reaches the Americas, the important business of loading the ship can begin. The galleon will sail to Porto Bello, on the Caribbean coast of Panama, Central America. Here, in October, the galleon and others from the *Tierra Firme Flota*, will load a cargo of silver shipped from Potosi in Peru.

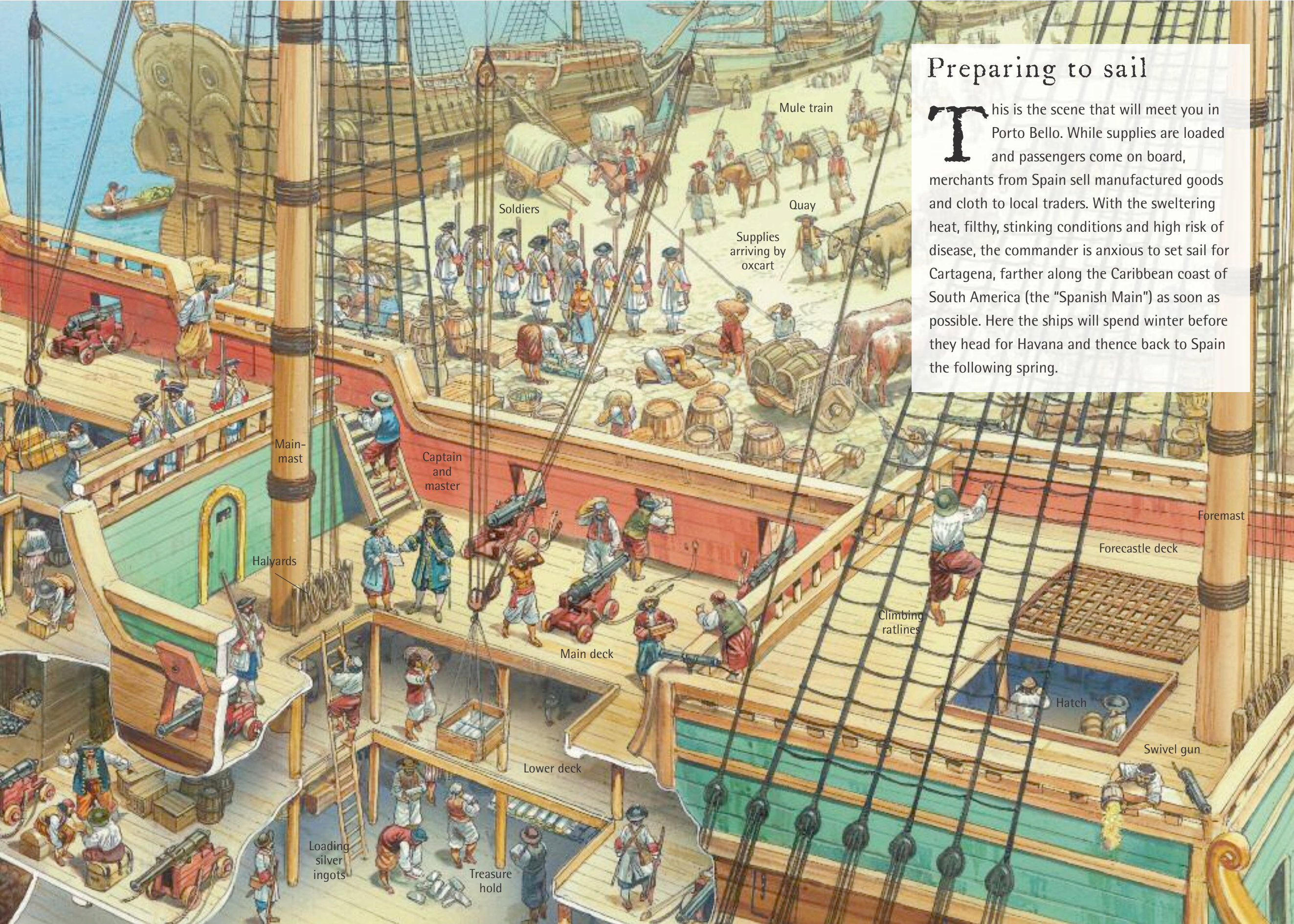
From Potosi, the silver is shipped to Panama City and then transported over land to Porto Bello. It is an extremely valuable cargo, so the Spanish government has decreed that it will only be shipped by its own royal galleons.

It will be a long time before the galleon reaches this stage of its journey, and it has many dangers yet to overcome. But it is important to plan ahead so that the galleon will be in port at exactly the time when the treasure arrives. The transportation of the treasure must be as smooth and efficient as possible.



Preparing to sail

This is the scene that will meet you in Porto Bello. While supplies are loaded and passengers come on board, merchants from Spain sell manufactured goods and cloth to local traders. With the sweltering heat, filthy, stinking conditions and high risk of disease, the commander is anxious to set sail for Cartagena, farther along the Caribbean coast of South America (the "Spanish Main") as soon as possible. Here the ships will spend winter before they head for Havana and thence back to Spain the following spring.



Mule train

Soldiers

Supplies arriving by oxcart

Quay

Main-mast

Captain and master

Halyards

Main deck

Lower deck

Loading silver ingots

Treasure hold

Foremast

Forecastle deck

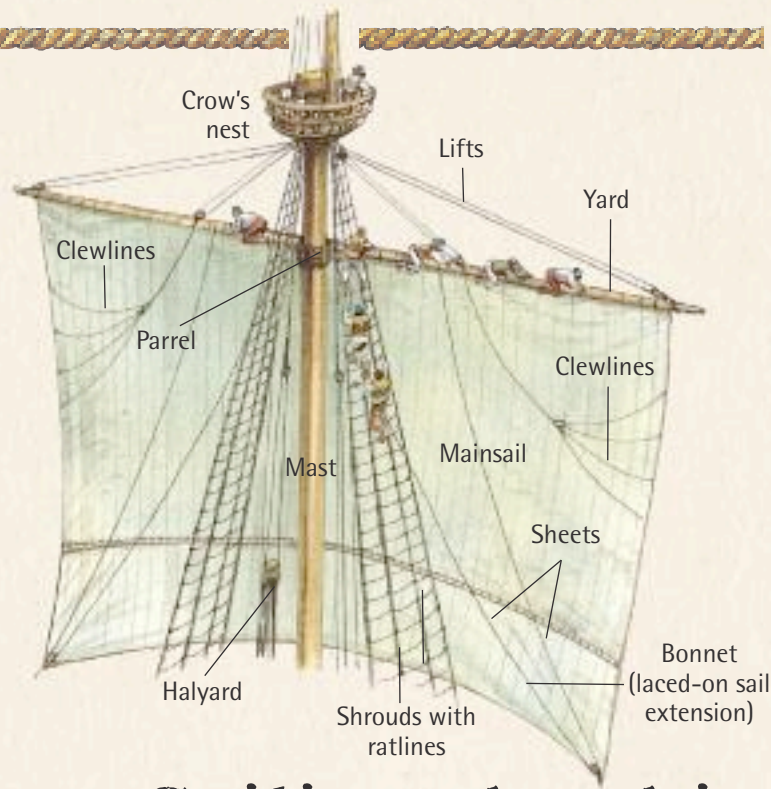
Climbing ratlines

Hatch

Swivel gun

Rigging

Standing rigging holds the masts securely in position. They consist of ropes called shrouds, which attach the masts to the ship's sides, and stays, which run between the masts. Running rigging takes its name from the blocks and pulleys through which the ropes run. They include the halyards, which hoist the yard up the mast, sheets, which keep the sails taut, and braces, which swing the yard left or right.



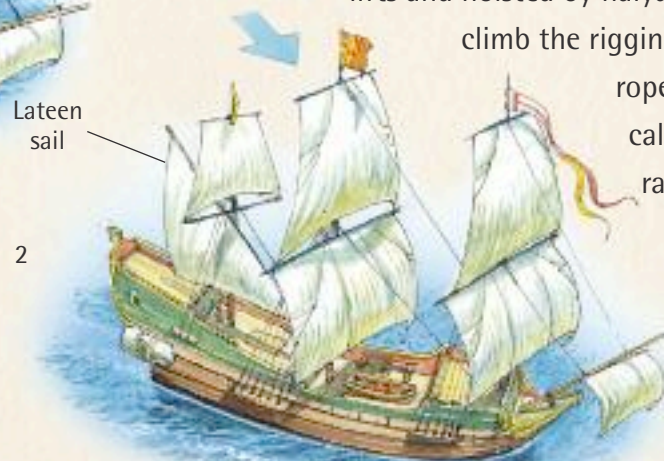
4. Sailing the ship

IT IS VITAL to have a detailed understanding of sailing and navigation techniques, especially when it comes to negotiate stormy seas.

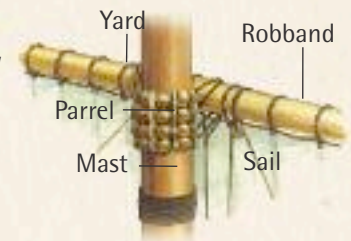
The ship's sails, together with the ropes used to adjust them, are called the rigging. A sail is attached to the mast on a horizontal yard, held in place by ties and lifts and hoisted by halyards. Men climb the rigging on rope ladders, called ratlines.



▲ This sequence shows a ship making a turn to the left. The sails are braced at right angles to the wind (1). Swinging the yards in a clockwise direction and unfurling the lateen (2, 3) starts to turn the ship. Angling the rudder to the left helps turn. Eventually the sails are almost parallel to the wind (4).



The galleon has three masts. From the bow they are: the foremast, mainmast and mizzen mast. The foremast and mainmast each carry two square sails; the mizzen mast carries one square sail and a triangular, or lateen, sail. To



▲ Sails are fastened to the yards by loops of rope called robbands. The yards themselves are mounted on the masts using a swivel device called a parrel. This allows the yards, to be adjusted to the position required.

change direction when the wind is constant, or to maintain a steady course when the wind itself changes direction, the position of the sails are adjusted. Braces, ropes attached to the ends of the yards, are used to swing them around. Keeping the sails braced at right angles to the wind will enable the ship to travel in the same direction as the wind. By bracing sails parallel to the direction of the wind, the ship can be slowed down.

To alter course, the square sails are adjusted in a clockwise direction to turn left or an anticlockwise direction to turn right. Unfurling the lateen sail helps catch the wind so the ship swings round smoothly. Adjusting the sails to a sharper angle causes the ship to make a tighter turn.



Rudder

The ship is steered by adjusting the sails and rudder. The rudder is controlled by the helmsman. He holds a handle, called a whipstaff, linked to the rudder by rods.



▲ The compass is the navigator's most valuable tool. The magnetic needle aligns itself with the Earth's magnetic field, and so always points north. From this, the navigator can work out the ship's direction of travel, or heading.

First compass

The compass was invented in China around the 2nd century AD. It was used for navigation by Chinese mariners in the 11th century. The compass was invented in Europe in about 1300.



▲ A sandglass measures time at sea. It is carefully designed so that it takes exactly 30 minutes for all the sand to fall from top to bottom halves.

Navigation

The pilot plots the course of the ship on a chart, a map of the sea and coastlines. The chart has a compass rose, indicating north, south, east and west, and a scale bar. This shows how far a distance on the map — a few centimetres, say — is in the real world — several tens of kilometres, perhaps. To measure how far the ship has sailed over a period of time, the pilot uses dividers (*right*).



He places the points first on the chart, one on the ship's position the previous day, the other on her current position. Then, keeping the points the same width apart, he holds them against the scale bar and reads off the actual distance in kilometres.



An essential aid to navigation is the telescope. Basically an extendable, hollow tube with lenses fixed inside, it brings anything seen through it closer to the viewer. A sailor can make out landmarks on the coast to help plot the ship's position. On cloudless nights, sailors can also use the stars to find their way. The Pole Star always lies in the north. It can be found by using the two "end" stars of the Plough, a familiar constellation, as pointers (*right*).



To work out a ship's latitude — how far north or south of the Equator it lies — sailors calculate the position of the sun at noon, when it is at its highest position in the sky. To do this, a sailor uses an instrument called a backstaff (*below*). Standing with his back to the sun, he looks through the sighting vane. Lining up the shadow cast by a part of the backstaff called the shadow vane with the horizon, he then measures off the angle of the sun above the horizon. The higher in the skies the sun is at noon, the closer the ship is to the Equator.



To work out longitude — how far the ship lies east or west of the Prime Meridian — is a more difficult task. The best way is to keep detailed records of the ship's speed and direction.

To work out her speed, sailors throw out a log line with a weight attached to the end from her stern (*below*). The line, which has equally-spaced knots tied along its length, is allowed to reel out as the ship moves forward. Using a sandglass, a sailor can then time the number of knots that are reeled out over the course of one minute. Multiplying this figure by 60 gives the speed in knots per hour. Using the compass, it is possible then to calculate the distance travelled east or west.



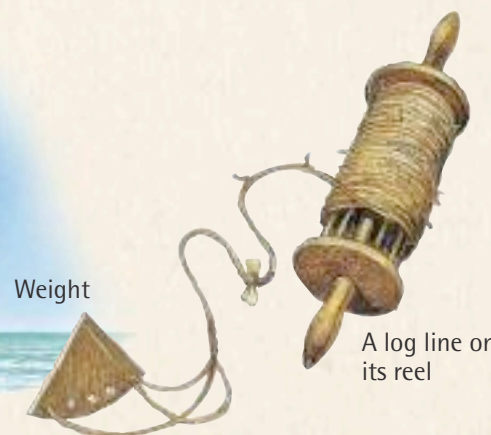
Weight

▼ To prevent a ship running aground, a lead line is used to measure the depth of water. Attached to a marked line, it is thrown overboard. From the type of mud picked up by the sticky tallow (wax) in its hollow base, a navigator can tell how close the ship is to shore.



Deciding on a course

The pilot applied the techniques of navigation to plot the ship's position, but the captain instructed the helmsman in which direction to steer. It was he, not the pilot, who decided on the ship's course.



A log line on its reel

Safe harbour

In the event of heavy weather, a commander would manouvre his ship into a place where she could ride out the storm, for example, a windward shore: a shore that the wind is blowing out from, (*centre, right*). Here, the waves would be smaller because of the reduced "fetch", the distance of water that the wind is blowing over. A safer strategy was to find a harbour. A wide-mouthed harbour on a windward shore was ideal. One on a leeward shore with a narrow entrance could be too dangerous to enter.

Surviving storms

Storms are a risk to any ship at sea. The best way to deal with heavy weather is simply to avoid sailing during times with a high risk of storms.

The hurricane season in the Atlantic Ocean lasts from June to November, peaking in September.

At the first sign of bad weather, the boatswain trims the sails (reduces the amount of sail, *below, left*). This prevents the ship from being flung in all directions by the wind, and ensures they are not ripped apart by gales. Some sail is left up, so that the helmsman still has control. In extreme conditions, the commander may decide to sail "bare poles" (without any sails

hoisted). The force of the wind on the hull and rigging is reckoned to be enough to propel the craft forwards.

The commander attempts to keep the bow or stern of the ship pointed end-on into the waves, since a non-breaking wave, however high, will not capsize a stable ship. He may decide in the first place to run with the wind, that is, to sail with the wind blowing directly from behind. The commander hopes that this will succeed in carrying the ship swiftly away from the path of the storm and into safer waters.



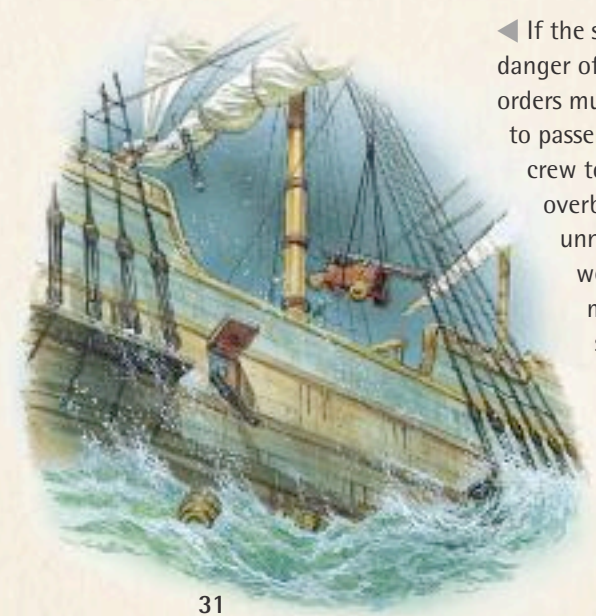
▲ Steering the ship into the direction of the oncoming waves to avoid capsizing.



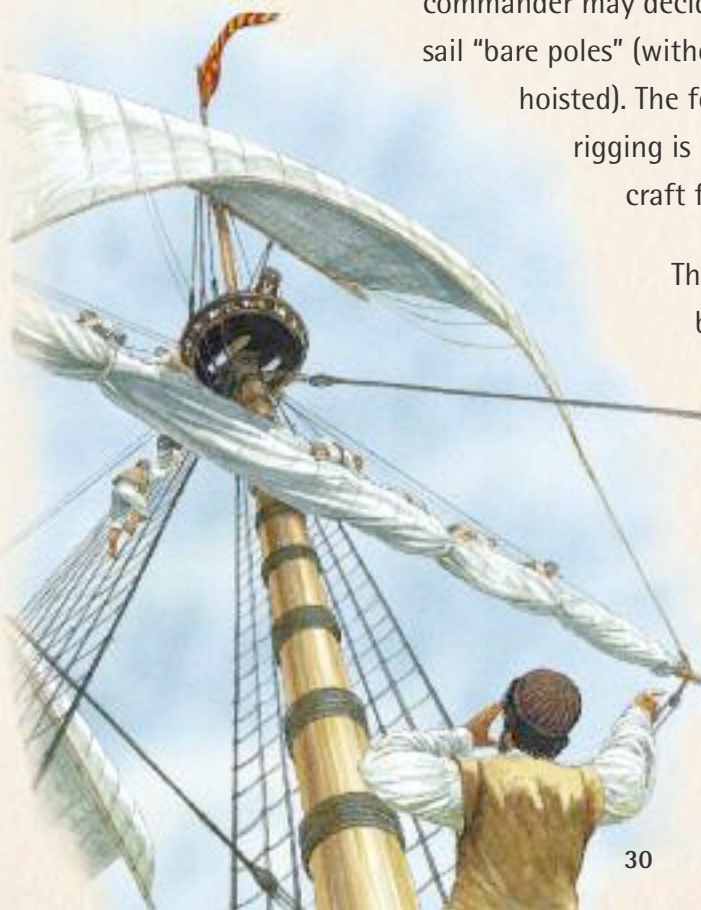
▲ Dropping anchor greatly slows the ship and can help realign her bow so she points directly into the waves.

But if it is no longer possible to control the forward motion of the ship, the commander may instead position her with her bow pointing directly into the wind. The ship is, however, at the mercy of the full force of the storm, and a very large breaking wave could pitchpoll (end-over-end capsize) her.

Providing the ship survives capsizing, there are other measures that can be taken to prevent disaster. The stove in the galley is doused to ensure fire does not break out. The bilges are pumped out around the clock so that any water getting into the ship is continuously ejected.



◀ If the ship is in danger of sinking, orders must be issued to passengers and crew to throw overboard any unnecessary weight. This may mean sacrificing cannon, ammunition, food stores and even precious cargo.



▼ The crew's daily rations are as follows: wheat biscuit (1), a soupy mixture of beans, lentils and rice called *menestra* (2) and a litre of wine per man (3). Boiled salted beef (4) and sardines (5) may be added on alternate days or, when it is unsafe to light the galley fires in rough seas, cheese. Garlic, olives and onions (6) provide vitamins and help make the diet healthier.



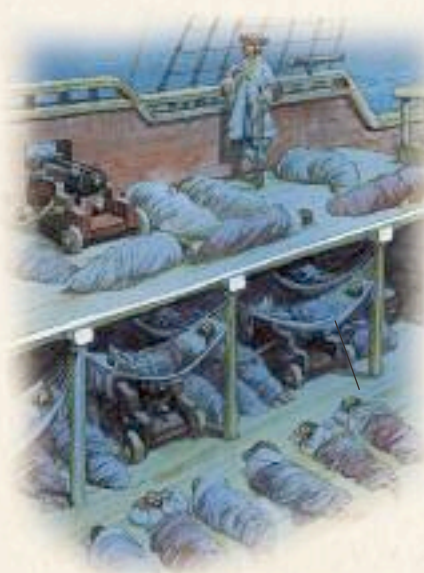
Keeping watch

A system of three watches operated while the galleon was at sea. The ship's company was divided into three teams, each keeping watch for four hours at a time. The passing of the hours was recorded by the turning of a 30-minute sandglass. The change of each watch was marked by the chanting of prayers.

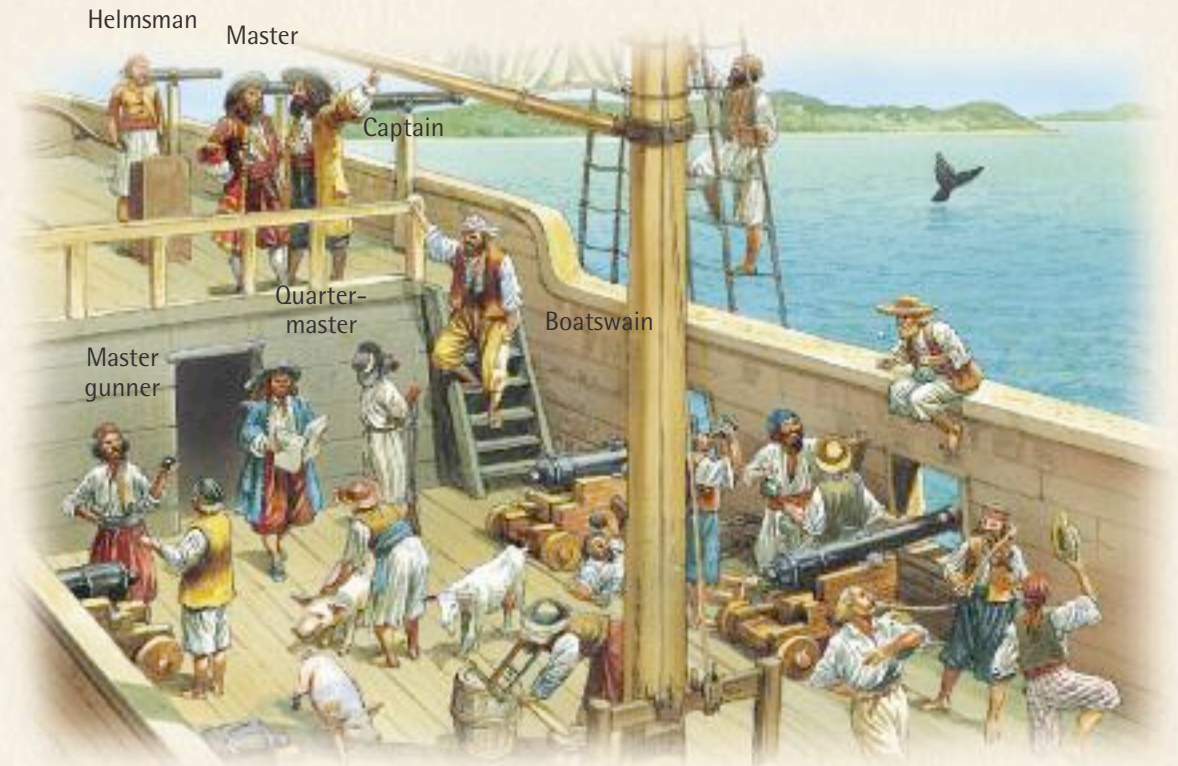
Life on board

With so many people and animals crowded together in a small space, conditions on board a galleon can become extremely unpleasant: noisy, filthy and smelly. It is important that the crew clean the ship thoroughly, including pumping the dirty water out of the bilges, on a daily basis.

The lack of proper toilets aboard can be a problem. The crew might use the "heads" in the ship's prow (*right*), holes cut into wooden boxes to either side of the bowsprit. Others may prefer buckets, or the bilges, which will soon stink of human waste. Attracted by the dreadful smell, rats will always find their way on board in their hundreds while the ship is in port. They not only spread disease but eat provisions, torment livestock and damage sails and rope.



Space is in short supply on board ship. The captain lodges in his cabin in the stern, while his officers sleep in screened-off areas on the upper decks. The crew and the solidiers sleep in hammocks or on the floor of the main or lower decks or, as many prefer, in the open air.



6. Pirates

FOR THE LENGTH of her voyage, particularly on the home leg when laden with treasure, the galleon will be under threat of attack by pirates and other treasure hunters. But who are these men? And how are they organized, armed and equipped?

Privateers (short for "private men-of-war") are seamen who capture and sell vessels and their cargo for ransom — a practice permitted by various nations hostile to Spain: Britain, France and The Netherlands. Buccaneers are fortune-hunters of English origin from Jamaica, Tortuga and Hispaniola. Together with their French and Dutch counterparts, known as filibusters or freebooters, the buccaneers try to steal and plunder the Spanish ships, often encouraged by their governments. These groups are also joined by pirates, murderous outlaws operating independently, who attack ships purely for their own gain.

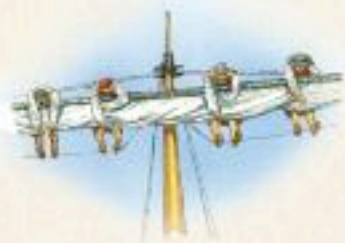
Pirate officers

The captain is the ship's commander but the master is responsible for sailing her. He is assisted by the boatswain, in charge of rigging and the quartermaster, who oversees the provisions.

▼ Recruitment is by word of mouth, or is carried out at local taverns.



▼ The boatswain and his crew furl the mainsail and topsails in preparation for battle. This keeps the vessel stable in a squall, improves visibility and ensures the vessel can be sailed with only a few men. The rest may be needed to board the enemy vessel.



▼ A pirate captain makes his ship "clear for engaging". The crew make the guns ready for firing, piling up shot and cartridges next to each cannon. Tubs are filled with sea water for fighting fires.



Encounter at sea

The Spanish Treasure Fleet always sails in convoy, escorted by several warships. But a galleon may become vulnerable to attack by pirates if she separates from the rest of the convoy. In a one-to-one confrontation with a pirate ship, the straggler may make a run for it, stay and fight, or even try and run ashore, with the hope of retrieving her cargo later.

On sighting a sail, the pirates go into action. First of all, they identify the ship, assess her fighting strength and decide whether she is a potential prize. A pirate ship will chase another ship at speed — but is also ready to turn and run if that ship turns out to be significantly stronger than her.



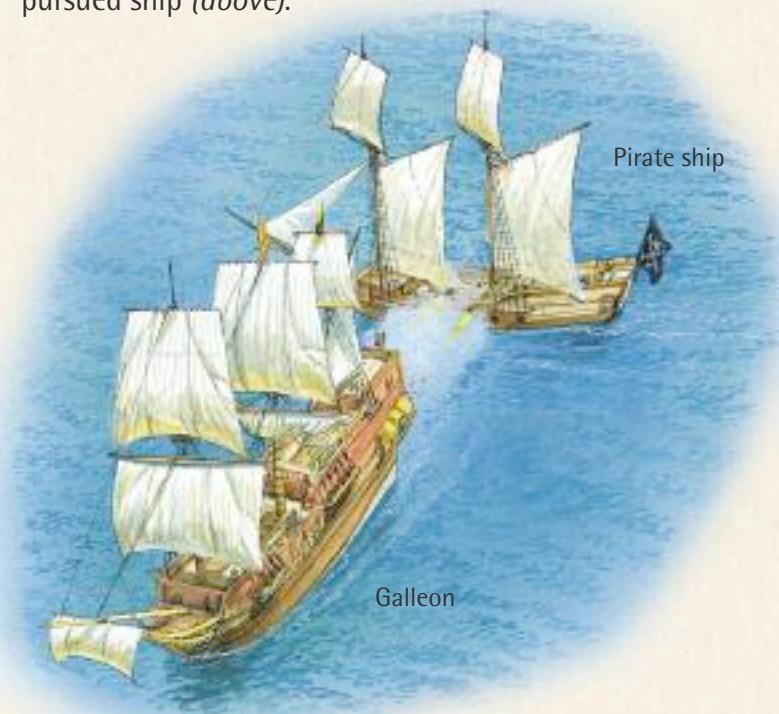
Galleon

Pirate ship



A chase can last several hours. Both pursuer and prey use their seaman-ship and judgment of the wind direction to make the chase longer or shorter. The galleon may hope to prolong the chase until

nightfall and then escape under cover of darkness. If the pirate ship succeeds on closing in on its target, the captain, having already made his own ship clear for engaging (*opposite, bottom*), fires a shot across the bow of the pursued ship (*above*).



Pirate ship

Galleon



▲ The pirate captain hails — calls out to the captain of the pursued ship — when the two ships are close enough. He will call for his opposite number to surrender without a fight. On seeing the pirate crew heavily armed, the skull and crossbones flag fluttering on the masthead and gunports opened, a terrified captain may do just that.

Point blank range

Although fighting the enemy by firing cannon broadside to broadside at point blank range was not considered a very effective tactic, many naval engagements were like this. The fighting resulted in much damage and many casualties — on both sides. But the greatest danger for either ship came from spilt gunpowder being set alight, blowing the vessel to pieces.

If the galleon refuses to strike (lowering her sails, signifying surrender), then battle begins. The pirate ship tries to manoeuvre to windward of its quarry, that is, lying between her and the oncoming wind, to gain what is called the weather gauge (*above*). From here, the pirate ship rakes her, firing down the length of the galleon from stern to bow, damaging her while making it difficult to be fired upon in return, since cannon fire only from the sides. The gunners will also aim to hole the enemy ship's hull below the waterline.

▼ Before they can board, the pirates must lay their ship alongside their prey. Amidships (1) or at the bow (2) are the best places. The worst place is at the stern (3), since the aftcastle is the vessel's highest point — although lying athwart the stern is the best place from which to fire cannon at her (4). Boarding across the bow (5) or from the bow to amidships (6) is unwise, the first because the men are forced to board one or two at a time, the second because the pirates will be dangerously exposed to enemy cannonfire.



Preparing to board

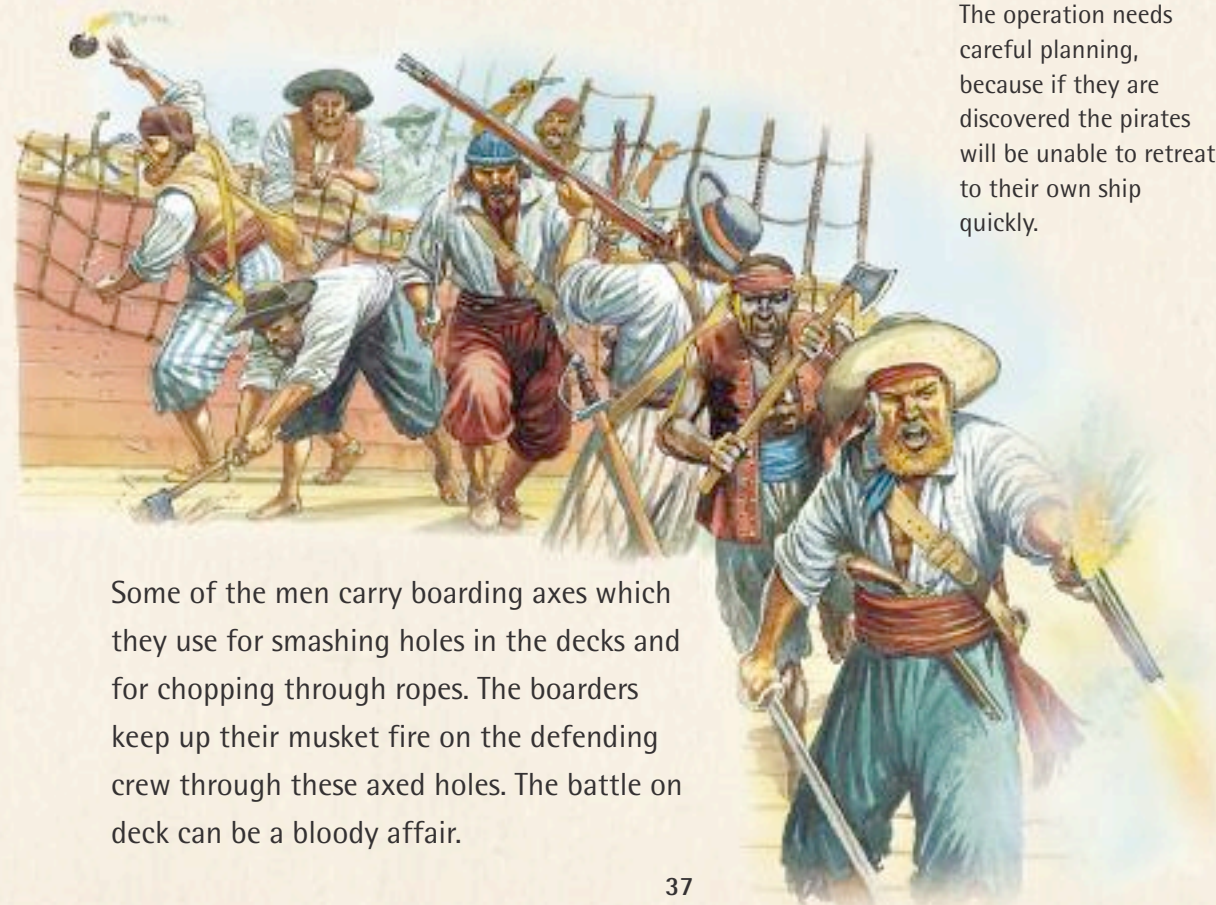
The pirates will be anxious to avoid a prolonged gun battle. If they damage the galleon too much, her prized cargo may be lost. Their own ship, more lightly-built, may herself suffer damage from cannonfire and be unable to escape at speed. So they will prefer to board the enemy vessel without delay.

Before they board, the pirates must clear the galleon's decks and force her gunports to stay closed. This they can achieve with musket fire. A large crew can fire a fusillade of up to 100 shots a minute at the decks of the enemy vessel (above).



Having kept the enemy from returning fire long enough to draw alongside, the pirates now prepare to board. When the two ships are only metres apart, the pirates light the fuses of their grenades (iron cylinders or glass bottles filled with gunpowder) and hurl them on to the galleon's decks. They also throw fire bombs. Others sling grappling irons, large claw-shaped hooks on the ends of chains, over the rails, and pull the ships to within touching distance so the lashers can rope them together (opposite, bottom).

Through the cover of smoke, the pirate captain "enters" his men aboard. They may need to slash their way through boarding netting with axes and knives. Musketeers fire at tubs of gunpowder that have been positioned ready to drop from the yardarms. They also take aim at enemy marksmen lurking high in the rigging.



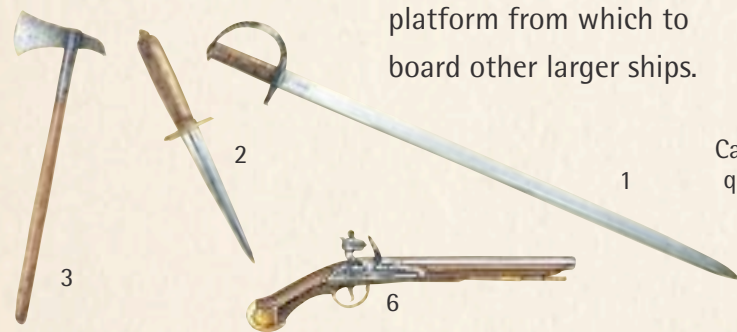
Some of the men carry boarding axes which they use for smashing holes in the decks and for chopping through ropes. The boarders keep up their musket fire on the defending crew through these axed holes. The battle on deck can be a bloody affair.



▲ One of the least risky ways for pirates to capture a ship is by surprise, especially at anchor and at night. In calm water, rowing boats can approach a vessel undetected, particularly if the watch is inattentive. The operation needs careful planning, because if they are discovered the pirates will be unable to retreat to their own ship quickly.



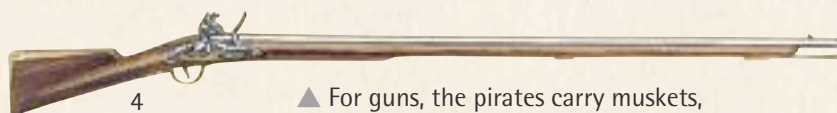
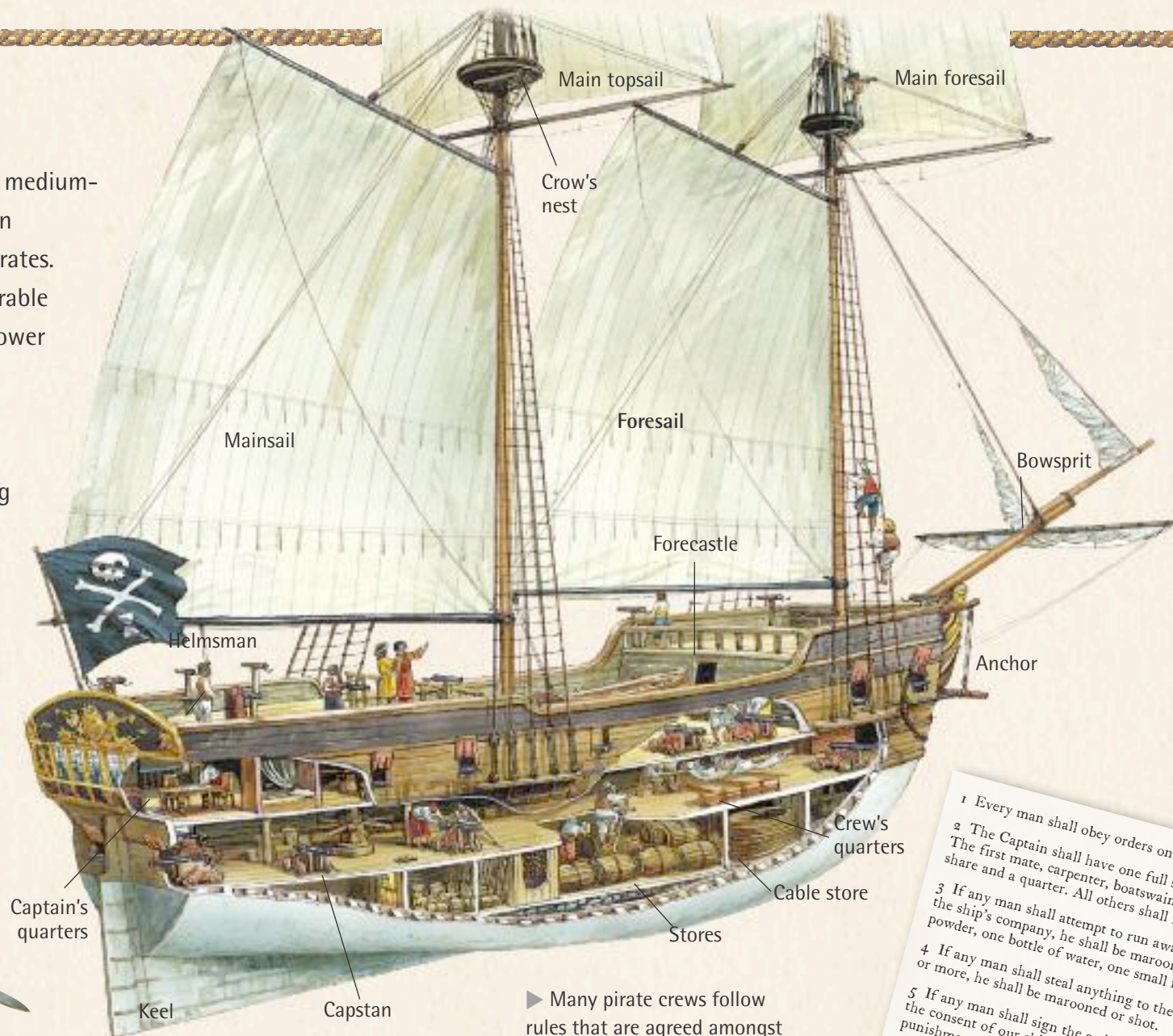
▲ Different flags have different meanings. A white flag is hoisted when pirates are willing to "parley" (negotiate). A red flag symbolizes bloodshed and indicates that they will give no quarter (mercy). Black flags mean death. Some captains add symbols such as the scimitar (above) or the famous skull and cross-bones to their flags.



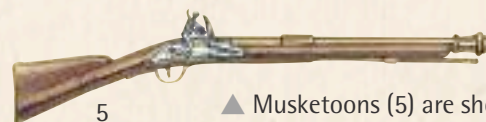
▲ Pirates going into battle carry cutlasses, daggers and axes as well as pistols. The cutlass (1) is the favoured weapon for all fighting men at sea. Its short, broad blade is ideal for use in small spaces on deck. Daggers (2) are useful below deck where there is even less room. Axes (3) can chop through ropes to bring down sails.

Pirate ship

A brigantine is a medium-sized ship often favoured by pirates. She is fast and manoeuvrable and can also sail in shallower waters where heavier warships cannot follow. These features are advantageous for chasing prey or for escaping from danger. At the bow, the forecastle is set higher than the rest of the upper deck to give a good view. It is also a useful platform from which to board other larger ships.



▲ For guns, the pirates carry muskets, musketoons and flintlock pistols. With their long barrels, muskets (4) are perfect for long-range, accurate firing.



▲ Musketoons (5) are short-barrelled muskets. Like muskets, they are fired from the shoulder, but, along with hand-held pistols (6), are easier to use on a cramped deck.

The pirate life

Pirates were certainly better treated, and had more freedoms and rights than "normal" sailors. Many of them became pirates in the first place to escape the brutal treatment they received on merchant ships or warships. On a pirate ship, both the captain and the quartermaster (the person in charge of food and living conditions on board) were elected by the crew. The captain was a man to whom the crew could give its trust rather than a hated figure of authority. He was often the bravest fighter amongst the ship's company.

► Many pirate crews follow rules that are agreed amongst themselves. They share out what they seize between them. But if someone takes more than his share of the booty, is found guilty of stealing or is judged a coward in battle, he is marooned (left on his own) on a remote island with only a little water and food. Details of how the spoils are to be divided are set out, along with other rules, in Articles (right), which every crew member signs.

- 1 Every man shall obey orders on this ship.
- 2 The Captain shall have one full share and a half in all prizes. The first mate, carpenter, boatswain and gunner shall have one share and a quarter. All others shall have one share.
- 3 If any man shall attempt to run away, or keep any secret from the ship's company, he shall be marooned with one bottle of powder, one bottle of water, one small firearm and some lead shot.
- 4 If any man shall steal anything to the value of a piece of eight or more, he shall be marooned or shot.
- 5 If any man shall sign the articles of another pirate ship without the consent of our ship's company, he shall suffer such punishment as the ship's company shall think fit.
- 6 If any man shall strike another, he shall receive 39 lashes on his bare back.
- 7 If any man shall fire his gun, or smoke tobacco, or carry a lighted candle below deck, he shall suffer the same punishment as in the previous article.
- 8 If any man shall not keep his firearms clean or fit for an engagement, or otherwise neglect his business, he shall be cut off from his share, and suffer such other punishment as the ship's company shall think fit.
- 9 If any man shall lose an arm or a leg during an engagement, he shall have 800 pieces of eight, or 400 if a lesser part.
- 10 No woman is allowed on this ship.

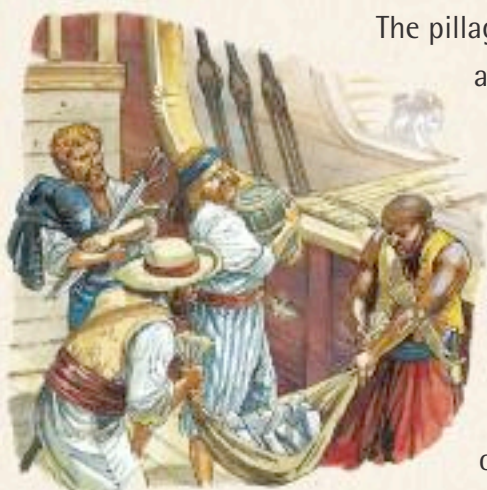
▼ To prevent attempts by the defeated crew to take back their ship, the pirates have them secured in chains in the hold. Here they remain until they are freed, put ashore or ransomed.



► The victorious pirates help themselves to their defeated opponents' possessions, arms, supplies and cargo.

Pillage and plunder

The battle won, the pirates cast off the lashings binding the two ships together, chiefly as a precaution against fire. The crew of the defeated ship are ordered to haul down or furl their sails, and then, along with their officers, they are secured under guard. The pirates will be wary at all times for any sign of treachery or of an uprising by the crew against them.



The pillaging starts straight away. The pirates seize their prisoners' clothing, jewellery, arms, and any other "moveable" items. The cargo itself is regarded as plunder, and is shared out between the officers and crew strictly according to the Articles.

A pirate's fate

What would happen to the pirates if they themselves were captured? If they were privateers, they might be ransomed or else exchanged for prisoners. Buccaneers, filibusters or pirates could be sent for trial or executed at sea by hanging or garrotting. As well as sudden wealth, death, injury, imprisonment or disease was the fate of most pirates.

Once their prize has been plundered, the pirates may either set the ship free, burn it, use it as a replacement for their own, or sell it for ransom. If the pirates choose to set the defeated ship and its crew free, they will firstly cut down the ship's masts and damage her rudder, thus ensuring she cannot quickly alert other ships as to the whereabouts of the pirates.

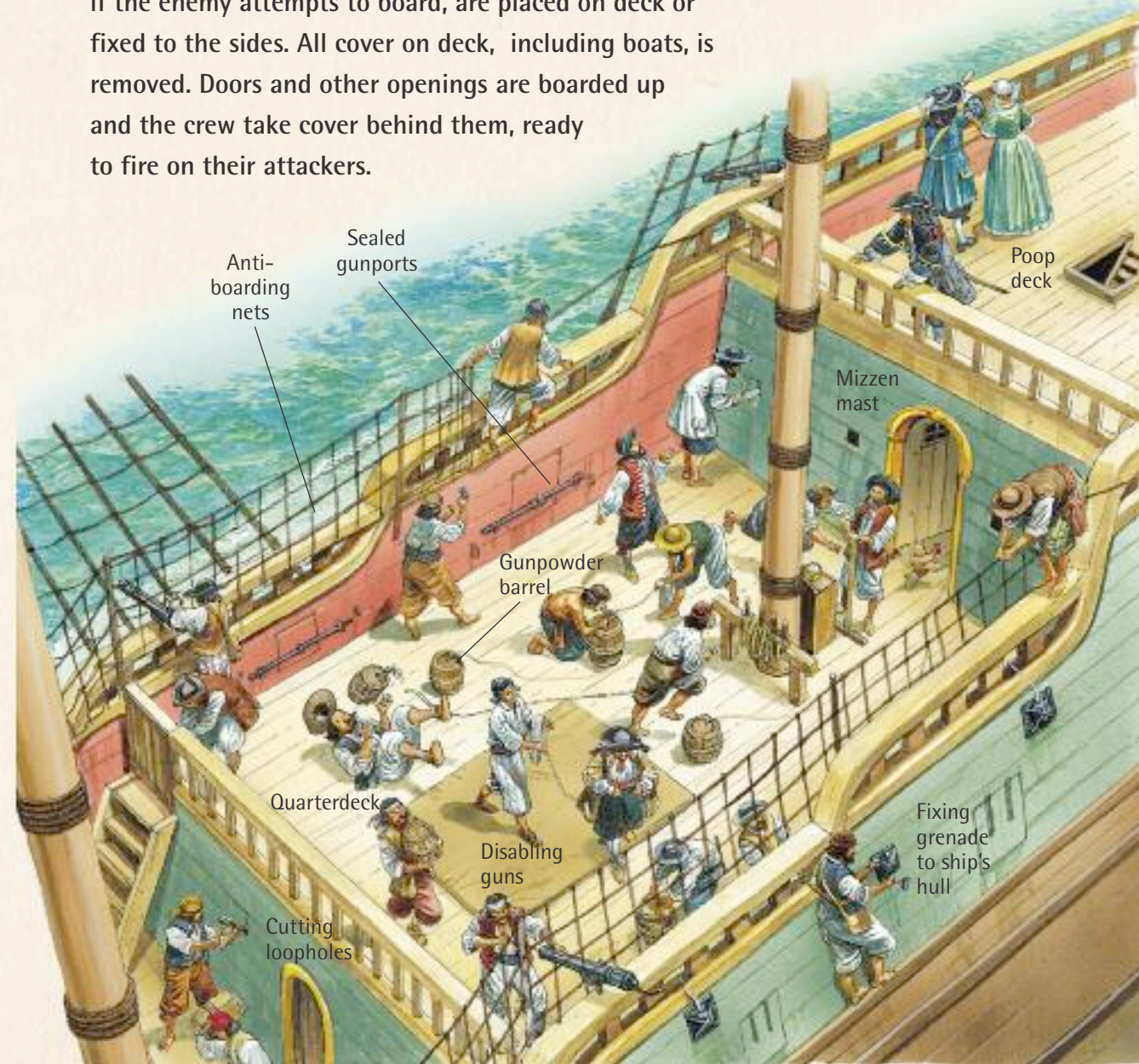


5. Defending the ship

IN ORDER TO PROTECT her crew and her precious cargo, the galleon must employ defensive tactics. Closed quarters, demonstrated here, is one such tactic that protects a ship's company from enemy fire and from being boarded by pirates. Anti-boarding nets are fixed to the rails. Barrels of gunpowder, primed to explode if the enemy attempts to board, are placed on deck or fixed to the sides. All cover on deck, including boats, is removed. Doors and other openings are boarded up and the crew take cover behind them, ready to fire on their attackers.



▲ All openings on board the ship, including hatches, grates, windows and gunports, are locked and lashed down from the inside.



Anti-boarding nets

Sealed gunports

Poop deck

Mizzen mast

Gunpowder barrel

Quarterdeck

Disabling guns

Cutting loopholes

Fixing grenade to ship's hull

► A gun crew prepares to fire a cannon. The gunner aims the gun and lights the match. His crew are on hand to load the cartridge and shot into the muzzle and then haul the gun into its firing position.



- 1 Sponge and rammer
- 2 Linstock with match
- 3 Tompion
- 4 Powder horn
- 5 Priming wire
- 6 Shot wads
- 7 Round shot
- 8 Double-head shot
- 9 Chain shot
- 10 Cartridge
- 11 Cartridge case

► Different shots are used for different targets: round shot is used against the hull or masts, while double-head is effective against rudders and chain shot against rigging.



Ship's guns

The ship's cannon are kept in good order in case of an attack. They are mounted on carriages with wheels. A breech rope is run through the carriage and secured to the hull on either side of the gunport (an opening in the ship's hull). Before engaging an enemy ship, the lids covering the gunports are removed. Each gun crew consists of an *artillero* (gunner) supervising three or four sailors and a ship's boy, who fetches gunpowder and shot from the store. The first job is to remove the tompion, the stopper that closes off the muzzle, and to unseal the vent or touch hole. Next, the loader takes a cartridge (a case of gunpowder) and places it in the muzzle (1). The rammer



shoves it down as far as it will go (2). He uses a pole which has a sponge — which cleans out the gun after a previous firing — at its opposite end. Then the shot is inserted, followed by a wad, usually made of oakum, fibres unravelled from old rope. The cannon is now ready for firing.

Now the gunner pricks the cartridge through the vent with a priming wire (3) and fills the vent with gunpowder from his powder horn, pouring

a little just behind the vent (4). Pulling on the breech ropes through the ringbolts, the gun crew haul the heavy cannon so its muzzle sticks out of the gunport (5). The precise direction of the gun can be adjusted slightly using handspikes (levers). When the order comes to fire, the gunner takes his linstock, strikes the match, and touches it to the powder just behind the vent (6). With the ship rolling up and down in the waves, his timing is crucial.



Immediately after the gun is fired (7), it recoils — jumps backwards — into the ship. While the muzzle is being sponged for the next firing, the gunner places his thumb over the vent to prevent any air accidentally igniting the gun.



▲ A verso or swivel gun is a breech-loading firearm: it is loaded at the rear of the barrel, not through its muzzle like a cannon. It can therefore be readied for firing much more quickly. Mounted on a yoke fitted to the rails around the upper decks, it can be easily swivelled towards its target. The gunner loads a mug-shaped device called a chamber, which is filled with gunpowder and shot — a musket ball or a mixture of nails.



Perfect timing

With both ship and target rolling up and down in the waves, the timing of firing was crucial to accuracy. In high seas, the gunner took care to fire just as the target ship was rising on a swell.

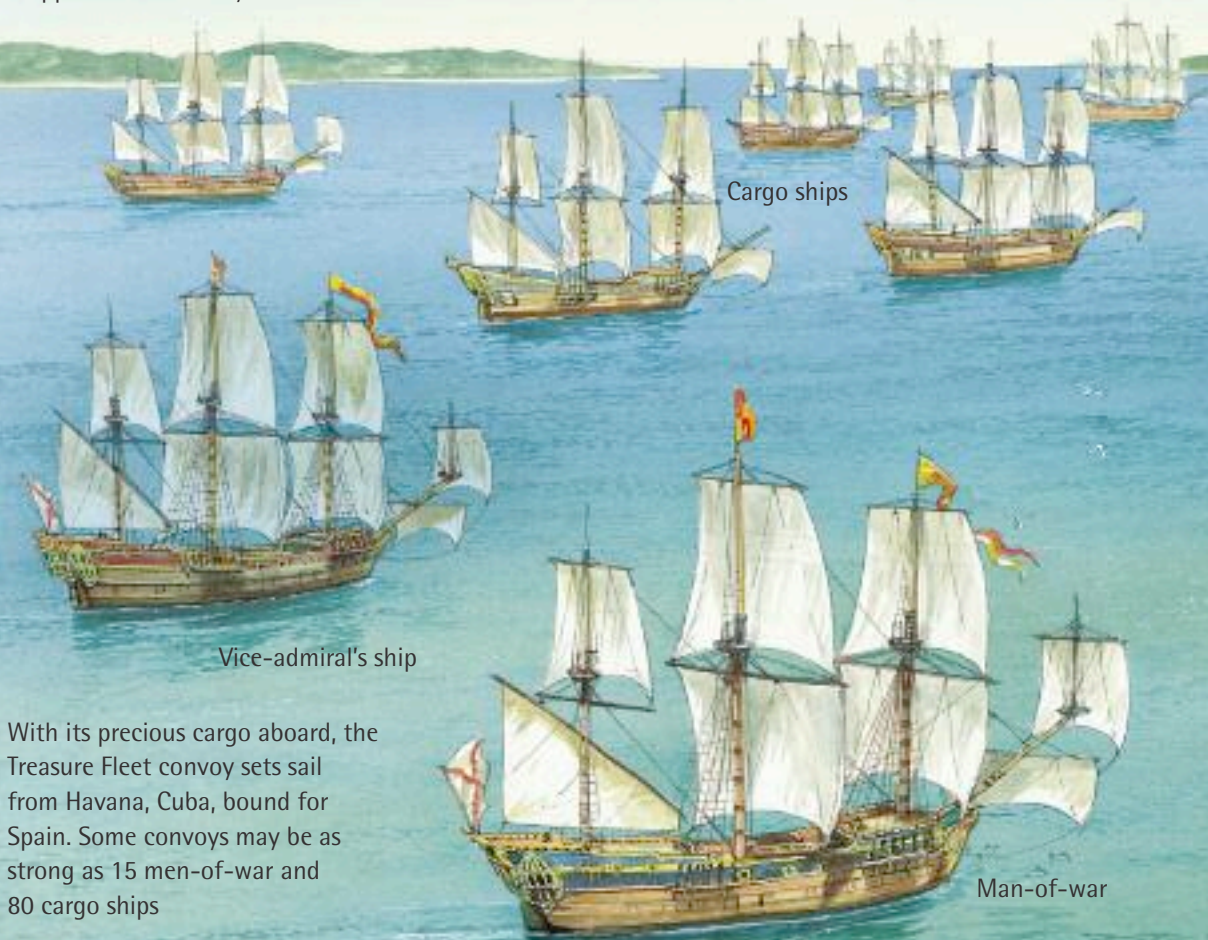


▲ With the wind blowing in this direction, the larger warship is lying to wind-ward of the smaller pirate ship. The warship can bear down on the pirate ship easily, whereas the pirate ship must tack from side to side to approach the enemy.

Escorting the fleet

The Spanish Treasure Fleet is a tempting target for every privateer, buccaneer, filibuster or pirate sailing in the Caribbean Sea, Gulf of Mexico and Atlantic Ocean. To deter pirates and offer protection against these predators, the Spanish Treasure Fleet always sails in convoy, accompanied by an escort of men-of-war: warships.

In a large convoy the admiral usually sails at its head, the vice-admiral at the rear and other men-of-war to windward. Keeping to windward gives the warships the "weather gauge": they can quickly chase pirates approaching from leeward. But sometimes the winds veer or calms hit the convoy unexpectedly — a time of maximum opportunity for pirates.



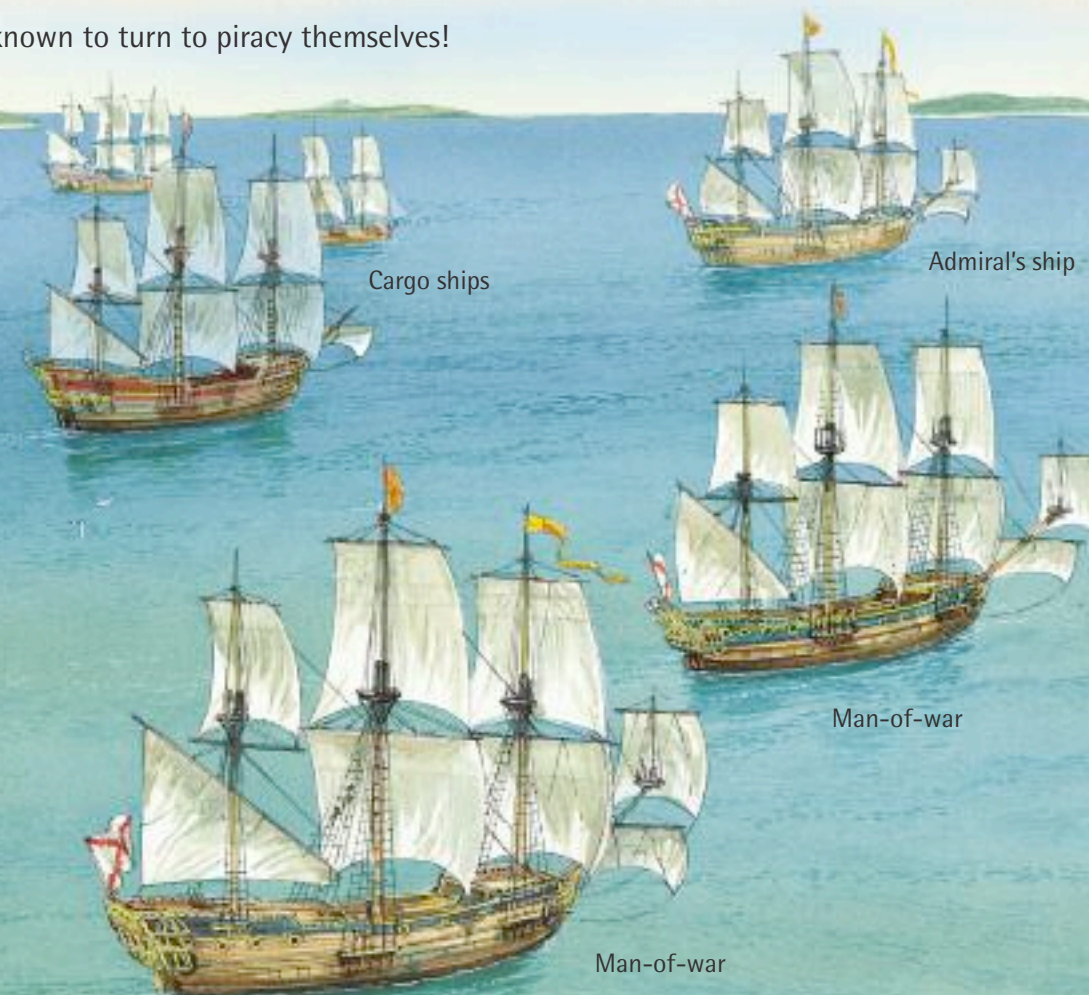
With its precious cargo aboard, the Treasure Fleet convoy sets sail from Havana, Cuba, bound for Spain. Some convoys may be as strong as 15 men-of-war and 80 cargo ships



To seek out and attack pirates off the Spanish Main, the Spanish have also authorized the setting up of *armadillas*, squadrons of armed vessels. Smaller types of ships, including sloops and *barque longues* (right), together with oared boats such as the canoe-like *piraguas*, form the defence of ports along the Spanish Main. But these craft often have

difficulty finding their targets, or come under attack in the battles that follow. Some of their crews have even been known to turn to piracy themselves!

◀ "A sail! A sail!" The first line of defence is the lookout on the masthead. A ship on the horizon can be spotted, in ideal conditions, up to about 40 km away.



Glossary

Aft Towards the rear of the ship.

Astrolabe A navigational instrument that measures the height of the sun and stars and aids calculation of latitude.

Ballast Any heavy material, such as stones, placed low in a vessel to increase stability.

Bilges The lowest part of a ship where any water in the hull collects. The bilges need to be pumped free of water at intervals.

Compass A magnetic pointer device used in navigation that always points north.

Cross-staff An instrument for measuring the altitude of the sun or stars.

Equator An imaginary circle around the Earth halfway between the poles.

Fore Towards the front of a ship.

Galleon A large, three-masted cargo ship used mainly by the Spanish to transport treasure back to Spain.



Gunports Square holes fitted with hinged lids in the side of the ship through which the cannon are fired.

Latitude The distance north or south of the **Equator**. The Equator has a latitude of zero degrees. The North Pole has a latitude of 90 degrees north; the South Pole has a latitude of 90 degrees south.

Lead line A rope, with length markings, attached to a lead weight used to find depth of water.

Log and reel A device for measuring a ship's speed.

Longitude The distance east or west of a particular location from a north-south line that passes through Greenwich, England. Greenwich has a longitude of zero degrees.

Mast A vertical pole, usually made of wood or metal, that supports yards and sails.

Musket A long, single-shot gun.

Musketo A shorter version of the **musket**, popular with pirates.

Navigation Plotting or directing the course of a vessel. Determining a vessel's position using navigational instruments.

Parley To speak to the enemy to see if it is possible to avoid a fight.

Parrel A swivel device that attaches a yard on to a mast.

Pilot A person who navigates a vessel.



Pole Star A star that is located due north, which makes it useful for navigation.

Privateer A ship and its crew members that are licensed by the government of one country to attack ships from an enemy country.



Rudder A device mounted near the stern of a vessel to control direction.

Sail An assemblage of cloth cut to various sizes and shapes (i.e., square and triangular), and designed to catch the wind and use its force to propel a vessel.

Scurvy A disease caused by a lack of vitamin C which is found mainly in fresh fruit and vegetables. Many sailors on long trips developed scurvy, as they did not have access to fresh food.

Spanish Main The Caribbean coast of South America, claimed by Spain.

Trade winds Strong easterly winds that blow from the northeast in the Northern Hemisphere and from the southeast in the Southern Hemisphere.

Whipstaff A vertical pole linked to the rudder and used to steer the ship.

Yard The pole on a mast that carries a sail.





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