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SHIPS & BOATS

From all ages and all parts of the world,
the fascinating story of craft under oar, sail, and power, and of the men who went to sea in them.
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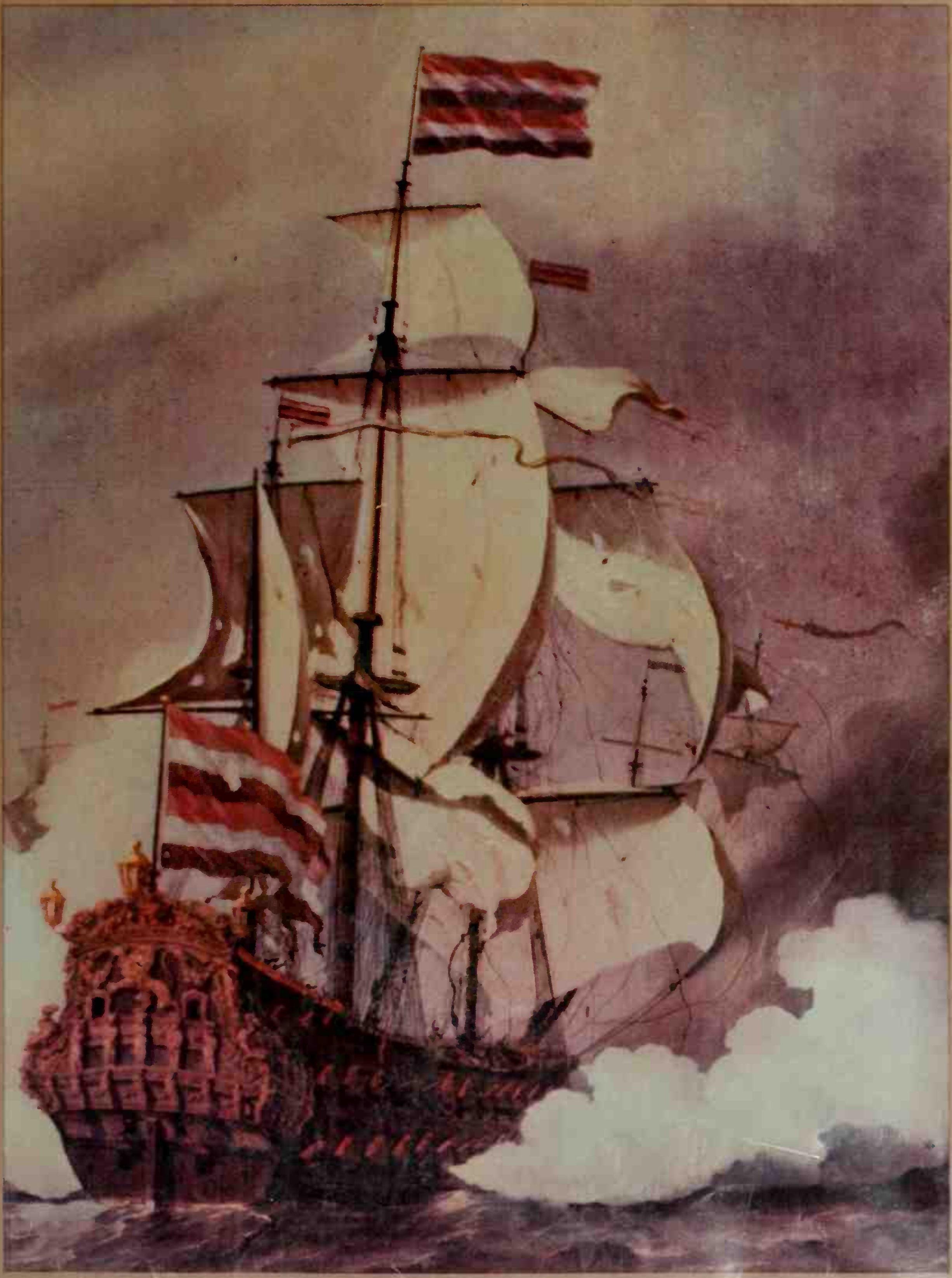
Lionel Casson



I.H.S.B.

Man has been devising watercraft since before the dawn of recorded history. From dugout canoe to nuclear submarine, here is a magnificent, 6000-year survey of nautical evolution.

ILLUSTRATED HISTORY OF

SHIPS & BOATS

Lionel Casson

Why does the Chinese junk, so cumbersome in appearance, have such fine sailing characteristics? How fast was the Yankee clipper, and how long did she reign after the advent of the ocean-crossing side-wheeler? Who mounted the first naval guns in turrets? What was life like aboard an Arab dhow or a French slave-galley? Why were Drake's English galleons superior to the towering, floating fortresses of the Spanish Armada? Where were the first iron-clad fighting vessels developed (centuries before the *Merrimack*)? What nation paid Robert Fulton *not* to make submarines? What was flank speed for the last of the giant 46,000-ton battlewagons?

These questions, and thousands of others, are answered in this stunningly illustrated, fascinating, chronological survey of man's watercraft down through the ages. The emphasis is on *why* and *how*: the

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ILLUSTRATED HISTORY OF SHIPS & BOATS

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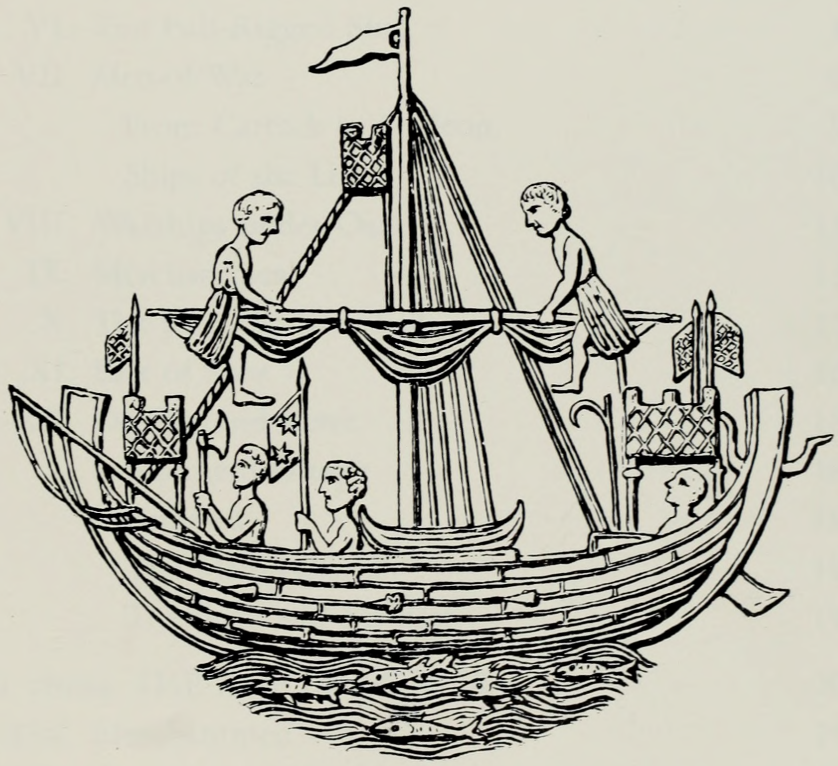
SHIPS & BOATS

By LIONEL CASSON



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CONTENTS

To Judy

PREFACE

This is the story of the myriad forms of conveyance men have devised for crossing water. In telling it, I have taken particular pains on two fronts. First, in order to provide not merely a chronicle of types but a coherent narrative, I have sketched in, wherever I could, the factors of history and technology and the conditions of geography that produced given craft at given times in given places. Second, in order not to drown the reader in the breakers of overtechnical discussion and language, I have concentrated as much as possible on what was critical and essential and passed by the details; moreover, for those aficionados of the sea who find the sailing man's jargon more or less an alien tongue, I have included (in Chapter One) a note on certain key nautical terms and introduced explanatory phrases for others throughout the text.

I have made the illustrations an integral part of the book; they are, as it were, interwoven with the text. And, in choosing them, one consideration was foremost: historical accuracy. I have kept hypothetical reconstructions to a minimum, including them only when convinced of their faithfulness or when nothing better was available. As often as I could I used pictures made by men who had seen with their own eyes what they drew or carved and, as soon as the narrative permitted, I turned to that most reliable of representations, the photograph.

Many organizations and people have helped me in many ways. I have plundered the resources of most of the important European and American museums, in particular the collections of the National Maritime Museum in London, the Musée de la Marine in Paris, the Peabody Museum in Salem, the Museo Storico Navale in Venice, the Scheepvaart Museum in Amsterdam. This book in a very real sense was made possible by the willing and expert cooperation of their staffs; I am especially grateful to Capitaine de Vaisseau Vichot and Capitaine de Frégate Javault of the Musée de la Marine, Mr. Marion Brewington and Mr. Osgood Williams of the Peabody Museum, and Mr. Howard Chapelle of the Smithsonian Institution. I must also thank the many curators who generously gave me carte blanche to photograph their treasures; the directors of the art galleries throughout Italy were particularly cooperative on this score. The Ministero della Marina of Italy kindly gave me free access to their fine library in Rome. Messrs. Leonard V. Huber, Frank A. Moorshead, Jr., J. S. Morrison, Richard Scheuer, Thorleif Sjövold, and Stanley Rosenfeld gave me invaluable aid in running down hard-to-get pictures or furnished them from their own collections. Captain Alan Villiers supplied some unique photographs and gave permission to quote from his inimitable writings on Arab seafaring. Dr. R. C. Anderson patiently answered a long list of questions. Many an important point I picked up during long talks with my good friend Mr. John Dusenbery, talks which often took place while happily cruising on his schooner *Nighthawk.* The text has received the rigorous going over that my father, whose severe critical eye countenances no excess in words or inaccuracy in language, gives to everything I write. To Joseph Ascherl, who brought to this book his skill as yachtsman as well as designer, go my thanks for solving the numerous knotty problems of layout and arrangement.

This book is fondly dedicated to my wife; she shared in every step of its creation, from the tramping of museum halls in search of illustrative material to the preparing of manuscript for the printer.

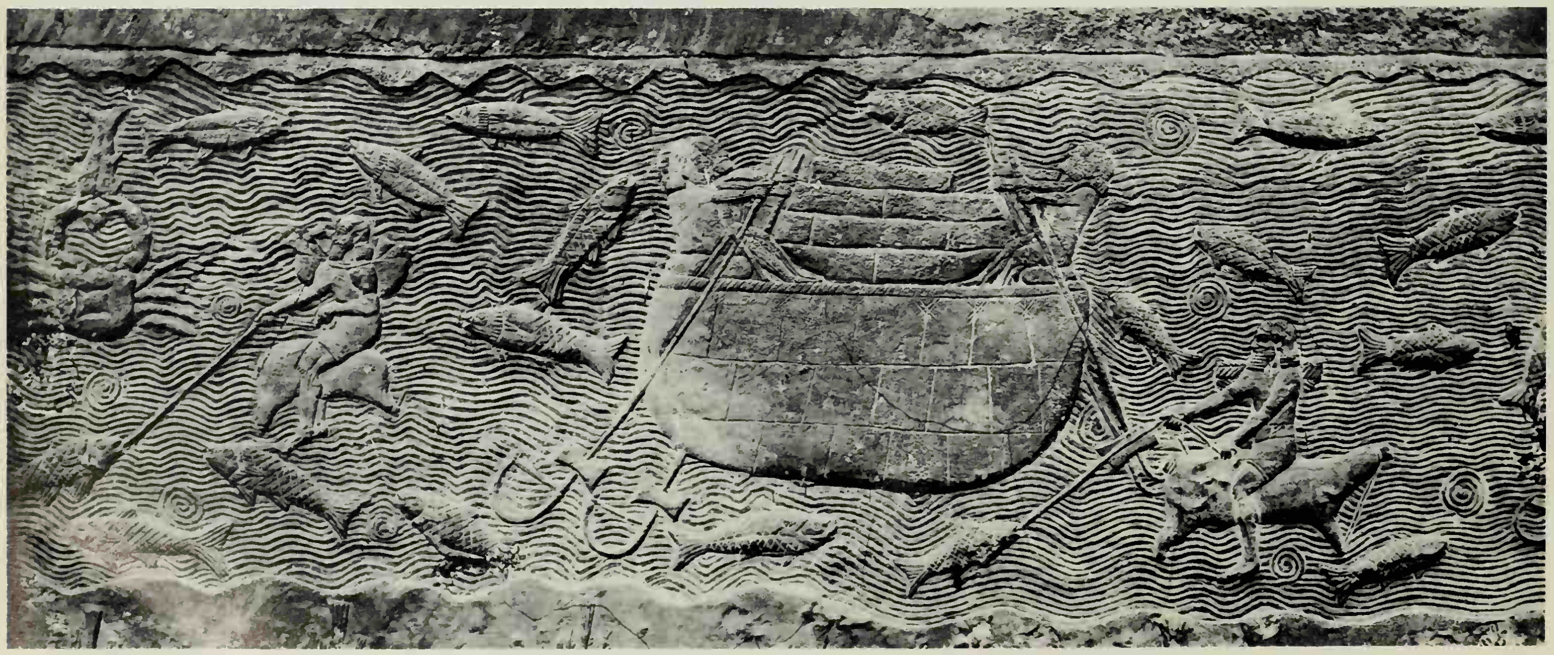
Part One

THE ANCIENT WORLD

1

1. Assyrian soldiers swimming on skin floats made of goat skins to the safety of a fortress. Ninth century B.C. soldiers were issued such skins as standard equipment. These two obviously had blown theirs up in a hurry, for they still have the mouthpiece between their lips.

2. An ancient Assyrian *quffa,* or large coracle, made of hides over a wooden frame. Early seventh century B.C. In the water two men are comfortably fishing—and very successfully—astride inflated skins.



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CHAPTER ONE

Birth of the Boat

AN IRAQI herdsman crosses streams on an inflated goat skin; a New Zealand aborigine stays afloat by straddling a bundle of reeds; a Tamil native does his fishing while drifting downstream with a log under his arms to keep him up, and a Sindhi does his while sailing along prone over a wide, open-mouthed pot. These, and others, were the ways in which men first took to the water: they went down not to the sea but to lakes and rivers, and not in boats but on anything that would float.

And then, from floats they progressed to boats, craft that would not only carry them across water but keep them dry in the process.

Men have always preferred wood as the material for their boats—at least until iron, plastic, fiber glass, and whatnot started to elbow it off the water. But wood isn't plentiful everywhere. Hiawatha, amid the forests of eastern America, had simply to take a few steps to the nearest tree. For the natives of scorching Iraq or barren Tibet or snowy Greenland, it wasn't that easy. They had to depend on whatever was available plus their ingenuity. This was especially true along the three great rivers where civilization first arose, the Tigris and Euphrates in Mesopotamia, and the Nile in Egypt.

In Mesopotamia, the natives found a most useful substitute in the skins of animals. Someone with imagination, observing his fellows riding about on inflated skins, was sooner or later bound to figure out that, if one float could hold up one rider, a number of them should be able to hold up a platform carrying several riders—and so there came into being the buoyed raft, on which men have sailed the Tigris and Euphrates from time immemorial. They still do today. Primitive though it may be, the buoyed raft is ideal for floating down the swift upper waters where stony rapids are frequent; an all-wood craft would be smashed to bits on the rocks, but a platform held up by a dozen or so inflated skins just gets a few blowouts which can be repaired in short order. Moreover, when the raftsmen want to get back home, they don't have to fight their way against the current—they simply sell the platform for the wood in it, deflate the skins, load them on a donkey which they had mindfully taken aboard at the outset, and leisurely walk back. Until a few years ago, there were rafts on the rivers all of fifty feet square and kept afloat by as many as a thousand skin bladders.

The primitive Mesopotamian in this way substituted skins for logs. He also substituted them for planking—he stretched them over a frame to form a light but serviceable craft. The version he built was the simplest form of skin boat, the coracle. Coracles, as we know them today from various more or less remote parts of the world, are cockleshells, generally saucer- or bowl-shaped but sometimes square or oblong, intended for one or two or three people. On the Tigris and Euphrates, they were used at an early date to handle the busy crossriver traffic in the smooth-flowing lower reaches and, as time went on, grew until they reached enormous size. The *quffas* of modern Iraq, which are lineal descendants of the ancient Mesopotamian coracle, run up to thirteen feet in diameter with a depth of over seven feet and can take as much as two tons of cargo; there's every reason to think that they were just as big ages ago. Quffas are made of basketry waterproofed by a coating of bitumen, not of hides as their forefathers were.

Skin-clad coracles have had a long life thanks to their lightness. The hunter who has to portage his craft from lake to lake, the nomad who must cross streams during his wanderings, the peasant who needs to get over a swift river where the current will carry him far downstream from his destination no matter what he uses—such people found these cockleshells well suited to their needs. In Britain they were in use from prehistoric times until very recently, when the inflated rubber boat and similar modern sophistications gave them the *coup de grâce;* they are still to be found in remote parts of Asia and South America.

But the use of skins as a substitute for planking didn't stop with the coracle. Certain peoples learned to stretch them over boat-shaped frames to produce the ancestors of our modern canvas-covered craft. The natives of western Ireland, forced to make a living from the ocean and having little wood available, created their famous hide-covered seagoing curraghs, which in bygone times were perhaps large enough to hold twenty people (today they run only about twenty feet long, and the hides have given way to canvas). The Eskimos, needing a craft for hunting whales, devised the umiak, a double-ended boat covered with sealskin or walrus hide, thirty feet long and five to six wide, and driven by a dozen rowers helped, when the wind was fair, by a large square sail. Now that Europeans have brought in wooden boats, the umiak has been contemptuously handed over to the women, but the men still use, even today, another skin-covered craft specifically developed for their special needs—their sealskin, made-to-measure kayaks.

In some areas, ingenious builders even came up with a substitute for a substitute: clay pots instead of animal skins. A row of little pots could buoy up a raft just as well as skins, and at a fraction of the cost; a big pot made a convenient one-man boat—and a potter could turn it out in far less time and for far less money than a tanner could the materials for a coracle. This meant a great deal in, e.g., areas that suffered from annual inundation, where even the daily marketing involved moving over water. Of course, pot craft are limited strictly to places completely free of rocks. In ancient times they were used for crossing the muddy streams and canals of the Nile delta; today they are still found in remote parts of India.

Along all three of the great rivers that cradled civilization, men early found another useful substitute, besides skins, for wood: reeds. This was particularly true in the land of the Nile, where the papyrus plant—the celebrated bullrushes that sheltered baby Moses—once grew in profusion. It couldn't have taken the ancient Egyptian long to progress from a single bundle, which he straddled as a float, to a platform made up of a number of them on which he stood or sat. Eventually he learned to lash the bundles to each other so expertly that he was able to give his craft a pleasing spoonlike shape. These graceful reed rafts were his standard conveyance for gliding through the Nile's ubiquitous marshes or for crossing the flooded fields during its yearly overflow.

Illustration 12, p. 18

Illustration 13, p. 18

Like the coracle, the reed raft too has had a long life, though it owes this to its cheap-

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3. Hercules on a raft buoyed by pot floats. Sixth century B.C. In the picture on the right he is shown holding his traditional club and bow.

4. Hercules sails to the Garden of the Hesperides in a pot coracle. About 480 B.C.

5. A party of Wuzurees, a hill tribe of the Punjab, crossing the Indus in 1864 in pot coracles.

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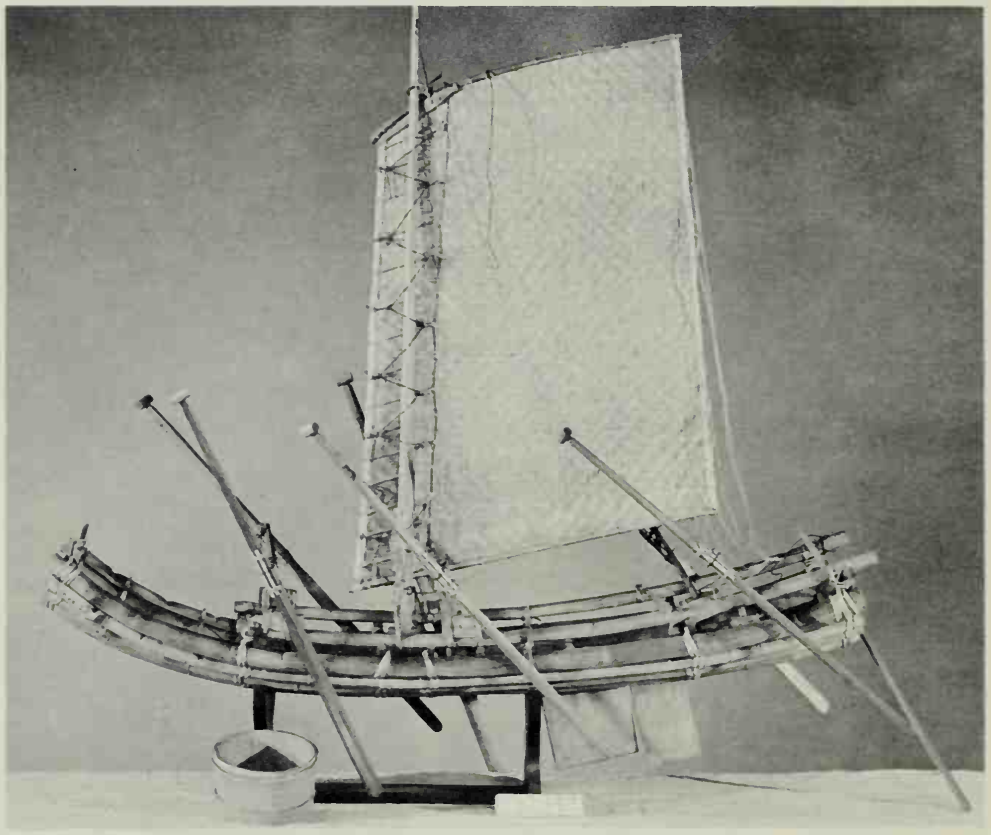

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ness rather than any natural advantages, since the bundles get waterlogged within a few months. In Africa, South America, and even parts of Europe, it is still in use. Nor is it necessarily small—the rafts used by Abyssinian natives today to transport coffee are thirty-five feet long and seven across, and can carry seven thousand pounds.

Skins, pots, reeds—they all have been, by and large, substitutes for wood. Where trees grew, primitive sailors turned to them first.

From a single log that a man sat astride or clung to, it was an easy step to a platform of several bound together. The wood raft, from this simple beginning, has grown in certain areas into a very sophisticated conveyance. The catamarans—shaped rafts—of India and China, for example, are a far cry from a mere platform of lashed logs: they have a distinct prow and stern, curved lines, mast and sail, adjustable centerboards, wash strakes building up the sides, and so on. Those used by the fishermen of the Coromandel Coast, who have to go up to twenty-five miles offshore to find the flying fish they hunt, can keep a seven-man crew at sea for two to three days. Explorers have left descriptions of Polynesian catamarans that ran from forty to fifty feet long and could carry upwards of twenty people, and the Polynesians' spectacular voyages over thousands of miles of open water to such farflung places as Hawaii were probably made, like the well-publicized journey of Thor Heyerdahl's *Kon-Tiki,* in big sailing rafts.

Although catamarans have many of the characteristics of a boat, the primitive crafts nearest to a true boat are the canoe, the bark canoe, and the dugout. The earliest bark canoes were nothing more than a chance piece of the proper shape stopped at the ends with chunks of clay. From this, canoe-builders graduated to steaming the pieces into the required shape and, eventually, to lacing the ends and adding ribs and thwarts and other helpful inside fittings. The dugout-builders started simply with a hollowed half-cylinder, its ends plugged with clay. From this they graduated to shaping the trunk, more or less proficiently; where trees of good size were available, some dugout-makers turned out such impressive productions as the great Maori war canoes. In one particular area, a line from Indonesia to New Guinea, sailors learned to steady their dugouts by adding an outrigger on either side, and thereby triggered a widespread and important development (p. 208).

Compare Illustration 250, p. 206

And some learned, too, to raise their dugouts' sides with wash strakes. This brings us very close to the planked boat—and with the planked boat we are out of the infant stage and into the growing-up days of water craft.

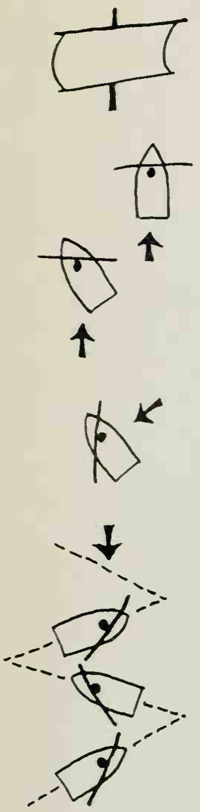
Compare Illustration 252, p. 206

6. Assyrian soldiers hunt down enemies in the marshes at the mouth of the Tigris and Euphrates using reed boats. Eighth century B.C.

7. Model of a seagoing sailing raft made of curved bamboo poles used by the Chinese of Formosa. Rafts such as these can be thirty to thirty-five feet long and seven to ten wide and carry a crew of three. The planks thrust down between the poles of the floor make effective centerboards.

8. Two big dugouts of oak, one about 46 feet long and the other about 41½, found in the vicinity of Ferrara, Italy. Both date from the later centuries of the Roman Empire, the fourth and fifth A.D. It was not unusual for primitive boats to linger on in highly civilized areas.

ON SAILS AND SAILING



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The first sail used was undoubtedly the square sail, a rectangle of cloth (or matting or whatever else was available) against which the wind pushed from behind. This enabled a boatman to go either in the direction toward which the wind was blowing or, by a slight shift in the angle of his sail, a little to the right or left of that direction.

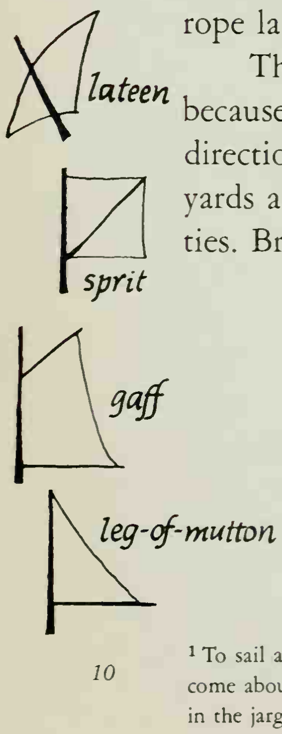
The real problem arose when he wanted to go "into the wind," i.e., in the direction *from* which the wind was blowing. Now, it's impossible for sailboats to go right into the eye of the wind. They can, however, make some headway against the wind by going at an angle to it. And, by "tacking," i.e., pursuing a zigzag course which angles from one side of the wind to the other,[1] they can in a slow and indirect way eventually attain a destination which lies to windward. Sailors try to avoid this if they're able, but it can be done.

Now, the square rig, though probably the best of all with a wind from behind, was not too efficient when sailing into the wind (at least not until the scientific developments of the nineteenth century) since it never permitted an angle much closer than 80°; and obviously, the closer the angle, the shorter the course will be and the quicker the voyage will be over. In order to better the angle, boatmen turned to the "fore-and-aft" rig, one in which the sails lie not athwartship, as square sails do, but in the fore and aft line of the craft. Over the centuries they worked out four chief versions of it, the lateen, the sprit, the gaff, and the leg-of-mutton (or marconi, as it is often called today).

A mast with its sail requires a complex of lines.

Some lines, once set up, more or less stay that way; these make up the standing rigging, as it is called, and chief among them are the lines which support the mast in all four directions: the forestay from the front, the backstay from the rear, and the shrouds on either side. In larger ships of certain types, short cords (ratlines) were laid across the shrouds to form a rope ladder for going aloft.

The other lines, used for controlling the sail, make up the running rigging, so called because the lines are constantly being run out or hauled in for changes in course, wind direction, and so on. Chief among these are the halyards, the sheets, and the braces. Halyards are for hauling sails up into position, and sheets for controlling their lower extremities. Braces, made fast to the ends of a square sail's yard, control its lateral adjustment.



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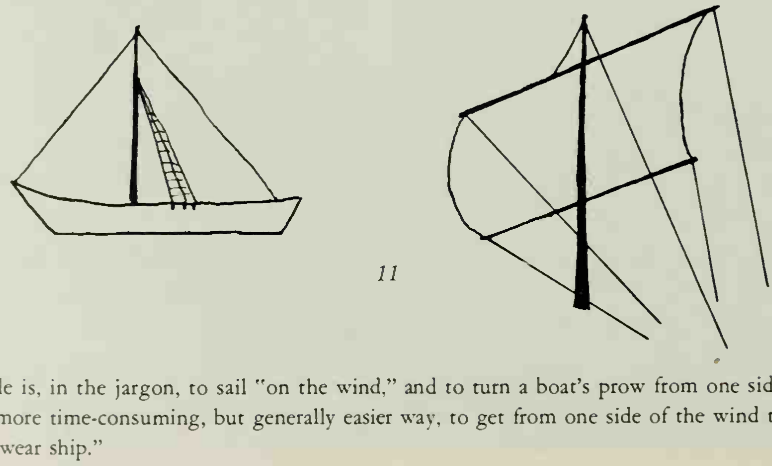

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[1] To sail at such an angle is, in the jargon, to sail "on the wind," and to turn a boat's prow from one side of the wind to the other is "to come about." Another, more time-consuming, but generally easier way, to get from one side of the wind to the other is to do it stern-first; in the jargon this is "to wear ship."

CHAPTER TWO

Egypt

EGYPT'S Nile is a most accommodating waterway. Not only does it stretch conveniently from one end of the country to the other, but nature was kind enough to bestow on it a prevailing wind (northwest) that blows against the flow: a boat can travel downstream with the current and, to get back, hoist sail and be wafted home.

And so, as we would expect, watercraft have played a varied and important role in the life of Egypt. In her ancient tombs, the source of so much information about her past, archaeologists have found pictures galore, even occasional miniature models, of humble reed skiffs, pushed by paddles or punts, nosing through marshes and canals, or of larger boats of wood, some carrying passengers and others freight, sailing up or being rowed down the Nile's main stream; we even catch an occasional glimpse of the seagoing vessels that traveled the length of the Red Sea for incense from Arabia and ivory from Somali, or headed up the Palestinian coast for timber and wine from Syria.

It is Egypt, in fact, that has provided the earliest undisputed picture of a sail. We don't know who deserves the credit for the epoch-making idea of stretching something out in front of the wind and letting it, instead of muscle, do the work of moving a boat, but the oldest record of the invention found so far comes from the hand of an Egyptian potter who, sometime around 3000 B.C., fired a vase with a picture of a sailing ship on it. What he shows—a handkerchief-sized square sail set far up in the bows of an elongated craft—couldn't have been very efficient. However, from a wealth of pictures and models that date only a few centuries or so later, we can see that Egypt's riggers and boatwrights both learned fast.

By about 2600 B.C., river and seagoing vessels were carrying no handkerchief but an ample tall and slender square sail which had a yard along the head and—a typically Egyptian feature—another at the bottom to spread the foot. The mast was of an unusual type, a two-legged affair that straddled the vessel and was supported by a forestay and a welter of backstays. Mast and sail were still set far forward; the rig was obviously intended only for running with the wind dead aft or slightly over the quarter, and at all other times the mast was lowered and the crew ran out the oars. These were worked with a stroke much like that used on the great galleys of later ages (Chapter Eight): the oarsmen, instead of remaining seated, rose to their feet to gain height as they plunged the blade into the water and then threw themselves back on the bench with the pull; Egyptian artists, with an observing eye for homely detail, occasionally show that each rower had a leather patch sewn to the seat of his loincloth as chafing gear. The helm consisted, as it was to for nearly the next four thousand years, of large steering oars on the quarters. The hulls had a graceful spoonlike form with fine curves and long overhangs fore and aft; they give

Compare Illustration 92, p. 75

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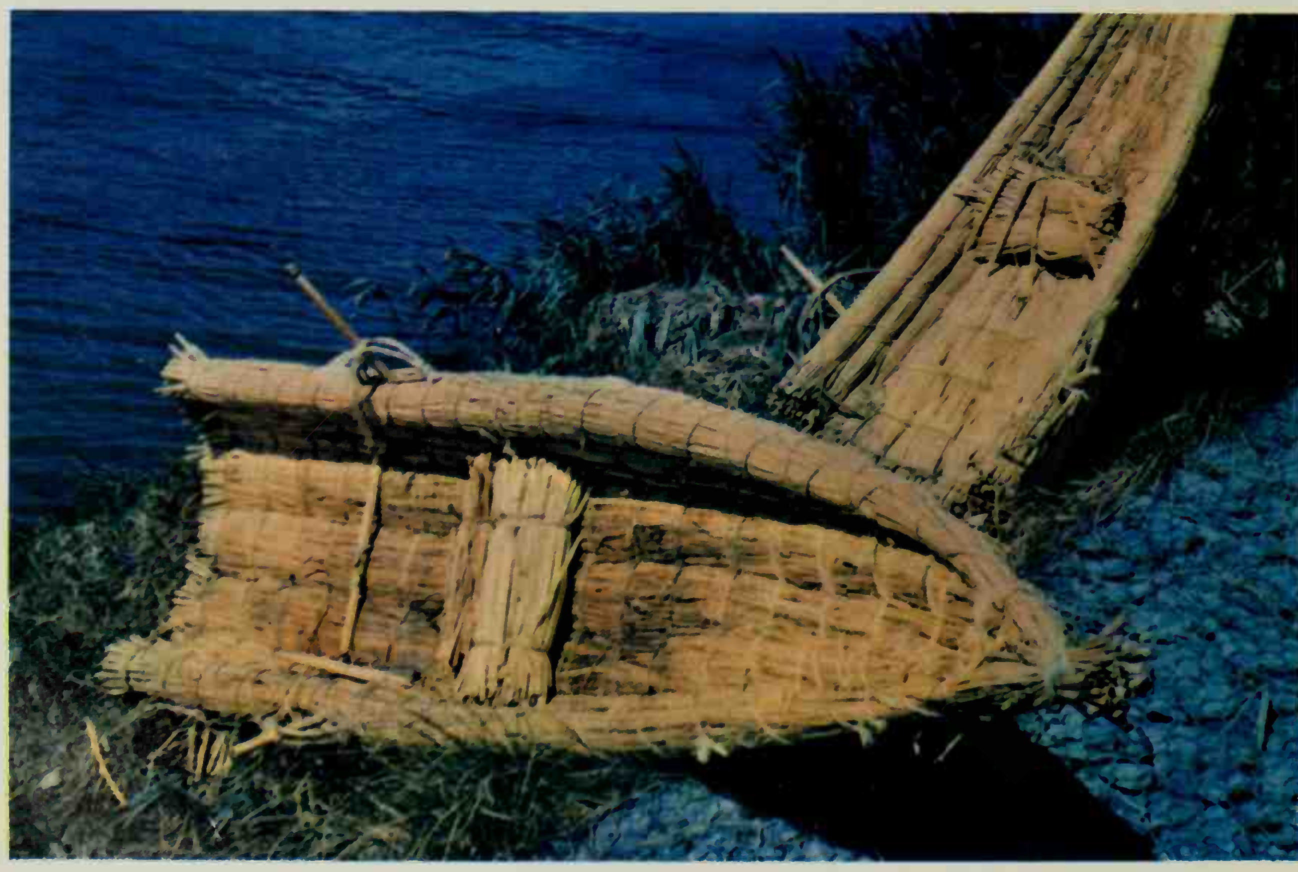

12. Fresco of about 1400 B.C. showing an Egyptian noble standing on a reed raft as he hunts birds with a boomerang in the marshes. *See page 12.*

13. Modern reed boats used on a salt lake near Oristano in Sardinia. *See page 12.*

14

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14, 15. The earliest examples of sails: Nile boats painted on Egyptian pots of about 3000 B.C. The one on the left is being rowed—and the artist has been lavish with his oars—and has two cabins amidships; the other has but one, placed near the sternsheets.

16. Sailors lowering (or raising) the mast of a river boat of about 2500 B.C.

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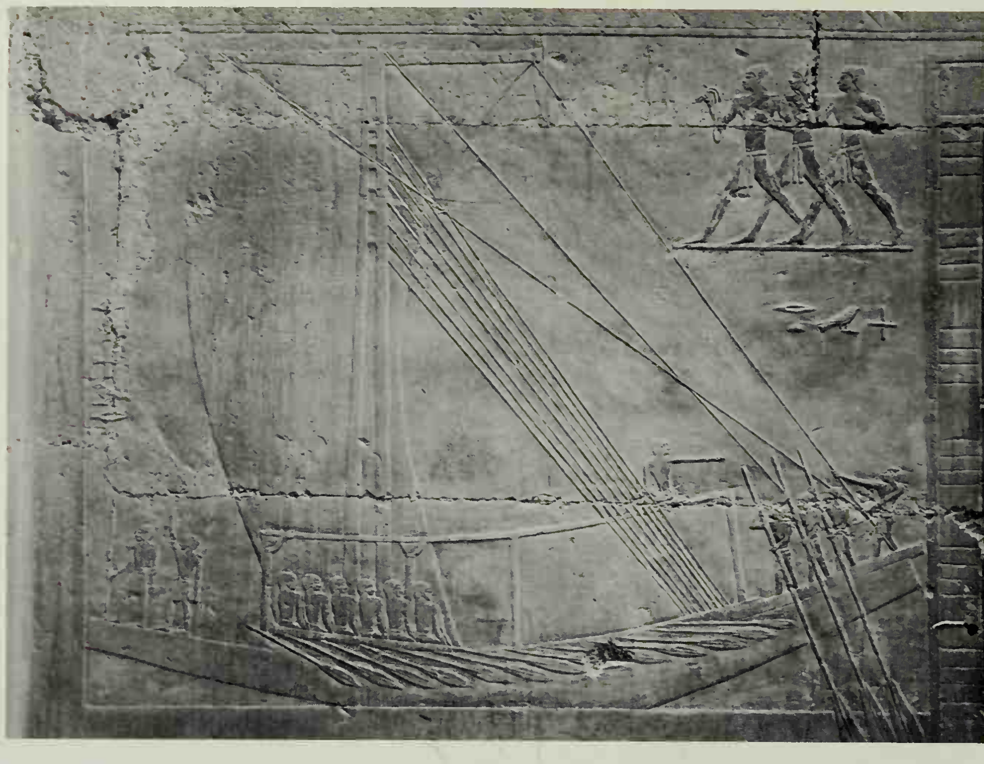

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17. A large river boat of about 2500 B.C. The tall, slender square sail, designed to reach above the banks and pick up the free-flowing breezes there, is set on a bipod mast supported by a network of stays running aft.

18. Seagoing ships of about 2550 B.C. The vessels are entering port and the crews are lowering the masts into the crutches. Each boat has a massive rope truss that loops about the ends and keeps them from drooping.

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19. A model, made about 2000 B.C., of a river boat being paddled. The wooden hull has the spoonlike shape of the standard Egyptian reed boats, and, like them, ends in a rounded stem and stern finished off to resemble a lotus flower.

the impression of having been modeled on the traditional light reed skiff. And they were put together in a very special way.

Generally speaking, in Egypt, Arabia, Persia, India, and other parts of Asia, the shipwrights' traditional method of constructing a hull has been just the opposite of the method we are used to in the West. Instead of starting with a skeleton of keel and frames and then wrapping a skin of planks around this, once they have laid a keel and added a stem- and sternpost at each end, their very next step is to build up the skin. Since there are no frames to pin the planks to, they make each fast to its neighbors by means of pegs, joints, or nails, or—a favored method of the Arabs and Persians in particular—they sew the planks together with twine. Only after the shell has been completely built up in this fashion do they insert a certain number of frames, generally minimal, to provide additional strength. A hull so made doesn't have the strength of one stiffened by a sturdy inner skeleton, and this is why, after 1500 when the Portuguese brought Western-style methods into the area, shipwrights by and large abandoned the traditional technique in their seagoing vessels, though they continued to use it for small craft and still do today in a few remote areas.

Compare Illustration 237, p. 199

Compare Illustration 188, p. 166

The ancient Egyptians, too, used the shell-first system but they had a variation all their own. In the Nile Valley lumber has always been in short supply; the one variety available locally is acacia and, besides being scarce, its wood is hard, brittle, and comes in only short lengths. So the Egyptian boatwright in most cases didn't even bother with a keel or stem- and sternposts: he made his whole craft out of very short pieces of plank, fastening one to the other with mortises and tenons or dovetails or both; Herodotus, the keen-eyed Greek traveler who visited Egypt in the fifth century B.C., likens boatwrights putting a hull together to masons laying bricks. This mode of construction explains the bipod mast: it

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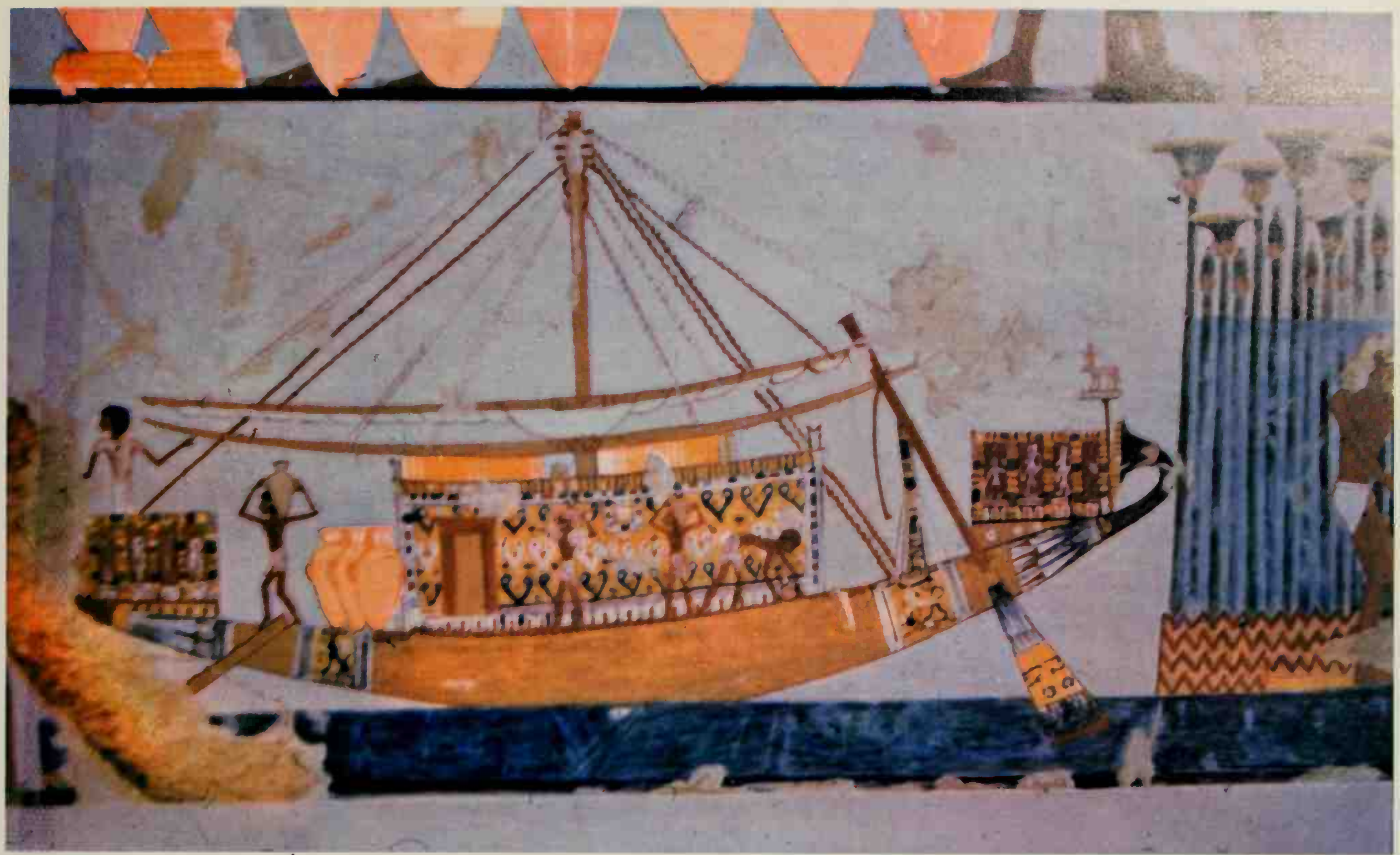
20. Egyptian shipwrights at work, about 2000 B.C. The lengths of planking, so short and narrow that they look like bricks, are made fast to each other. The men create the boat's lines by adzing each plank into the proper curves before they fit it.

21. Egyptian shipwrights completing a boat, about 2500 B.C. These men are lucky enough to have long lengths to work with. In the upper panel, two men are pounding a plank to drive home the joints or dowels that pin it to its neighbor below, while a third holds a wedge in the seam to make sure the plank eases into place without doing damage. Other workers smooth down the underside of the hull with adzes. Lower panel: left, a gang is preparing to fit a bulwark plank into place; center, one man is sawing a log lengthwise; right, two others are splitting a log.



22. A river boat of about 1450 B.C. By now the bipod mast has given way to a pole, and the tall sail to a broader one, which is carried high to catch the upper breezes. 22

distributed the thrust evenly to the two sides and hence was preferable to a single pole which, with no keel to be stepped in, might have dug its heel through the frail bottom planks. The last step in putting a hull together was to install, just below the gunwale, a series of thwarts, which were often extended right through the sides; these kept the hull from spreading laterally and, on larger craft, served as beams for a deck.

Boats so built were fine for a river; sturdier stuff was needed for the open water. Seagoing ships very likely from the first had some sort of keel and at least a minimal amount of framing; yet it apparently wasn't enough to keep the long overhangs fore and aft from drooping, particularly when battered by rough seas. The Egyptians solved the problem with a most ingenious device—a rope truss. They looped a heavy cable about the bows, carried it over the deck on upright forked sticks to the poop, and looped it about the stern. A lever thrust in between the strands enabled the crew to twist the cable like a tourniquet, and by twisting and twisting they were able to bring it to just the proper tension to keep bow and stern from sagging.

The two-legged masts and tall sails set forward of amidships lasted until about 2000 B.C. From then on hulls were made sturdy enough to take a single pole, and it was stepped amidships where its performance must have been vastly improved. The tall and slender sail, a nuisance to raise or set or take in, gave way to one which was broader than high; not only must it have been a good deal easier to handle but it required a lot shorter mast with simpler staying.

One of history's first great queens was Hatshepsut, who ruled Egypt about 1500 B.C. She built for herself a vast tomb and covered the walls with a graphic account of her achievements, including one she was particularly proud of, the reopening of the old Red Sea

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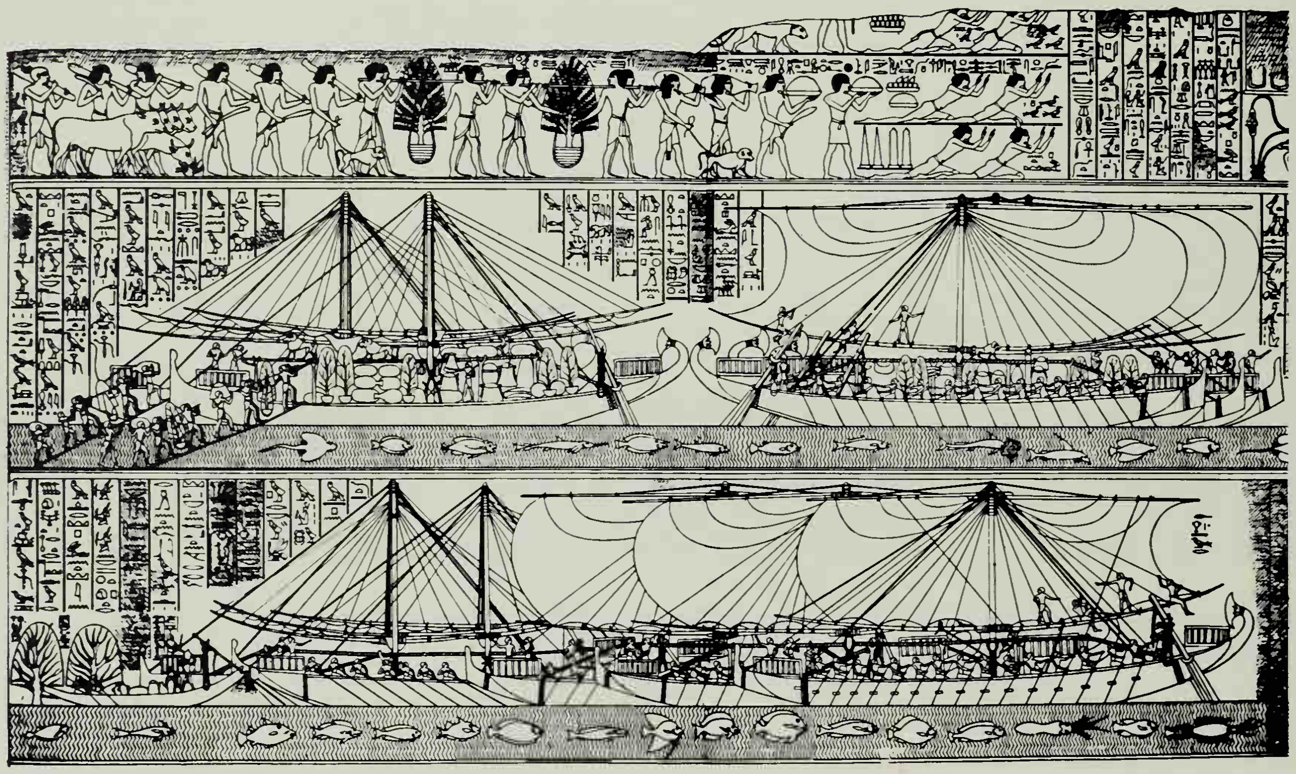

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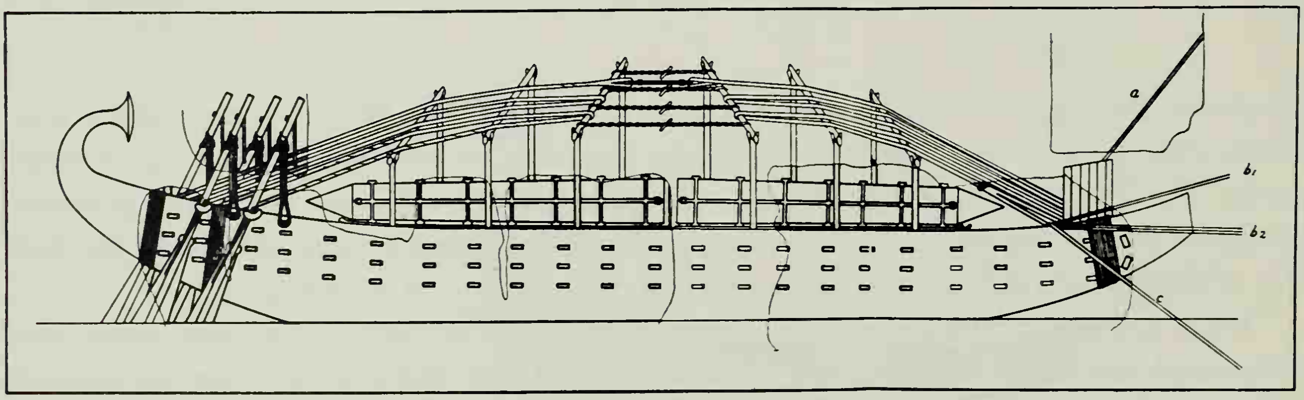

23. The ships of Hatshepsut's expedition to the spice lands, about 1500 B.C. The lowermost panel shows the ships arriving; the first two have already moored and furled sail by dropping the upper yard to the lower. The middle panel shows one ship already under way for the return fully loaded and two others still taking on cargo. The freight includes incense trees for transplanting and, as the uppermost panel shows, cattle and pet monkeys. The series of rectangles in the hull of the ship on the lower right represent the ends of the deck beams, which pass right through the side.

24. A possible reconstruction of the great barge that took Hatshepsut's obelisks down the Nile. The cables leading forward are the towropes, *b1* and *b2* leading to a line of tows in the center, and *a* and *c* to a line of tows to port and starboard.

trading route. She had it illustrated with reliefs showing the expedition, and these constitute a key document in the story of Egyptian shipping, for the craft pictured there surely represent the highwater mark of Egyptian boatbuilding. Though seagoing craft of some size (we can only estimate their dimensions; ninety feet long and twenty-five wide is as good a guess as any), they have the traditional graceful spoonlike shape and were built in the traditional manner with the anti-sagging truss. Each carries an immensely broad square sail spread, in the Egyptian manner, at both head and foot by slender yards, which are supported by a veritable web of lifts. These ships must have been fast downwind, although, like all Egyptian craft, their performance was probably not especially good on any other point of sailing.

There is another impressive achievement of marine architecture recorded on Hatshepsut's tomb. The queen had set up at Karnak (where they still stand) two enormous obelisks, each just under one hundred feet in length and about three hundred and seventy tons in weight. Since they were quarried out of the granite of Assuan, 120-odd miles up the river, they had to be brought down by water, and Hatshepsut, to commemorate the event, had her artists carve a picture of the brobdingnagian barge used for the operation. On her seagoing ships only one truss had been needed and only one line of thwarts held up the deck; this monster, which carried seven hundred and forty tons on its deck, needed three levels of thwarts (with, no doubt, a series of uprights running from one level to the other to distribute the weight) and there is a whole intricate network of trusses. The towing was done by no less than thirty rowed "tugboats." We know from Egyptian records that, for two smaller obelisks weighing half as much, a barge two hundred and seven feet long and sixty-nine wide was used; the one pictured would be even bigger. The river must have seen a good many of these giants, for numbers of other obelisks as well as mighty blocks of granite used for monumental statues and architectural members had to come by water from the quarries at Assuan.

The last pictures we have of Egyptian seagoing vessels date from about 1200 B.C., and by this time significant changes have taken place. The rope trusses are gone, and the sails have lost their spreaders along the foot; they are now loose-footed as square sails traditionally are. It looks as if the Egyptian shipwright had learned a new thing or two. The most likely source would be his neighbors—and it is, therefore, to their story that we must now turn.

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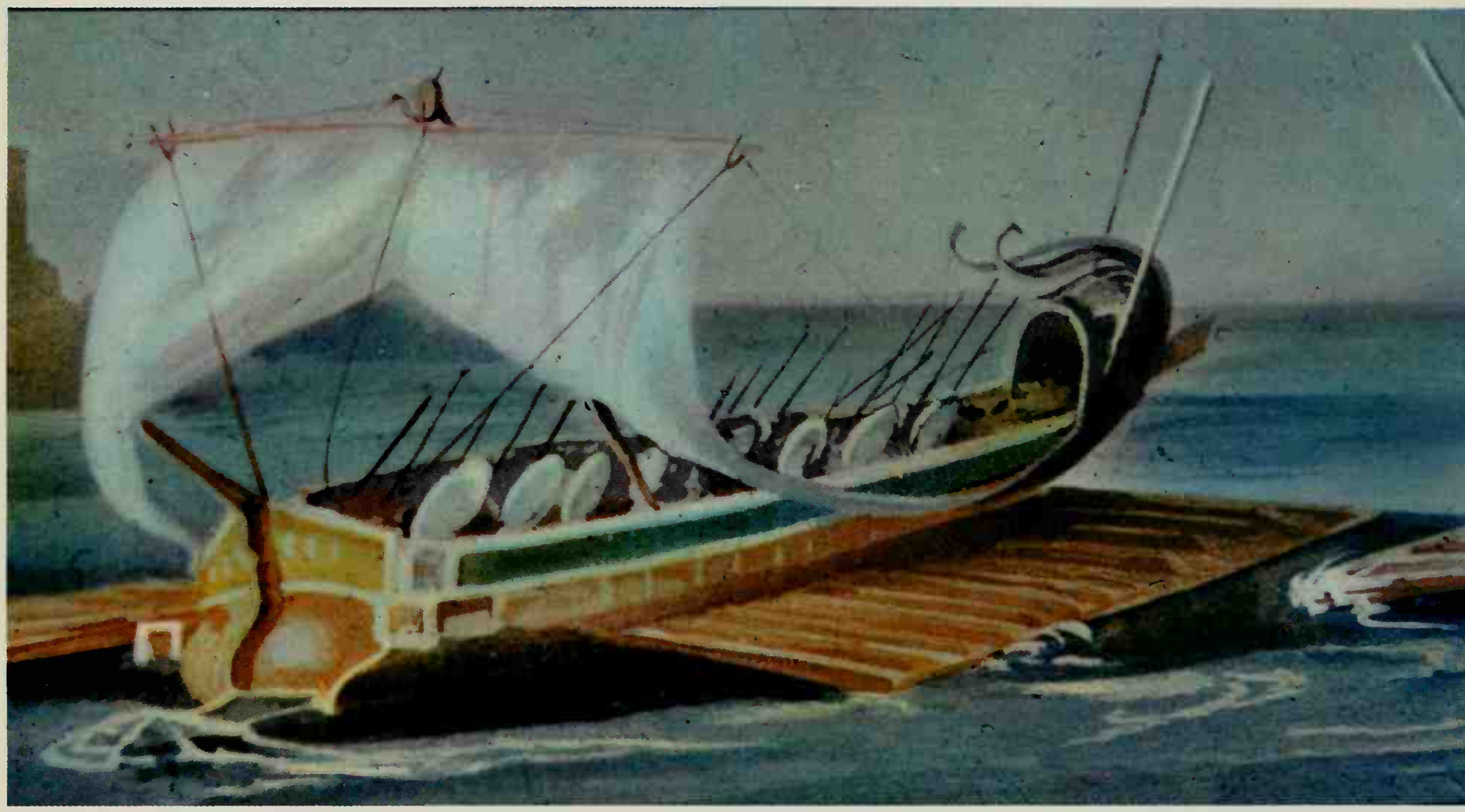


50. Warship, probably Liburnian, of the first century A.D. *See page 41.*

CHAPTER THREE

Greece and Rome: Warships

DURING the centuries that the pharaohs were sending their ships down the Red Sea or along the Palestinian coast, a maritime people living on the island of Crete in the center of the eastern Mediterranean gradually came to the fore.

They are a shadowy race whose history is known only through the impressive remains that archaeologists have uncovered of their cities. Though the Cretans can be traced as far back as the third millennium B.C., they didn't hit their stride until about 2000 B.C., when they emerge as an important sea power, sending their ships across the water to Egypt, Asia Minor, Greece, and even Sicily. However, about this same time, the people who were later to be known to history as the Greeks moved into the peninsula of Greece and, settling at likely points along the coast, took to the sea themselves. A clash was inevitable. The Greeks eventually won out and, from about 1500 B.C. until the emerging of Rome some thirteen hundred years later, lorded it over the eastern Mediterranean.

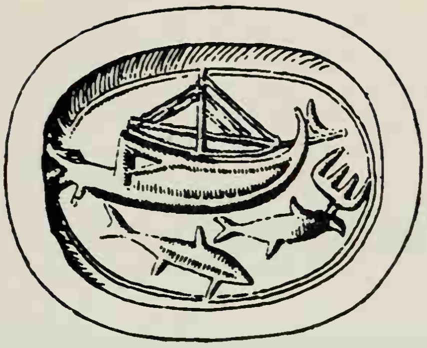
We know exasperatingly little about the ships either side used. All we have to go on are a few tiny carvings on gems and seals and some rough, schematic drawings on pottery; they reveal no more than that merchantmen were round-bellied, single-masted sailing craft, and warships low, swift, many-oared galleys. It's only when we come down to about 1200 B.C., after Crete had long been driven from the seas and the conquerors themselves had degenerated from maritime traders to piratical raiders, that Homer's great poems suddenly turn a light on in the darkness. For, though he himself lived many centuries later, the loot-hungry sea-rovers he sang of belonged to this age.

Homer's heroes sailed to the shores of Troy in light, open galleys manned by a single line of rowers; the standard craft had ten men on each side, some larger types twenty-five. No strictly naval weapons were carried; these vessels were intended for landing a boarding party on the deck of a freighter or a raiding party on an unwary town that offered rich pickings, not for fighting other ships. The men worked the oars only when absolutely necessary; most of the time they stepped the mast, raised sail (a large square sail), and let the wind do the work. Our only clue to how Homer's galleys may actually have looked comes from some rare, sketchily drawn pictures on vases. One, done probably sometime in the twelfth century B.C., shows a vessel that nicely fits the details gleaned from the poet: it has a large square sail stepped amidships, and the hull, long and low, is obviously built for speed. The prow, however, rises abruptly from the keel without curve whereas Homer, in a vivid figure of speech, often likens the shape of his ships to the horns of cattle. But another picture on a vase of about the same time or perhaps a bit earlier shows a bow profile that neatly suits the poet's phrase.

Illustration 28, p. 29

Illustration 29, p. 29

These swift, open craft served the Greeks very well so long as their activity was limited to piracy and raiding. But then, sometime between 1200 and 900 B.C., peace and



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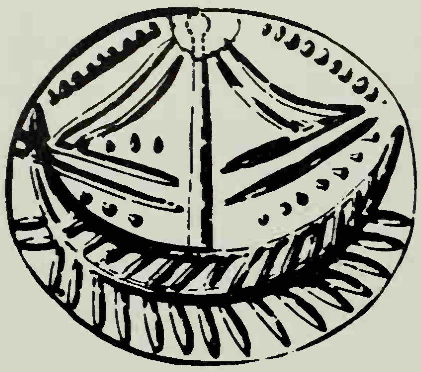

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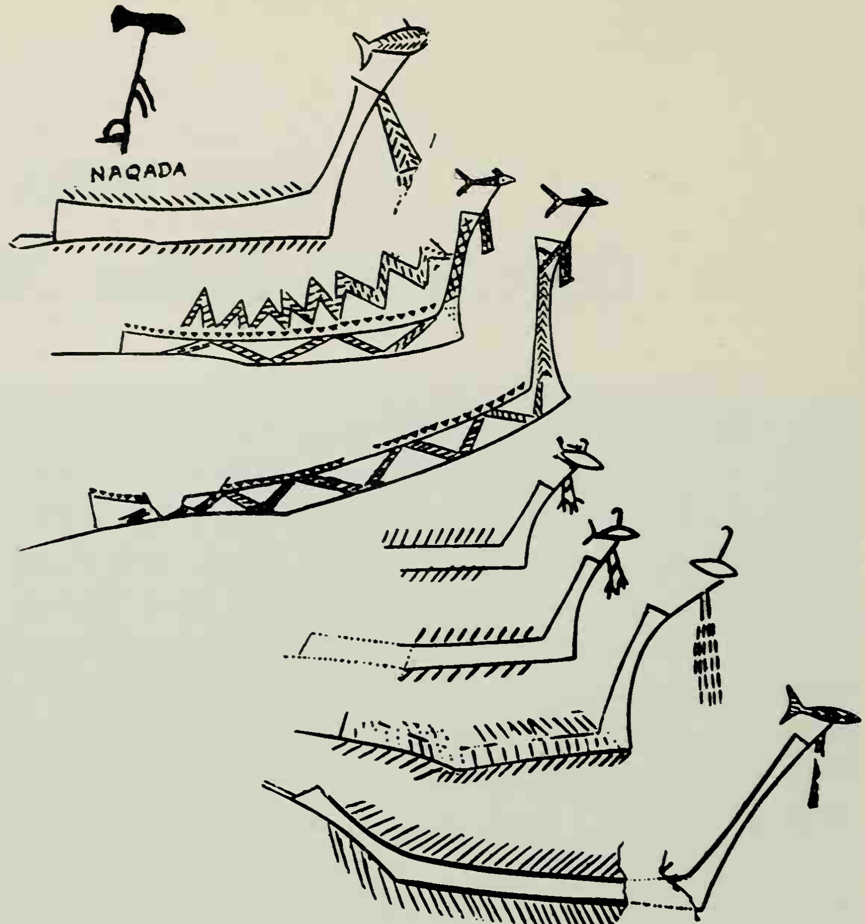

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25. Merchantman on a Cretan seal of about 2000 B.C. The high end is the prow.

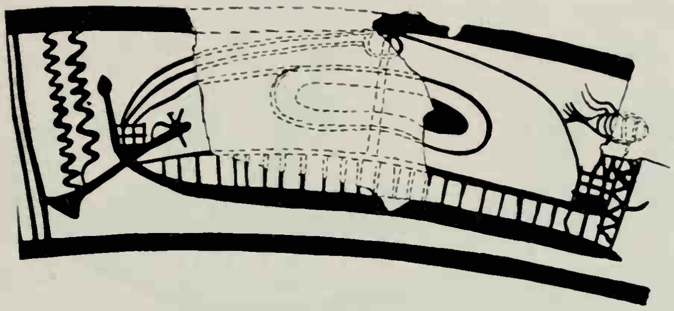
26. Galley on a Cretan seal of about 1600 B.C.

27. Warships of about 2000 B.C., drawn on the backs of mirrors found on Syros in the Cyclades.

legitimate seaborne commerce finally returned to the Mediterranean. Greeks and those businessmen par excellence of the ancient world, the Phoenicians, began to send cargoes the length and breadth of the sea. Maritime states, interested in building up their navies, wanted something more than a raider's galley. So shipbuilders began experimenting and, by the ninth century B.C., were taking the first steps toward creating the vessel that was to serve as the standard ship of the line for the next thousand years. A revolution in design was carried out, every bit as sweeping in its day as the mounting of guns on shipboard in the fourteenth century or the introduction of ironclads in the nineteenth.

As in the case of so many other key changes in the ancient world, there are no written records to tell how this one took place. But its course can be followed thanks to the Greeks' characteristic of insisting on artistic and interesting decoration for his pottery—whether used for holding his ancestor's ashes or carrying slops. The vase painters of this naval-minded age included among the scenes they favored pictures of vessels in action, some drawn with exquisite care.

The very earliest, painted probably between 850 and 800 B.C., shows that a new type of warship had already come into existence. It's clearly the offspring of those of Homer's day and before, for it has the high, rounded stern and straight prow of the earlier craft, and the



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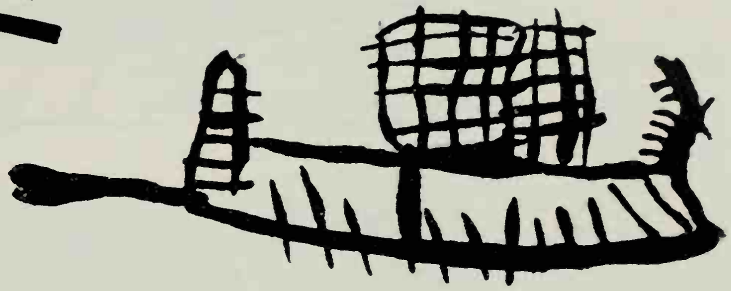

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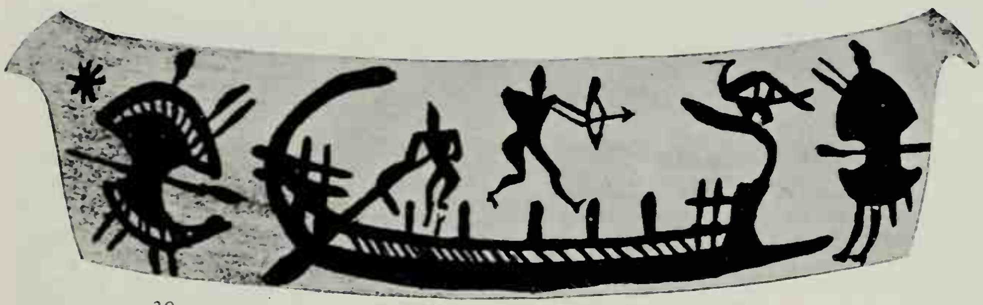

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AEGEAN WARSHIPS, 1200–800 B.C.

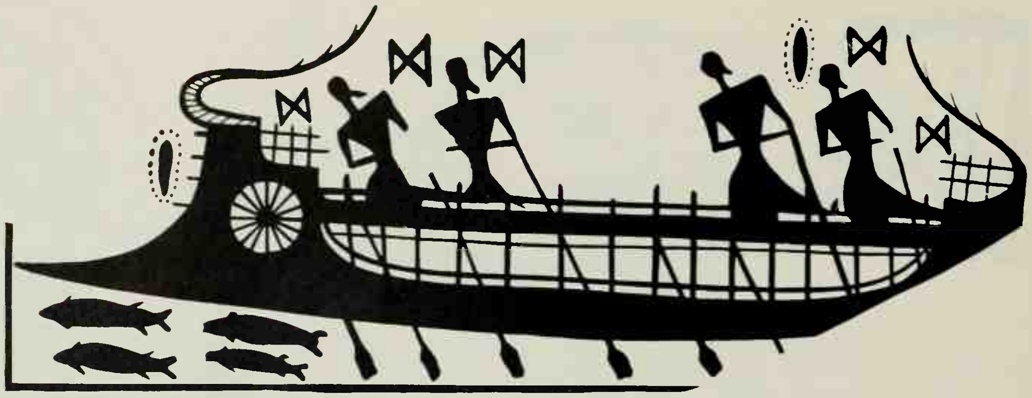
28. Galley of about 1200–1100 B.C., probably fifty-oared, on a cylindrical clay box found at Pylos.

29. Galley of about 1200–1100 B.C. on a vase found at Asine.

30. Galley of about 850–800 B.C. on a cup found at Eleusis (on the original the ship faces left).

two give the "horned" effect that Homer had noted. But a revolutionary new feature has been added. The vessel has been given an offensive weapon: from its prow juts a powerful pointed ram. This must have inaugurated a new era in naval tactics. No longer was a sea battle simply an encounter involving overtaking and boarding an enemy. Now success or failure depended on the oarsmen: victory would go to the crew so trained that they could respond instantly and accurately to command and work their ship to where it could slam, like a projectile, into an enemy's vitals. A fight now became a contest in maneuvering, the galleys using their oars as, centuries later, ships of the line were to use their sails to gain the proper position for a broadside. Since the ram first appears on Greek vases, credit for the invention is generally given to Greece. Perhaps the Phoenicians thought of it earlier but there's no way of knowing, for they never pictured their ships on their pottery.

Homer's vessels had been open, undecked affairs. The new age required something more efficient and protected. So a second radically new feature was added, a fighting platform from which marines—archers and spearsmen—could operate. It took the form of a deck that covered most but not all of the ship; it ran over the centerline from stem to stern but not from board to board. A space along each side was left open and, when the vessel was merely cruising, the rowers sat at the level of the deck and worked their oars



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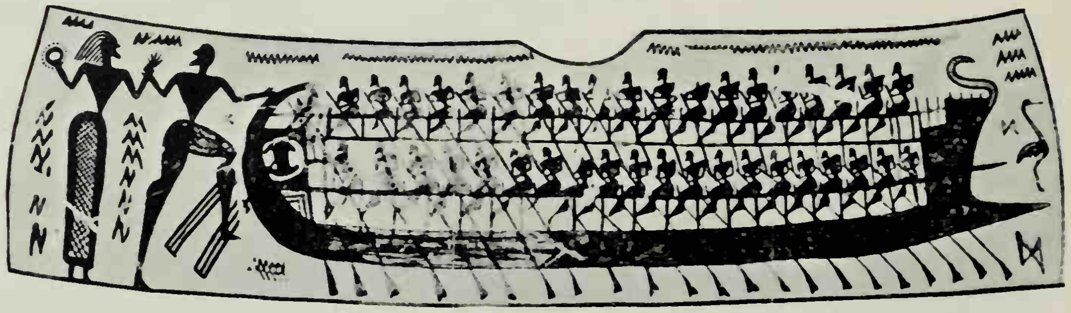

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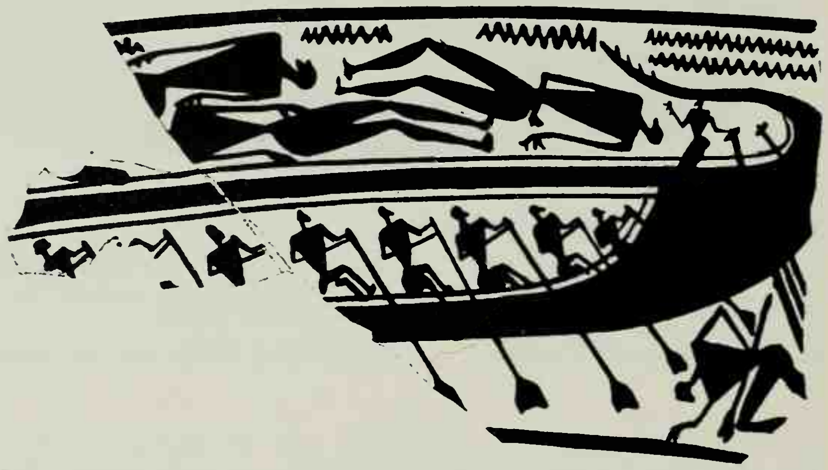
GREEK WARSHIPS, 800–700 B.C.



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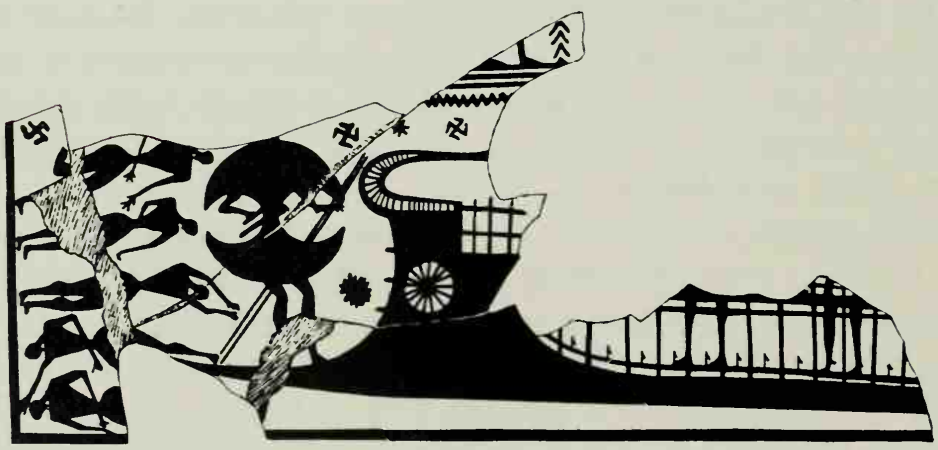

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31. Galley, probably twenty-oared, cruising.

32. Galley, probably fifty-oared, preparing to shove off. The vessel has actually only one bank of oars: the artist, wanting to include both port and starboard rowers, but not able to handle the perspective involved, naïvely portrayed the one above the other.

33. After portion of a galley in action.

34. Forward part of a galley showing the key-like tholepins.

from there. In action such a position was dangerously exposed. The naval architects met this weakness by an ingenious device: they installed a complete series of rowers' benches at a lower level. When a ship engaged in combat the oarsmen took their places down there; with their heads well below the line of the deck they were protected from enemy darts. To provide ventilation and an escape hatch for emergencies, the area between the upper and lower thwarts was left open as a low waist covered only with a kind of lattice. Panels probably closed in the open spaces between the slats when the water was choppy.

The ancients, instead of using rowlocks, worked their oars against tholepins; the Greek word for these means literally "keys," and in the vase paintings they have just that sort of shape. The oars were made fast by a leather strap looped loosely over the pin so that they couldn't go over the side in case a rower lost his grip.

Improvement continued apace until, by 600 B.C., a much more workmanlike man-of-war had evolved. The prow was straightened and lost its swept-back curve. The stern was finished off in a plume- or fanlike adornment which became thereafter the distinguishing mark of a warship and was looked on, along with the ram, as a sort of naval scalp: victors cut them off vanquished vessels and carried them home as trophies. The low waist and its lattice was almost completely eliminated and, as a result, the hull took on a sleeker, trimmer look. The rig, as before, was a single broad square sail, but now we can make out some details, particularly the distinctive way in which the ancients shortened sail: they used a series of lines (brails) which, looped about the sail, bundled it up against the yard much the way a venetian blind is raised. Though ships manned by twenty rowers, as in Homer's day, were still around, larger types were favored, because the more force behind the thrust of a ram, the more damaging was its blow. Thirty-oared craft were now built for lighter work, and the ship of the line was the fifty-oared galley, the *penteconter* as it was called. Twenty-four rowers lined each side, and two steering oars at the stern filled out the complement. Yet, a single bank of oarsmen that extended this long had its drawbacks. It made the penteconter, for example, an excessively slender vessel, expensive to build, difficult to maneuver, and not especially seaworthy.

Illustrations 35–37, p. 33

Then, shipbuilders got a bright idea: if a galley could be rowed either from the deck-line or from some lower point, why not from both at once? And so they designed a new kind of penteconter, one in which the twenty-four oarsmen were split into two superimposed banks, twelve along the gunwale and twelve along lower thwarts who rowed through ports in the hull. To fit everybody in, the oars were staggered so that each of the upper bank was centered over the space between two of the lower. The new craft were shorter than the old by at least a third; they were more compact, more sturdy, more seaworthy—and offered 33⅓ per cent less of a target to an enemy ram.

The earliest picture we have of these two-banked galleys is in a relief carved on the palace of an Assyrian king who reigned from 705 to 681 B.C. The vessel must be Phoenician because the Assyrians, having no navy of their own, used the fleets of the Phoenician cities which they controlled at this time. Shortly thereafter two-banked galleys, lower and lighter than the Phoenician type, appear on Greek vases. It's anybody's guess which of the two nations deserves credit for the invention. Whichever it was, the other quickly followed suit.

Illustration 38, p. 34

Greeks and Phoenicians were conservative when it came to rigging their warships. The new types carried the same rig that Mediterranean craft had for centuries, a single broad square sail. But this was almost exclusively for cruising. In battle a vessel had to be able to move in any direction in its effort to get into position for a ram attack, so it was impossible, even dangerous, to depend on the wind. A captain, on going into action, generally ordered mast and sail unstepped and left ashore—he had no space aboard to store such bulky gear—and, from that moment on, depended solely on the muscle and reflexes of his oarsmen. Pirates, who had to carry sail at all times in order to chase down merchantmen, to meet their particular requirements actually worked out a special version of the two-banked galley, the *hemiolia* or "one and a half-er." It was so constructed that, when the quarry was overtaken and the boarding action ready to begin, half the rowers in the upper bank, those between the mast and the stern, were able to secure their oars and leave the benches; this left not only an ample space in the after part of the ship into which the mast and sail could be lowered and stowed away, but a dozen or so hands available to carry out the work.

Illustration 41, p. 34

In the second half of the sixth century B.C. the fighting ship par excellence of the ancient world made its debut: the *trieres* "3-er," as the Greeks called it, or trireme, as it is more familiarly known.

Illustrations 43–45, pp. 36–37

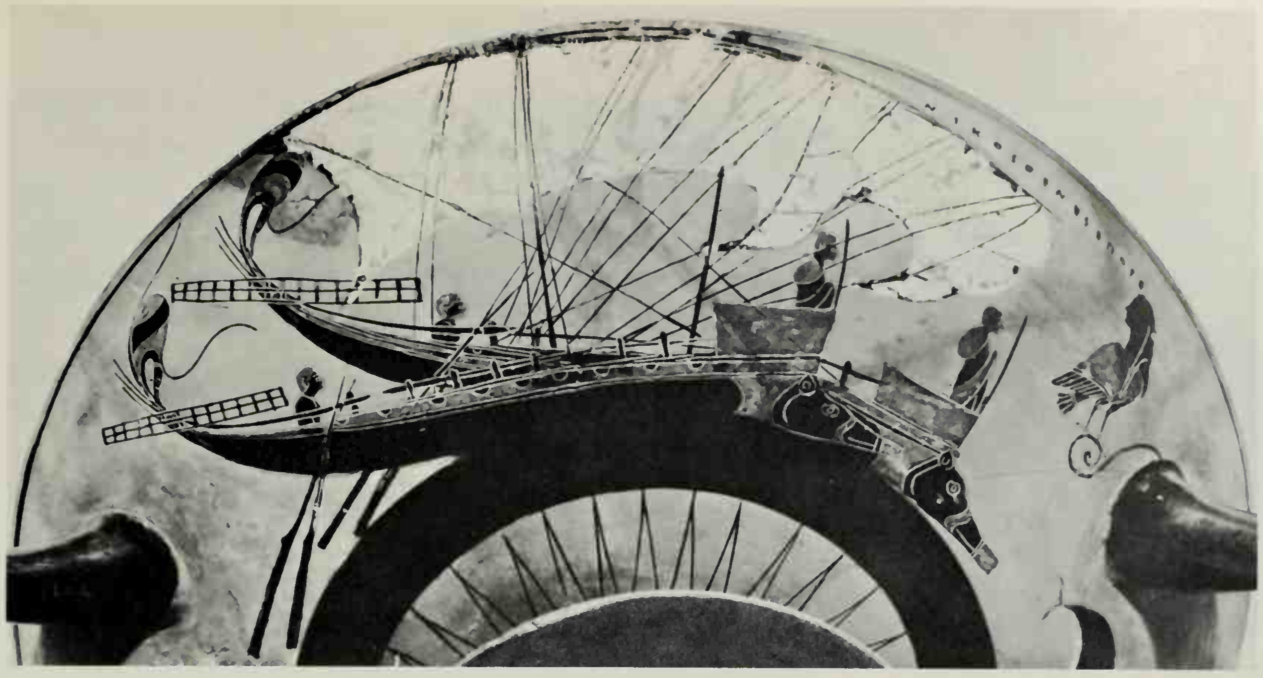
When shipwrights first sought to improve the performance of the original long galley with its single line of rowers, they found the answer in dividing the oarsmen into two levels. How could the power and speed of such vessels be increased further? One solution, used by later ages, was to put more than one rower on each bench or more than one to each oar. This was not the Greeks' way. What they did was to add a third level and create the trireme; it was a "3-er" because it had three lines of rowers, each more or less above the other.

In the fourteenth century of our era this system of superimposed banks was abandoned, never to be used again. What advantage did it have that recommended it so to the Greeks? One great one: *it enabled the oarsmen to row seated.* In the galleys of France or Venice or the other great naval powers of later days, the crews rowed as the ancient Egyptians had, by rising to their feet and throwing themselves back on the bench to deliver the stroke. The Greeks preferred the smoother, evener movement of the seated rower. They had to pay a price: a trireme, higher and more topheavy than, say, the average big galley of the seventeenth century, was necessarily not as seaworthy or stable. But the Greeks considered the gain worth the cost. Nor were they the only ones in the history of oared warships to feel that way: in the Far East, Malayans and their neighbors were using galleys with superimposed banks in the eighteenth century and very likely had been doing so long before (below, p. 130).

Compare Illustration 92, p. 75

To accommodate the third tier of oarsmen, the only major change the shipwrights introduced was to add an outrigger on either side above and projecting laterally from the gunwale. In this way they avoided drastic alterations in the general lines of the hull, yet ended up with a craft that, to the speed and maneuverability of its predecessor, added vastly increased power. The new design caught on everywhere. During the whole of the fifth and much of the fourth century B.C., triremes were the acknowledged queens of the sea, and they were to be found in the fleets until almost the end of ancient times.

No good pictures or models of triremes have survived, but much miscellaneous information about them has in one way or another been collected. The official records for the Athenian navy yard, for example, fortunately for posterity were carved on stone, and some



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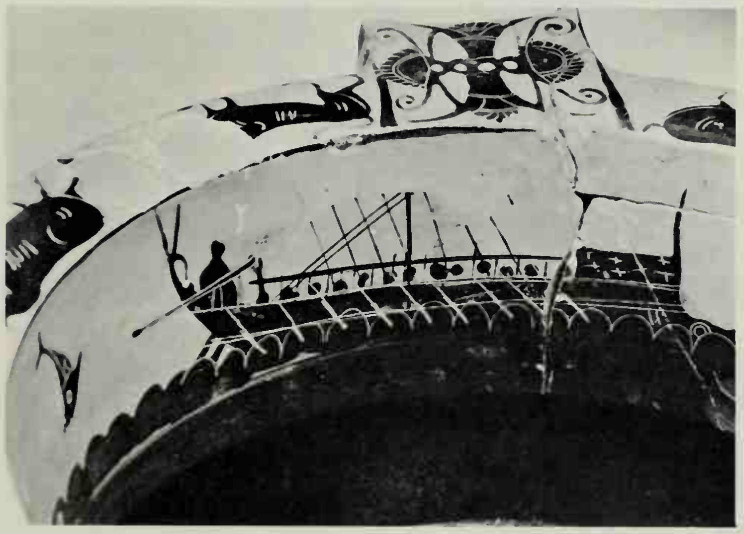

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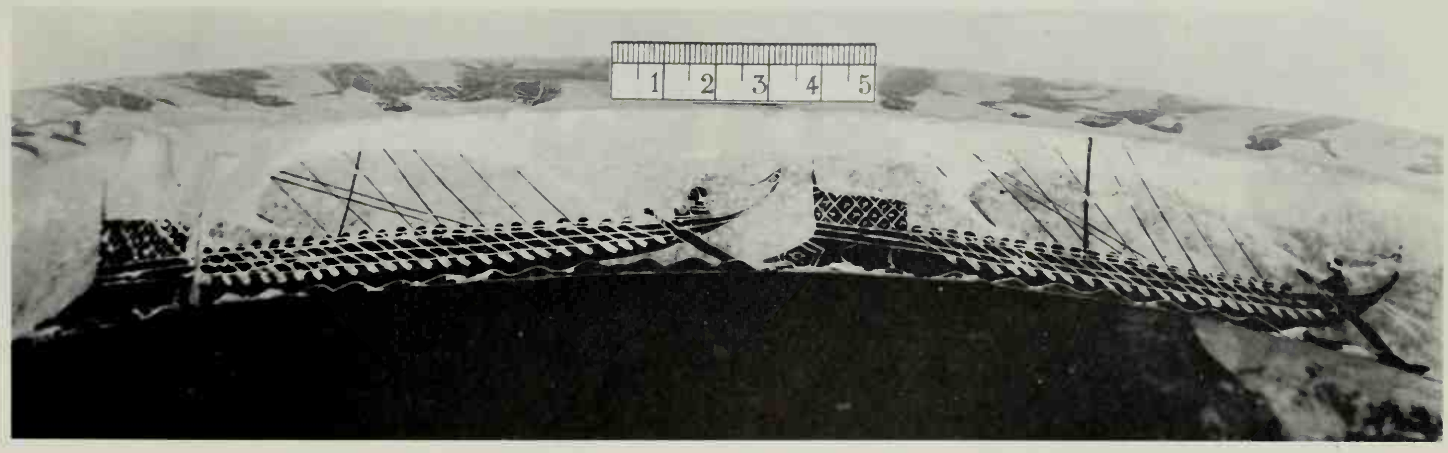

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GREEK WARSHIPS, 600–500 B.C.

35. Galley, probably twenty-oared, cruising. The double lines slanting aft are the brails for shortening sail. The bow watch on each ship is obviously keeping a taut lookout.

36. Galley, probably twenty-oared, cruising. The artist has shown the ship under sails and oars, although the use of the two together was rare; similarly, marine painters today like to render sailing ships with every stitch of canvas set and drawing.

37. Galley, probably fifty-oared, cruising.

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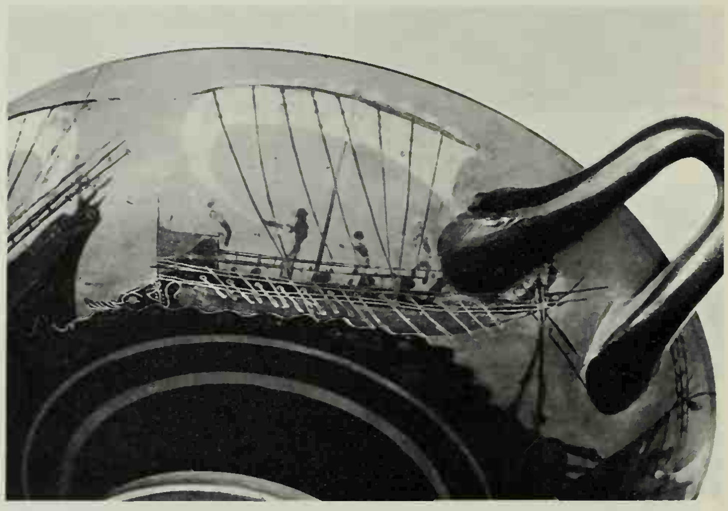
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TWO-BANKED WARSHIPS, 700–500 B.C.

38. A two-banked Phoenician galley of about 700 B.C.

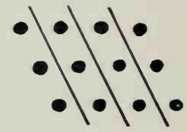
39. A two-banked galley, probably fifty-oared, in action; sixth century B.C.

40. A two-banked galley of about 575–550 B.C. The stroke is having a bad time—he can't get the oarsmen of the two banks synchronized.

41. A *hemiolia* "one and a half-er". Half the oars in the upper bank, those abaft the mast, have been secured as the craft prepares to board a merchantman.

fragments have been dug up; they list the exact amount of gear of various types issued to the ships. Several of the slips where triremes were docked in the Athenian navy yard are still visible, and archaeologists have examined and measured them. The biggest is a little under one hundred and twenty-five feet long and twenty feet wide; these then must be the approximate dimensions of the largest galleys. The total freeboard of a trireme was probably not much over eight feet and it very likely had a draft of about three, shallow enough to enable it to be drawn up on a beach or portaged on rollers. The lowest bank of rowers worked their oars through ports that were not over a foot and a half above the waterline; a leathern sleeve, fitted snugly about the oar and its opening, kept out the sea, but in any sort of chop these oars were secured and the ports sealed with coverings. The dockyard records show that there were twenty-seven rowers in this bank on each side. The next higher row had the same number, with each oarsman sitting above and slightly forward of his corresponding member in the bank below and working his oar over the gunwale. On special benches built on top of the gunwale sat the topmost row, with each oarsman slightly forward of and higher than his corresponding member in the middle bank and working his oar against a tholepin set in the outrigger, which projected about three feet from the side of the ship. The topmost rowers had the most strenuous stroke, for their oars, pivoting so high up, struck the water at a relatively sharp angle. Since the hull curved up into long overhangs, it squeezed out the two lower banks at each end but left some room for the highest; consequently there were four more oars in that bank, or thirty-one on each side. All in all, a trireme mounted 170 oars, not including the pair for steering.

The rowers were so ingeniously arranged that the oars of the three banks were almost all the same length, fourteen feet, four inches, just about the standard used on some navy cutters today. Thus, not only the manufacture of oars but the stocking of extras was enormously simplified. Each ship was able to do with just thirty of these interchangeable spares.



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If you looked at a trireme from the side, the oars seemed to make a quincunx pattern. The important cluster was the group of three in an oblique line; these gave the vessel its name, *trieres* "3-er." The distance between rowers is a constant, about three feet, set by the size of the human body, so a trireme was not very much longer than Homer's biggest ships with their twenty-five oars a side. But it was infinitely more powerful, more maneuverable, more adaptable. In calm weather it could be rowed easily from the lowest bank and, when a sea was running, comfortably from the uppermost. In action, driven by all three, it could sprint at a seven-knot speed and spin about in an amazingly tight circle. In spite of its size and strength, it was light and shallow enough for its crew to run it up on a beach at night.

The full complement of a trireme amounted to two hundred, not counting marines. In addition to 170 rowers, there were twenty-five petty officers and miscellaneous hands and five commissioned officers. Manning one of these ships was almost as difficult and expensive as building one. A good-sized navy could run to as many as two hundred units, and this meant a total of no less than thirty-four thousand oarsmen, a tall order for the populace of any Greek city to supply. What's more, in those days the army and not the navy was the senior service; people who could afford the price of a suit of armor understandably preferred to fight in the field rather than to sweat on a bench in a ship's foul and steaming hold. Slaves in sufficient numbers were hard to come by and even when enough were available, being untrustworthy and very expensive (they had to be supported for life and not for

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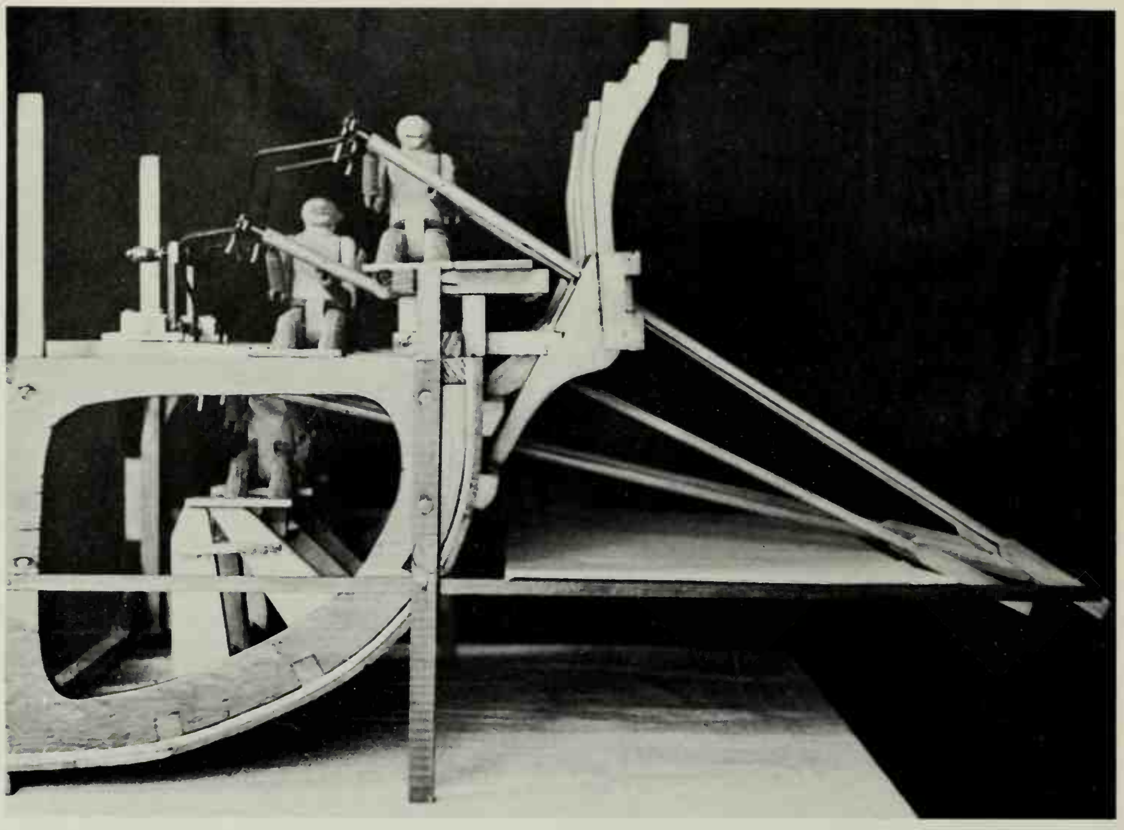

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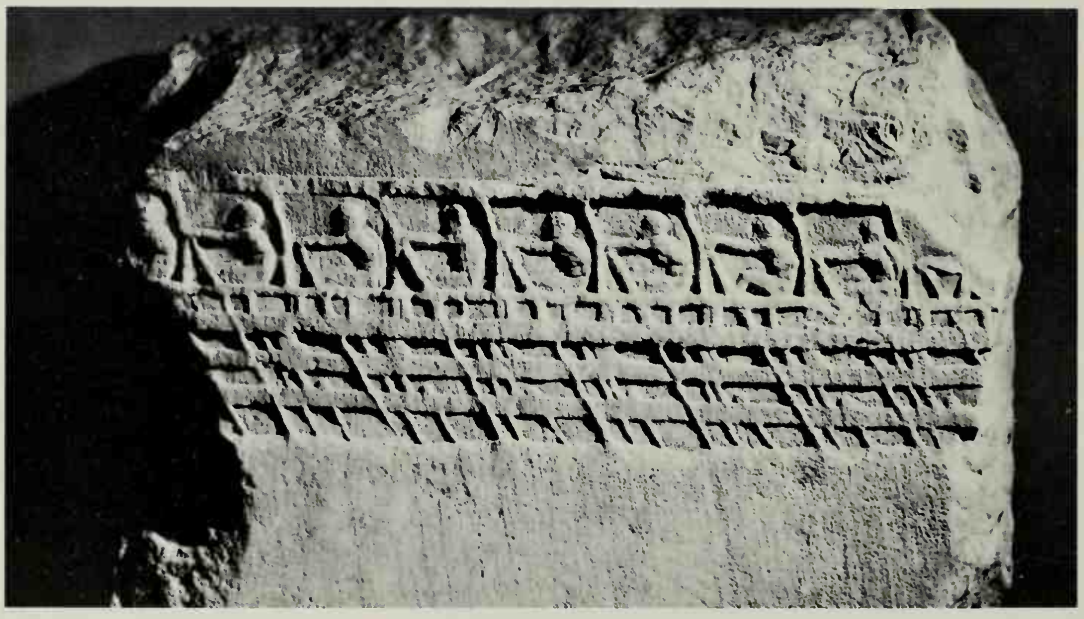
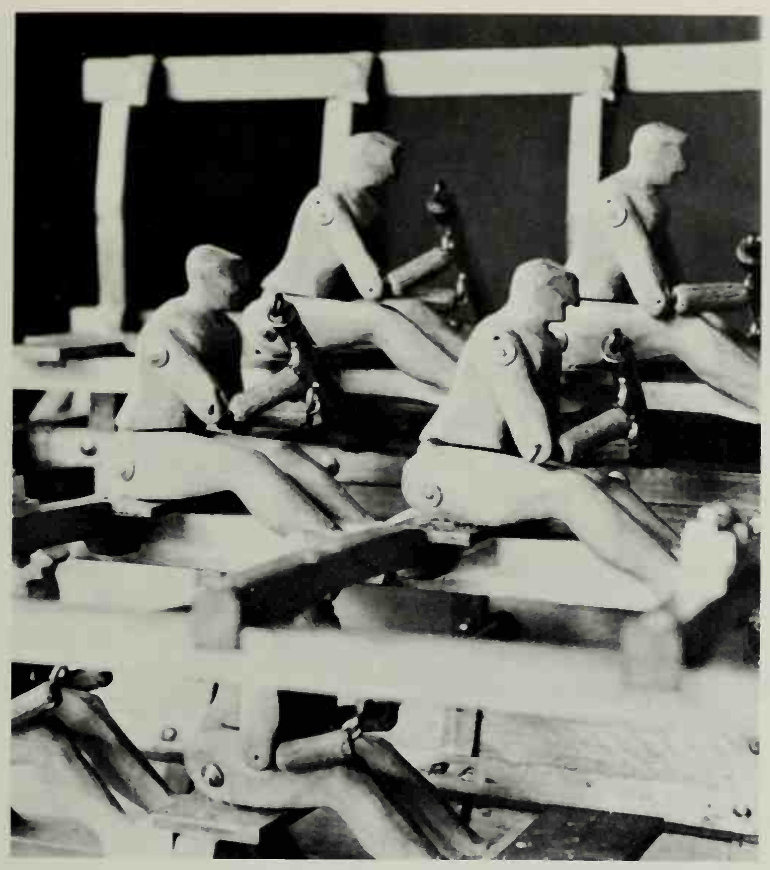


just a given campaign), they weren't often used; Athens, for example, turned to them only when she had exhausted all other sources of manpower, and didn't conscript but asked for volunteers, offering freedom as the inducement. Most of the rowers came from the poorest class of citizens, those who didn't have the money to equip themselves as soldiers. The rest simply had to be hired. Since the service was both arduous and dangerous, it commanded attractive salaries; the oarsmen of the topmost bank, who had the hardest stroke, could even receive a premium. The crews, citizens or well-paid foreigners, were a far cry from the miserable bands of galley slaves of later ages. No lashes were used aboard Greek warships; the rowing officers beat only time, never the rowers. On occasion, especially after severe losses,



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THE TRIREME

43. Relief of the fifth century B.C. showing part of the starboard side of a trireme. Only the rowers of the topmost bank are visible, each framed by the struts holding up the outrigger.

44. Reconstruction of the cross section of a trireme modeled on the above; flat platform at right represents the waterline.

45. The starboard rowers as seen from inside the hull.

bringing crews up to full strength wasn't always possible, and many a vessel went to sea with only two, sometimes only one, of its three banks manned.

A trireme had a single mast carrying a large square sail. Running rigging included two halyards, two braces, two sheets, and eighteen loops of brails. Standing rigging consisted only of a double forestay and a backstay; the forestay was a particularly stout line since the deckhands raised and lowered the mast with it. As in earlier days, the sail was used only for cruising; it and its gear were left ashore when a vessel went into action, and there was taken aboard instead a smaller mast and sail, a "boat sail" as the Greeks called it, to use in case of flight; to "hoist the boat sail" was Greek sailor slang for "run away." Warships of later, Roman, times are depicted with the *artemon,* a small sail set over the bows on a short raking mast (see illustration 49), but those of this age probably didn't yet carry it. To counterbalance the weight of the superstructure, ballast—rocks or gravel or sand—was carried in the hold.

The trireme carried two weapons. The first was its ram, a massive timber, jutting from the forefoot, that was sheathed in bronze tipped by a three-pronged spur with subsidiary barbs above, a much more effective instrument than the single-pointed device of earlier times. The second was the marines on its decks. The Athenians, favoring the ram, limited the

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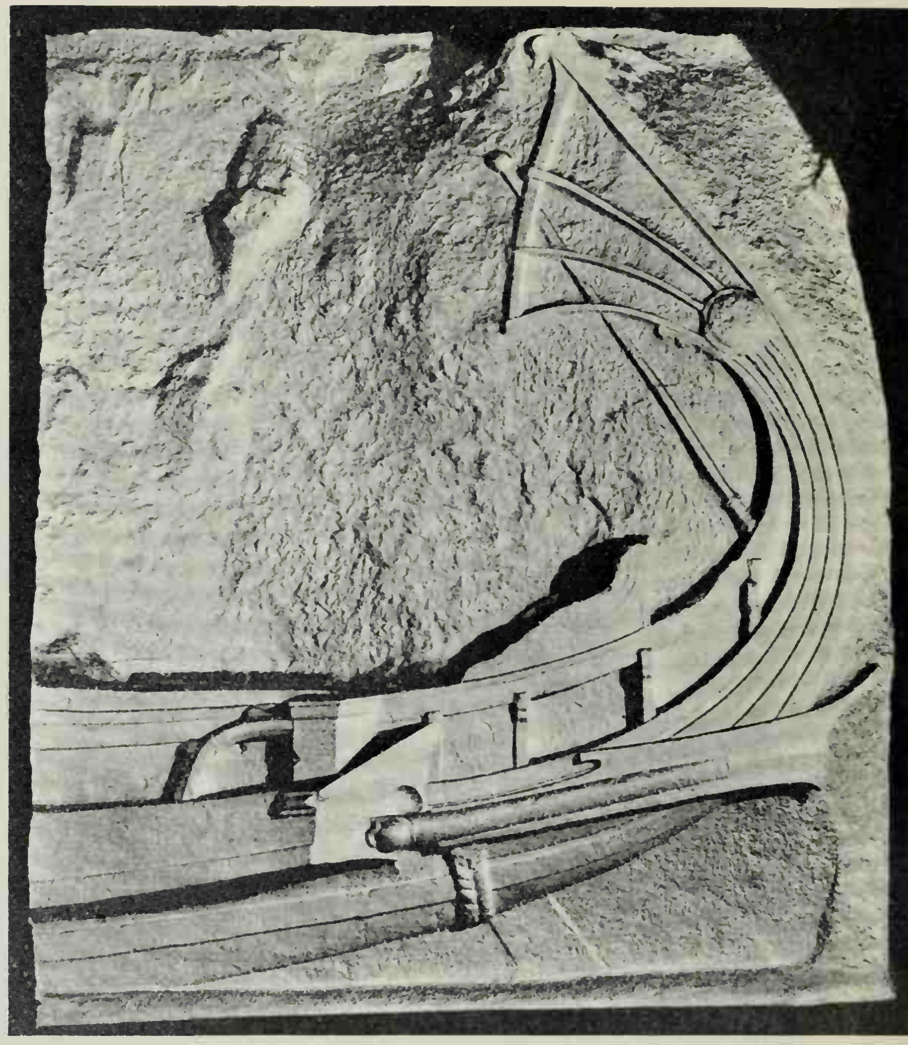


47

GREEK WARSHIPS, 300–200 B.C.

46. Prow, with its ram, of a warship belonging to the navy of King Antigonus of Macedon. Pictured on a coin minted about 253 B.C. The figure seated on the forward end of the outrigger represents the god Apollo.

47. Stern of a Rhodian warship. Relief carved about 200 B.C. on the side of a cliff at Lindos on Rhodes. The Rhodian navy specialized in antipiracy patrols, and the vessel is probably one of the lighter types used for that purpose. Note the very comfortable chair provided for the skipper.

marines to fourteen or so per ship, whose main job was to ward off enemy boarders; other navies, which went in for heavier ships and aggressive boarding tactics, used as many as thirty.

The trireme had the two drawbacks that plagued all ancient galleys, insufficient space and excessive lightness. It was useless in heavy weather and, unable to carry provisions in any quantity, had to have bases readily available. Sailing freighters could strike across the open sea, but a fighting squadron had to follow the coast so that each night the men could beach the ships and cook, eat, and sleep ashore; naval actions always took place in sight of land. Since operating in waters where the enemy held the seaboard was out of the question, commanders were never able to maintain a true blockade. They might bottle a fleet up in a harbor or cut off a port from seaborne supplies, but they couldn't patrol an extended shoreline that was securely in hostile hands. This limitation on cruising range made the open sea a sort of no man's land, and so it remained until the coming of the roomy sailing ship of war.

The trireme ruled the waves for almost two centuries. Then the inevitable search for more size and power started again; a "3-er" was somehow not enough.

In the fourth century B.C., "fours" make their appearance and soon thereafter "fives." In 323 B.C. Alexander the Great's death touched off a bitter three-way fight among his successors: each carved out for himself a great kingdom and sought to become the paramount naval power. The upshot was an arms race as hectic as any known to subsequent history. Within less than a half century, "fours" and "fives" had become small fry. The galley's prime weapon was no longer the ram and, as a result, speed and maneuverability took second place. Now she was fitted with fighting turrets fore and aft (see illustration 48), from which archers and spearsmen could hurl down their shafts, and with catapults, the earliest form of naval artillery, to heave oversize darts and big rocks at the enemy. All this required room and strength. Alongside the "fours" and "fives" arose "sixes," "sevens," "eights," "nines," "tens," and "thirteens." These last were the largest ever built as a class, but bigger individual ships kept coming off the ways. One navy came up with a "fifteen" and a rival countered with a "sixteen." An "eighteen" was countered by a "twenty." Then came two monster "thirties." The climax was reached toward the end of the third century B.C. when Ptolemy IV, King of Egypt, launched a brobdingnagian "forty." To provide the needed strength, its designer made it twin-hulled—one of the mightiest catamarans in naval history. It was over four hundred feet long and fifty wide, the figureheads on prow and stern towered seventy feet or more above the water, there were no less than four thousand rowers manning the benches, and the topmost oars were enormous sweeps fifty-seven feet long. But this behemoth never saw action and may have been only for display.

Just what kind of ships were these supergalleys? Though seamen and scholars have speculated about the problem for centuries, it still remains unsolved and probably will until some archaeologist is lucky enough to dig up a sculpture or painting that will settle the age-old controversy once and for all. The "fours" and "fives," many are willing to agree, could have been single-banked vessels in which four or five men pulled one large sweep as on the galleys of the sixteenth century and later. Perhaps "sixes" and "sevens," possibly even "tens," worked on the same principle; when Mark Antony fought the famous Battle of Actium in 31 B.C. his flagship was a "ten" and yet it stood a mere ten feet above the water, which hardly allows room for more than one line of oars. But what of the larger ones? The "fifteen," and the "twenty," the "thirty" and the great "forty"? We can only guess. Maybe they were oversize two-bankers or even triremes, that is, with two or three superimposed lines of long sweeps, each manned by a number of men. The "fifteen," for example, may have had two banks, eight men to an oar in the upper and seven to an oar in the lower. The forty was almost certainly an overblown trireme, with a total of forty men distributed among the three corresponding oars in the upper, middle, and lower banks.

Whatever the arrangement, one thing is clear: the Greek must have given up his favored method of rowing from a seated position on these big ships. Their long sweeps could only have been worked the way rowers worked the sweeps on galleys of later ages, by rising to their feet and then falling back on the benches.

Rome ruled the Mediterranean for half a millennium, from the second century B.C. to the third A.D. Very soon after she took over the seas, she eliminated all rivals. With no other

48

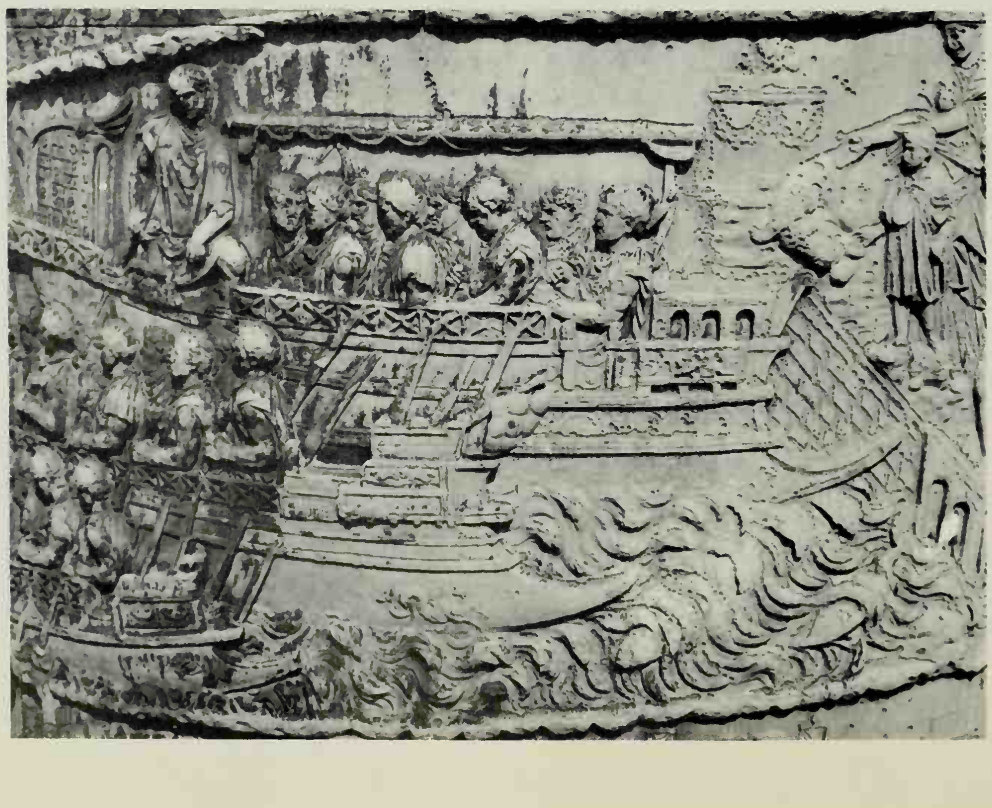
ROMAN WARSHIPS

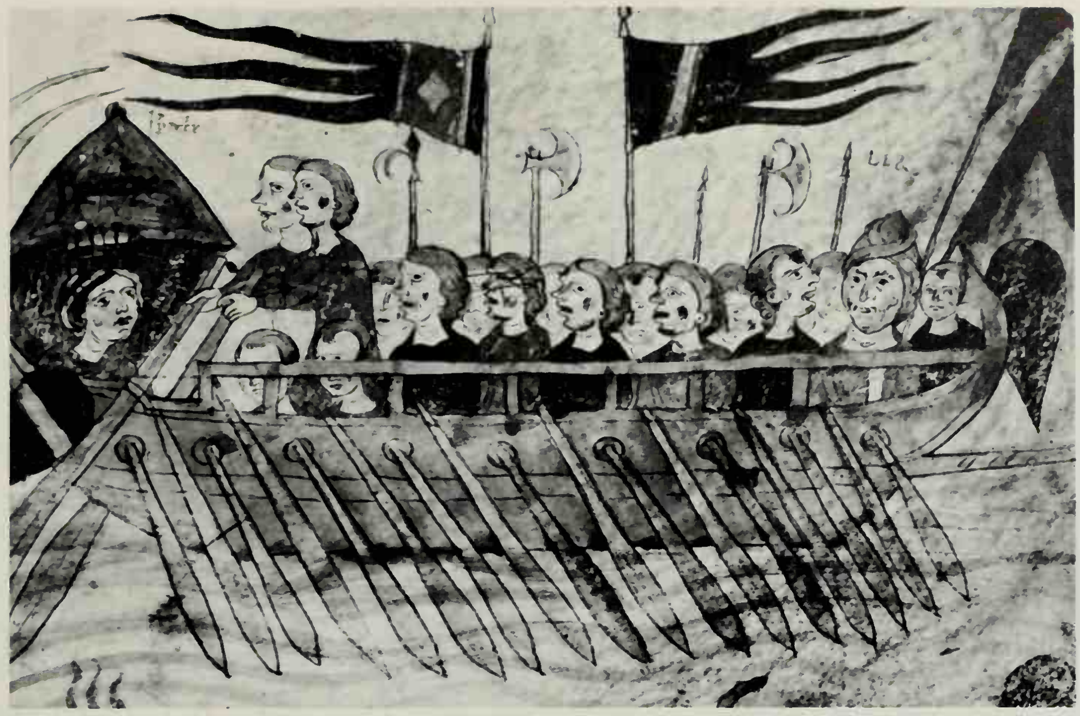
48. One of the heavy ships that fought in the Battle of Actium in 31 B.C., in which Antony and Cleopatra, Queen of Egypt (symbolized by the crocodile), were defeated. The vessel has two banks of oars, each manned by multiple rowers. It is completely fenced in on top (by a deck) and at the sides. Forward is the mast for the *artemon* and, behind it, a fighting turret. The relief of the head of Medusa perhaps represents the vessel's name; the niche behind has a female bust, possibly of a goddess.

49. Two-banked Liburnians under oars, and a trireme under oars and the *artemon*, arrive at a port; about A.D. 100.

50. Color illustration, page 26.

49





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52

THE *DROMON* AND GREEK FIRE

51. Two-banked galley of the twelfth century.

52. A flame thrower in action as pictured in a fourteenth-century manuscript.

navies to fight, there was little need of big ships, and the giants of the preceding age swiftly became obsolete. From the beginning of the Christian era on, all that Rome required was a peacetime navy. The trireme returned to the scene as the standard ship of her fleets, there was a sprinkling of "fours" and "fives," and an occasional "six" served to carry the flag. One new type of warcraft did make its appearance, particularly well suited to the major work the Roman navy now carried on, the pursuit of pirates and the carrying of dispatches. This was the Liburnian, a light, fast, highly maneuverable vessel which the Liburni, a pirate tribe from the Yugoslav coast, had originally devised and which Rome found useful enough to adopt as a standard unit; her auxiliary fleets, stationed all around the Mediterranean coast,

Illustration 50, p. 26

found it particularly useful. Originally it was most probably single-banked, but its borrowers developed a heavier version driven by two lines of oarsmen.

When Rome's western possessions were swallowed up by the Goths and Franks and Vandals in the fifth century A.D., the fleets once stationed there simply vanished. In the eastern Mediterranean, however, her rule was carried on by the Byzantine Empire, which didn't go under until the Turks took Constantinople in 1453 and which maintained a navy that had no peer until the rise of the great Italian cities in the Middle Ages. But no triremes or Liburnians or any other of the traditional types were to be seen in the Byzantine fleets. The standard ship of war was now a two-banker called the *dromon* "runner," and its prime weapon was no longer the ram but fire.

The dromon, as its name suggests, was designed especially for speed. It carried one hundred oars, twenty-five in each level on each side. They were all worked through ports in the hull; there was no longer an outrigger. Though there were larger and smaller classes of dromon, all ran more or less about the same length, 130 feet or so, enough to provide room for twenty-five oarsmen and for fighting decks fore and aft. It was the beam that varied. Some classes were wide enough to seat two rowers, and the largest class three, at each of the upper oars. The ships were rigged with two masts, sometimes three and, in the later centuries at least, these were fitted with lateen sails—another break with the past. The sails must have been light and easy to handle, because they were carried during battle and not left ashore as had been the practice previously.

The prows of the dromons, like all earlier warships, jutted forward to end in a ram, but it was no longer important; fire weapons now played the major role. The ancients had long known the use of fire in battle, but it wasn't until the seventh century A.D. that navies learned to wield it effectively. The base for the various combustible mixtures had always been crude oil, which, throughout the oil-rich areas of the Near East, could be scooped up at dozens of points where it oozed out of the ground. Although it was flammable enough in its simple state, the general practice was to lace it with sulphur or pitch or quicklime. Then, in the seventh century A.D. came the discovery that if saltpeter were added, a compound capable of spontaneous combustion resulted. "Greek fire," as it was called, became Byzantium's invincible weapon. It was packed into breakable clay pots which dromons, armed with catapults, hurled on an enemy's decks. Even more effective were flame throwers, which every dromon, big or small, mounted in the bows; these would envelop in flames any opponent who dared come within range. The formula for Greek fire was top secret and—more than can be said for most military secrets—was kept so for years; it never got into the hands of the powerful Arab navies which unsuccessfully contested Byzantium's supremacy for centuries. When, about 1100 or so, she finally yielded the palm, it was not to the Arabs but to the Italians, the up-and-coming navies of Genoa, Venice, and others.

CHAPTER FOUR

Greece and Rome: The Carrying of Cargo

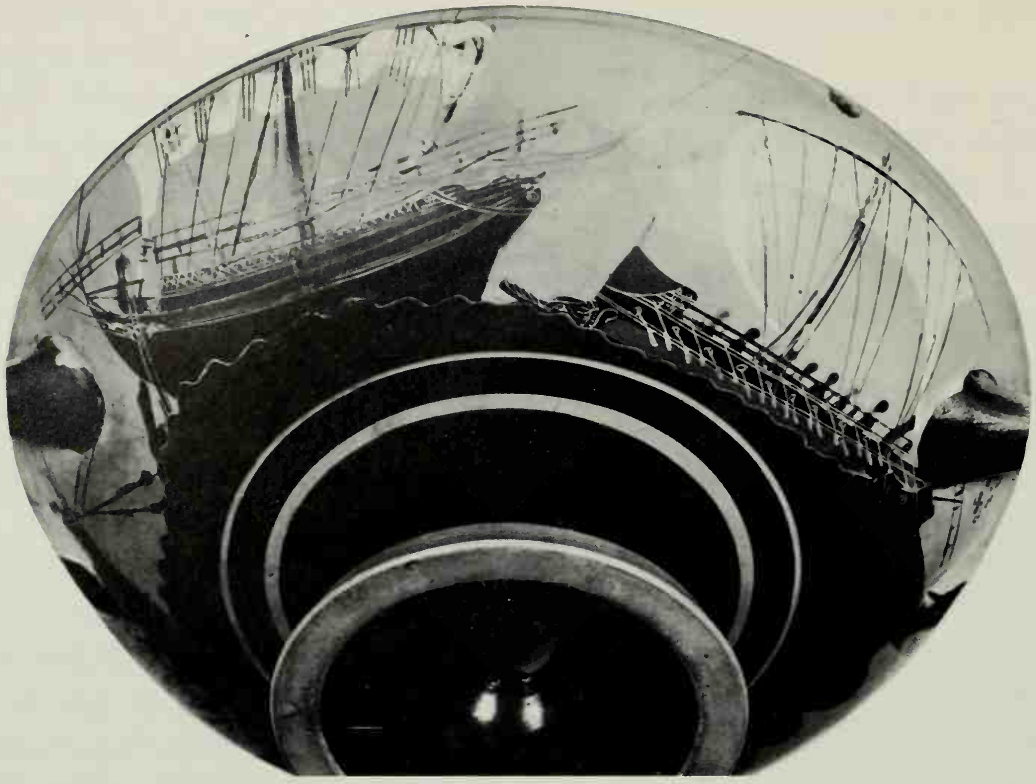
IN LONDON'S British Museum there's an Athenian vase, made probably between 540 and 500 B.C., which has painted on it a unique scene: a pirate vessel in the act of overtaking a merchantman. It is the one good picture we have of a seagoing cargo ship that dates before the beginning of the Christian era.

The vessel portrayed, as one would expect of Greek artisans, is a beauty. Though round and beamy, her lines are graceful and her prow has the same concave curve that gave such distinction to the famed American clippers. The rig, a single broad square sail, is a great billowing spread that needs a complicated system of brails (above, p. 31) to shorten it. There were no convenient quays where this craft put in, so, lashed on deck are two landing ladders, a short one for beaches that dropped abruptly and steeply, where she could come in quite close, and a longer one for those occasions when, near a beach that shelved gradually, she had to stand farther off.

A mainsail was not the only canvas merchantmen of this age spread. A recent happy discovery discloses that they also carried a foresail—though everyone up to now thought a true foresail wasn't seen on the seas until two thousand years later, not many decades, in fact, before Columbus embarked on his epoch-making voyage. In 1957 Italian archaeologists opened up an Etruscan tomb dating about 480 B.C. and found as part of the decoration a fresco of a ship that was a close kin of the one on the vase with a single all-important difference: in addition to the usual mainmast with its mainsail amidships, forward was a stout foremast carrying a good-sized foresail.

These two illustrations are like a flash of light: they suddenly give us a glimpse of the cargo ships of about 500 B.C. After that the shadows fall again and don't lift until just before the first century B.C., at which time information begins to be fairly abundant. The pity is that, as we can gather from hints dropped by Greek and Roman writers, important developments were taking place in the meantime. After the death of Alexander the Great in 323 B.C., maritime commerce broadened vastly in scope. Bulky cargoes were now being sent far and wide and big ships were needed to haul them. Merchantmen grew in size: the average ran between one hundred and two hundred tons burden, and we hear of one leviathan which could carry up to sixteen hundred. But we have no idea what these ships looked like. All we can say is that, in all probability, they resembled the ones we know of from Roman times a century or so later, and that the improvements visible then were in all likelihood introduced during this key period.

Our knowledge of Greco-Roman ships from the first century B.C. on comes from two sources. First, now that simplified and inexpensive apparatus is available, amateur divers have been investigating the floor of the Mediterranean, have come across literally hundreds of ancient wrecks, and have actually excavated—at immense trouble and expense—a



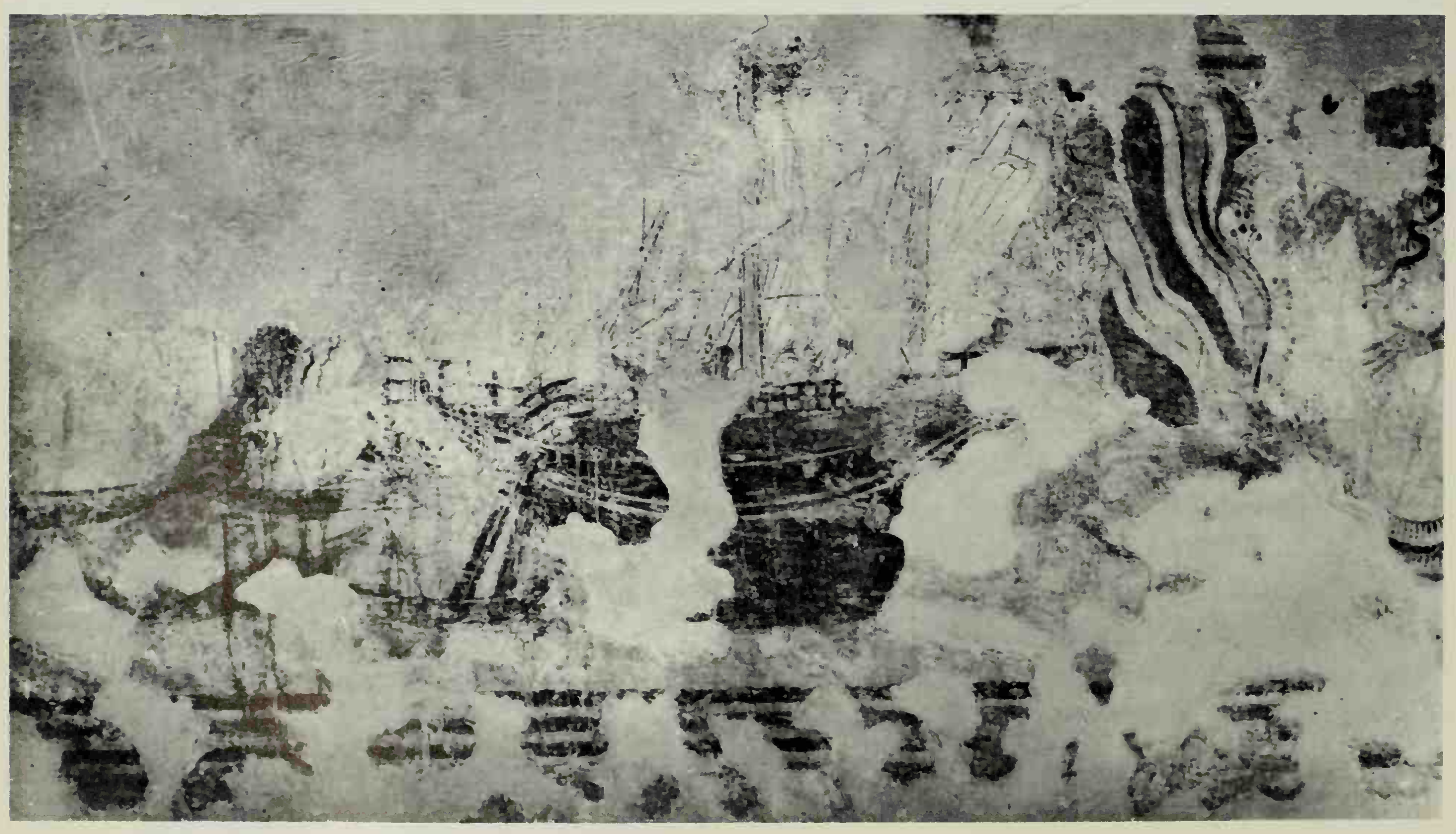
53

GREEK MERCHANTMEN, 550–450 B.C.

53. A merchantman being overhauled by a pirate galley. The sea is choppy and the merchantman, unaware of the danger, is traveling under shortened sail.

54. Merchantman approaching shore. This is the earliest example of a foresail. It antedates by over eight hundred years the next that has survived.

55. Reconstruction of the above. The lines leading out from the edge of the foresail bent around to go horizontally across the front surface of the sail.

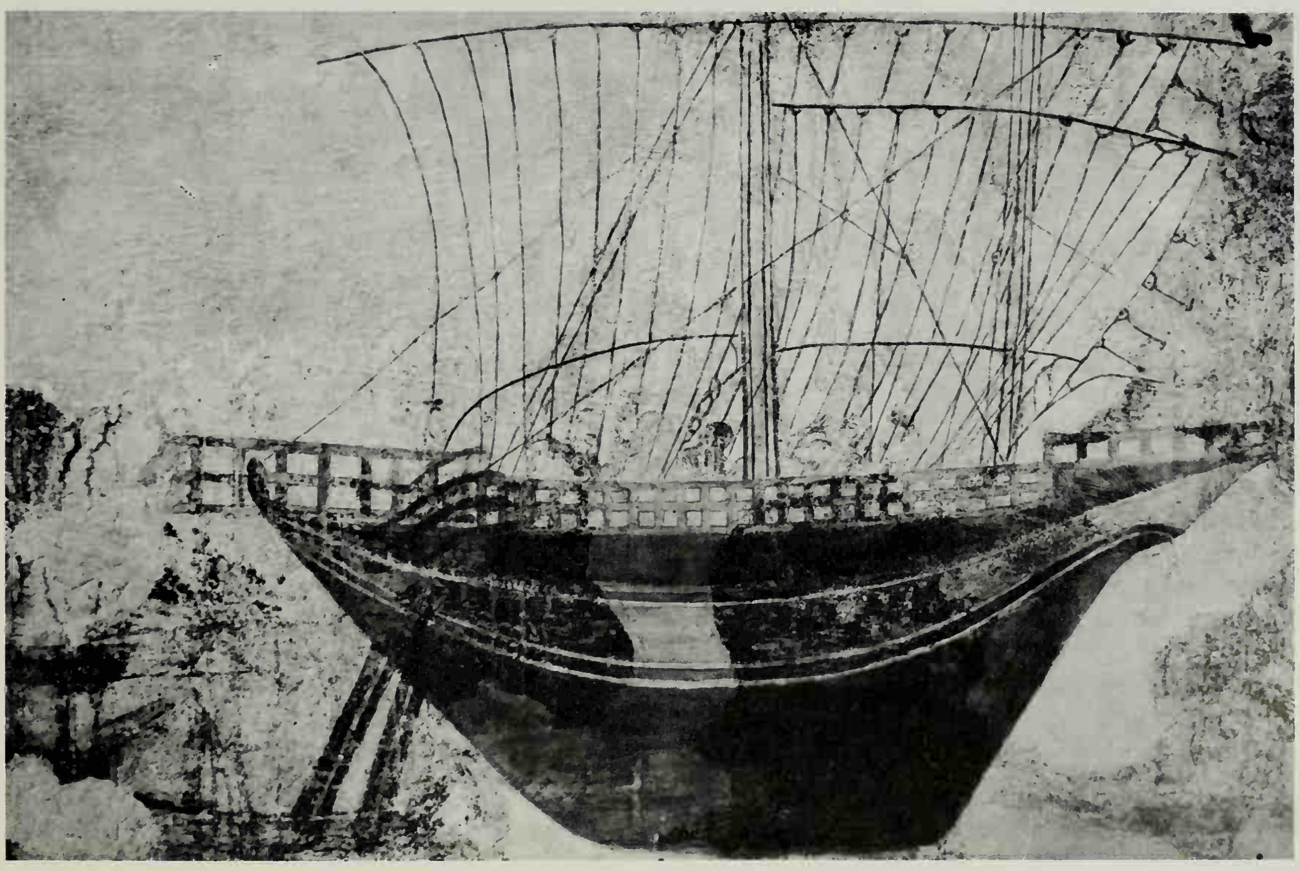


54

half dozen or so. Their work has given us accurate figures for the dimensions of ships and invaluable details of their construction. Secondly, quite a few contemporary paintings and sculptures showing boats have survived, and these give a fair idea of the shape of ancient merchantmen and a good idea of how they were rigged.

The vessels the divers have examined, mostly carriers of bulky cargoes of wine and olive oil, which were shipped in large clay jars, run between one hundred and 150 feet in length, thirty to forty in width, and one hundred to 150 tons in burden. Nothing of the rig, of course, is ever preserved, but under certain lucky circumstances parts of the hull are, and these reveal a startling fact: Greco-Roman vessels were put together in a very special way, one that combined the methods traditionally associated with East and West.

The ancient Egyptian, in building a boat, started with a shell of planks, which he could stiffen by inserting a minimal amount of framing, and this by and large remained the traditional technique in many parts of Asia. In the West, however, we do just the reverse: we start with a sturdy skeleton of frames and then pin a skin of planking to this. Now, the Greco-Roman shipwright began the way an Egyptian did—he first created a shell of planks. But his way of putting these together was far superior to any used in the East—he joined each plank to its neighbors more as a cabinetmaker would than a carpenter. He used only mortises and tenons, and so lavishly that often they stood only a few inches from each other; as an added touch, he transfixed each with a dowel to draw it up snugly and keep it from ever coming apart. Thus the skin he created was one of extraordinary strength. Then, for good measure, he inserted a system of framing as complete as any ever found in later Western shipbuilding. Since his shell was so strong, he could afford to use relatively light timber but, as if to make up for that, he set his frames cheek by jowl: a



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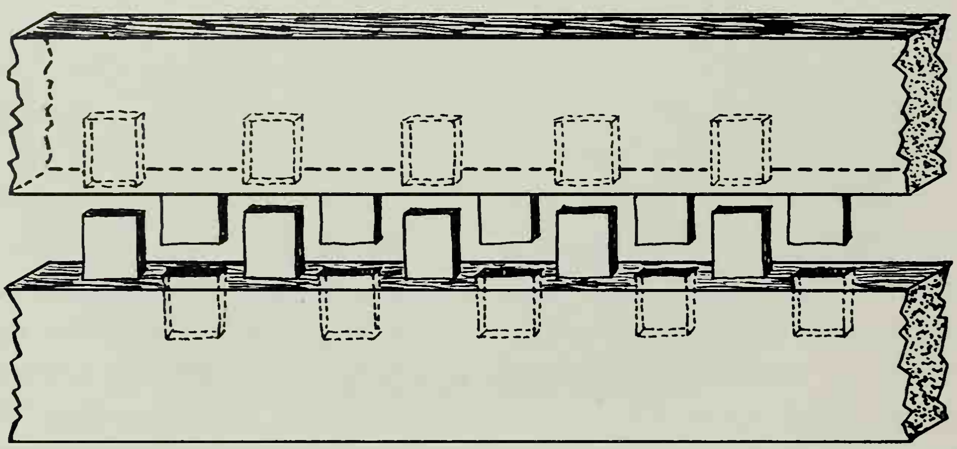
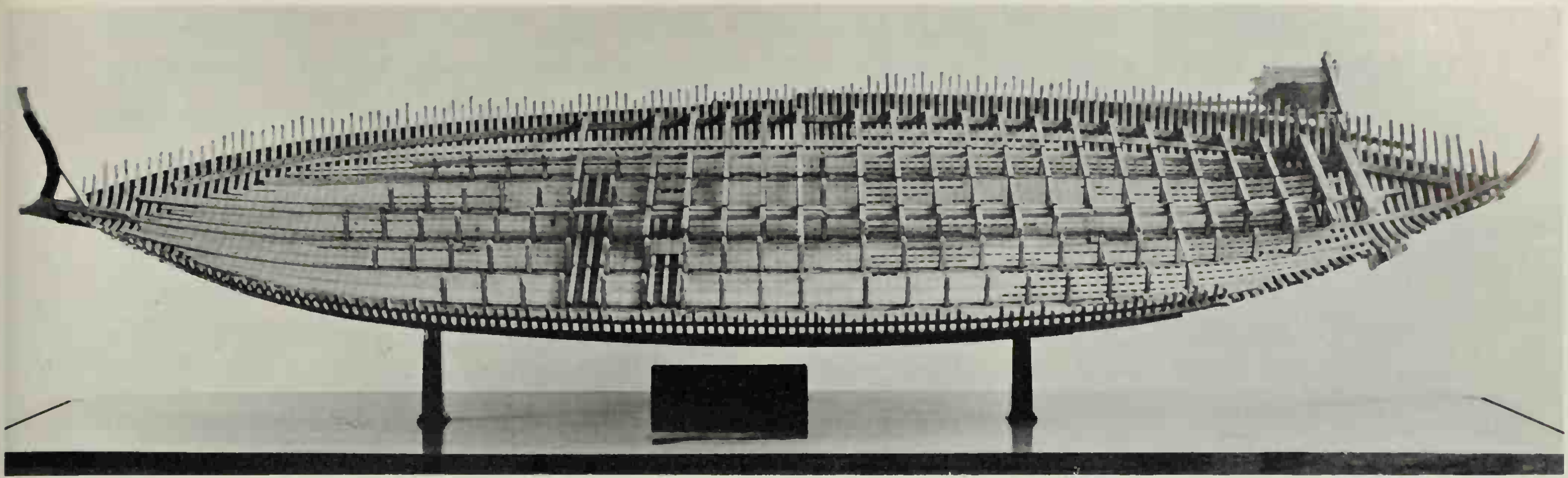


56A

GRECO-ROMAN SHIP CONSTRUCTION

57



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56. A piece of planking, split lengthwise, from a wreck of the second century B.C. found off Marseilles. The plank is about 6″ wide and 2–2¼″ thick, the mortises are 2⅜–3⅛″ deep and about 2¼″ broad, and they stand less than 2″ apart.

56A. Reconstruction of the above.

57. A shipwright finishing up a hull; second or third century A.D. The skin of planking having been completed, he is now busy adzing a frame to insert in it. The inscription reads, "Longidienus pushes ahead on his work."

58. Model of one of two enormous barges of about A.D. 40 that were excavated from the bottom of Lake Nemi near Rome. The originals were destroyed during World War II. The model, made before the catastrophe and exact to the last detail, shows the complicated and strong internal structure. The planks were about 12″ wide and 4″ thick; the mortises were about 4″ deep and 4″ broad and stood 4″ apart. The frames were 7¾″ × 12″ in section and stood about 20″ apart. The barge was 234′ × 66′ over-all.

59. The second barge before its destruction. Note the lead sheathing made fast by large-headed bronze nails set in a quincunx pattern. In the foreground is one of the anchors found with the craft. Most ancient anchors were made in this fashion: a heavy lead stock, wooden shank, and wooden arms tipped with metal.

merchantman that measured 130 feet in length, of average size in other words, could have frames set a mere four inches apart; a huge two hundred-foot barge built to do nothing more violent than serve as a floating chapel on a little sacred lake had frames no more than twenty inches apart.

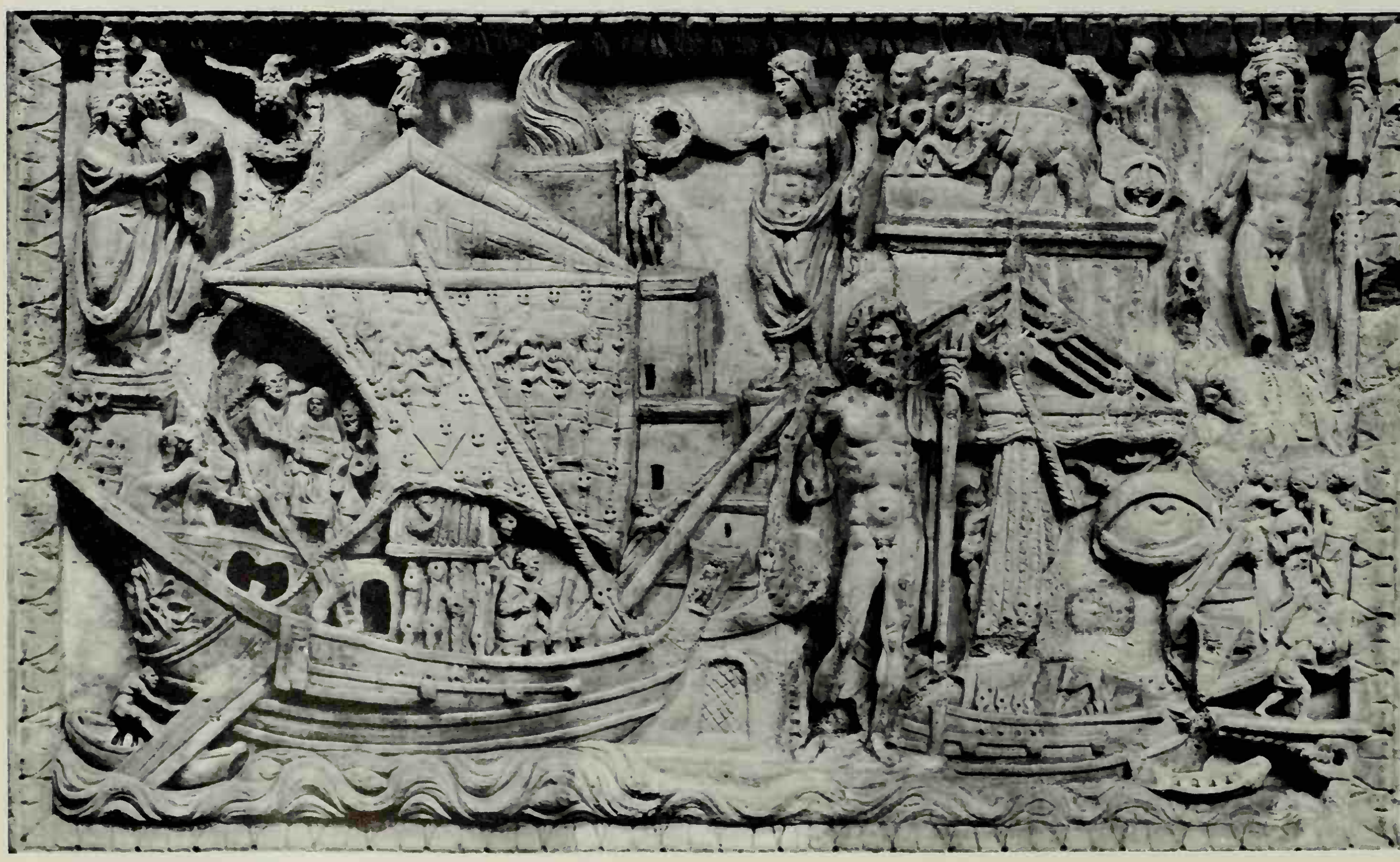
Careful joining and framing will protect a boat from the battering of the seas—but not from the insidious inroads of the marine borer. The Greco-Roman shipwright had his solution for this; unfortunately, in subsequent centuries it was forgotten and had to be rediscovered in the eighteenth century. He swathed the whole underwater surface with a layer of wool or other fabric impregnated with pitch and then covered this with a thin skin of lead sheathing.

Enough for the merchantman's hull. Let's turn now to its rigging. Here the many pictures that have survived are a godsend. They show that the standard rig was still the big square mainsail amidships. Most craft also carried the *artemon,* a sail set, like the bowsprit-

MERCHANTMEN, A.D. 100–200

60. Merchantmen in Portus, the harbor of Rome; about A.D. 200. One vessel has just moored, and a stevedore is busy unloading its cargo of shipping jars; the deck hands are still aloft furling sail. The other ship, under reduced sail, is moving past the great lighthouse that stood at the entrance to the harbor. Poseidon, god of the sea, stands prominently in the center, and Liber, god of wine, in the upper right-hand corner. The vessels are named after Liber; note his picture carved on their prows.

61. Merchantman taking in sail as she approaches port; first century A.D. The *artemon* has already been taken in, one deckhand is hauling on the brails to bring the canvas up to the yard, two hands are already on the yard to furl, and two more—one going up the forestay and the other the ladder abaft the mainmast—are hurrying to join them.



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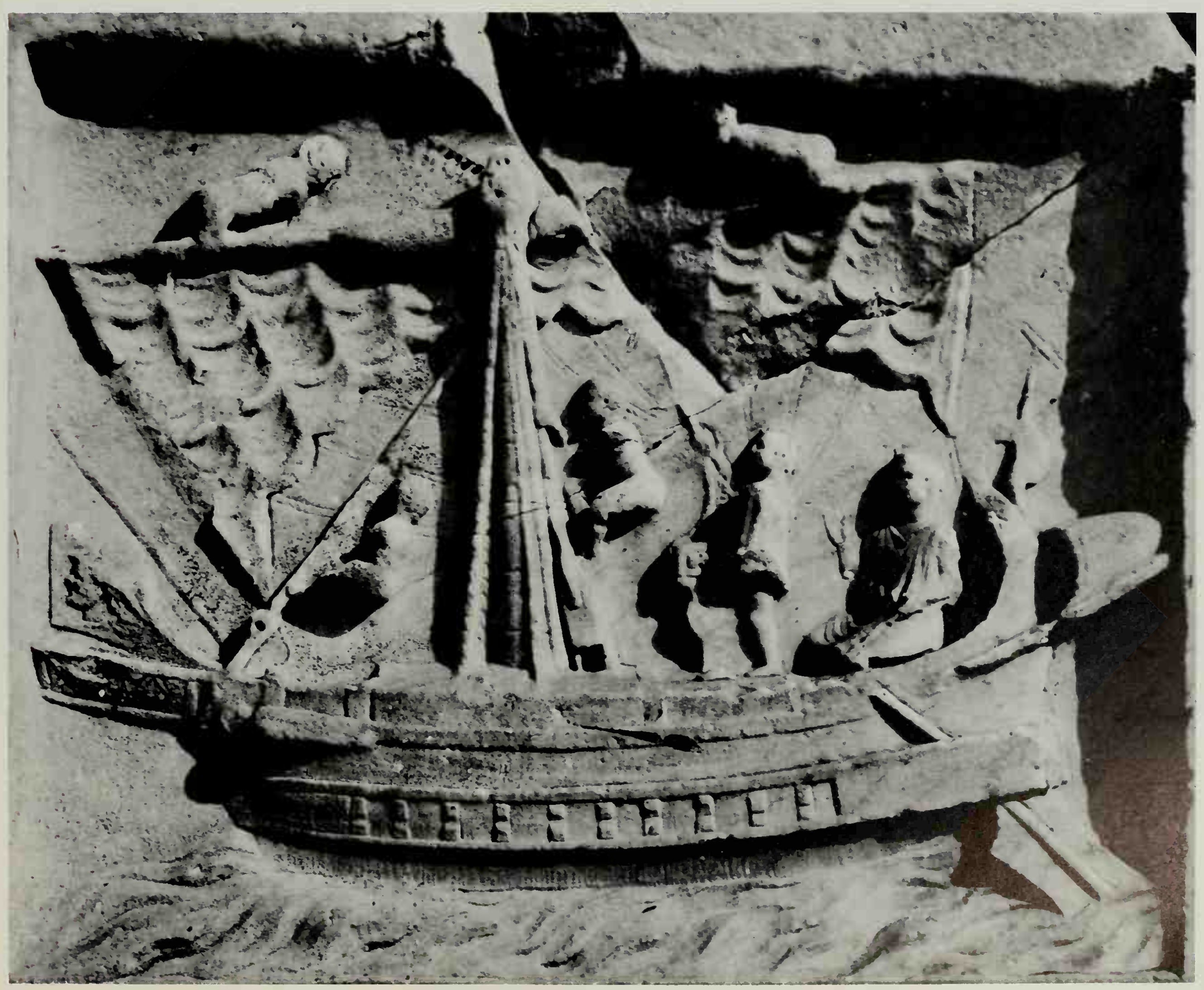
sail of later ages, on a raking mast that jutted over the bows. The foresail for some reason is never seen again after its appearance in the fifth century B.C. Perhaps it was gradually transformed into the artemon. A foresail is useful for added drive, but Greco-Roman merchantmen, with their big bellies and scant spread of sail, were built for space, not speed (they averaged no better than five knots with the wind and less than half that against), and the extra that a foresail could add would have been a drop in the bucket; the artemon, on the other hand, was strictly to aid maneuvering, and help on that score was unquestionably welcome. Some vessels carried a main topsail, a triangular piece of canvas that had its base spread along the main yard and its apex hauled to the truck. And the largest ships were three-masters, with a mizzen in addition to the main and artemon.

Standing rigging consisted of a heavy forestay and shrouds set up with tackles so they could be easily cast off. Since ratlines can't be used in shrouds of this sort, a ladder abaft the mast had to be provided for getting aloft, and this remained the practice in the Mediterranean for the next thousand years (below, p. 76).

Everyone knows of Rome's genius for building roads and organizing land transport. What isn't so well known is her genius for building merchant fleets and organizing sea transport. In her heyday, the first and second centuries A.D., Rome's merchant marine had



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62. Merchantman leaving port with a fair wind; about A.D. 200.

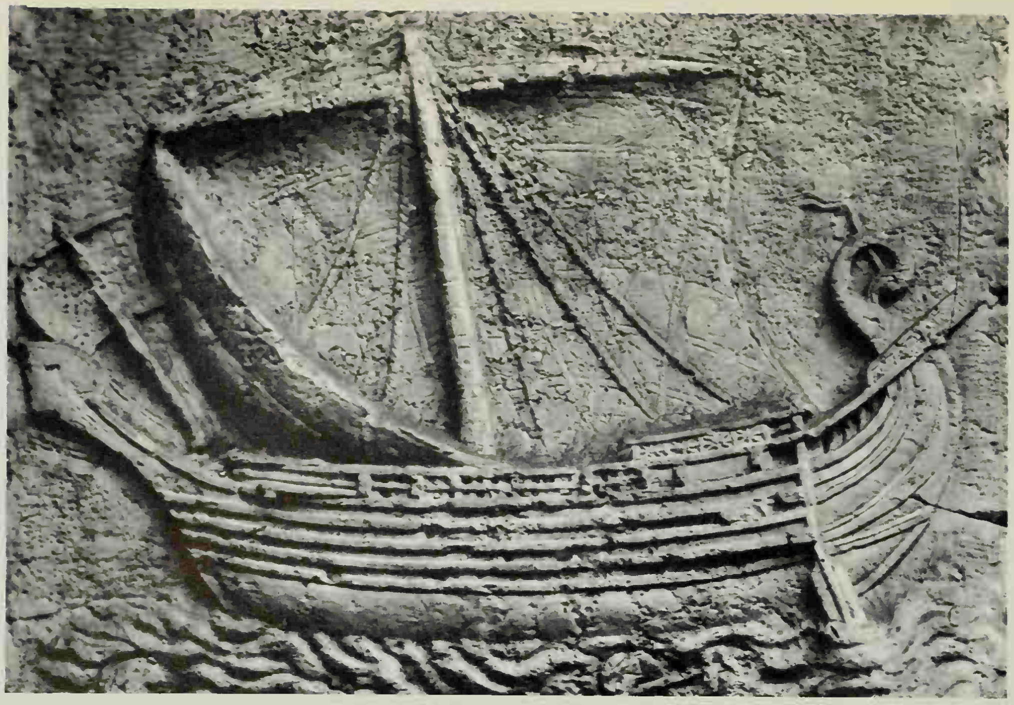
63

63. Etruscan fishing skiff of the fifth century B.C.

64

64. Another harbor boat, the type used for hauling grain from the port up the Tiber to Rome. Since the mast is stepped rather far forward, the vessel probably had some form of fore-and-aft rig, probably a sprit; see, e.g., illustration 72. It is named the *Isis Giminiana.* Farnaces, the skipper (*magister*), stands by at the steering oars. Stevedores carry sacks of grain aboard, which are emptied into an official measure under the eyes of the vessel's owner, Abascantus, and of a government inspector (holding an olive branch). A stevedore who has already emptied his sack rests in the bows. The picture probably adorned Abascantus's tomb.

65



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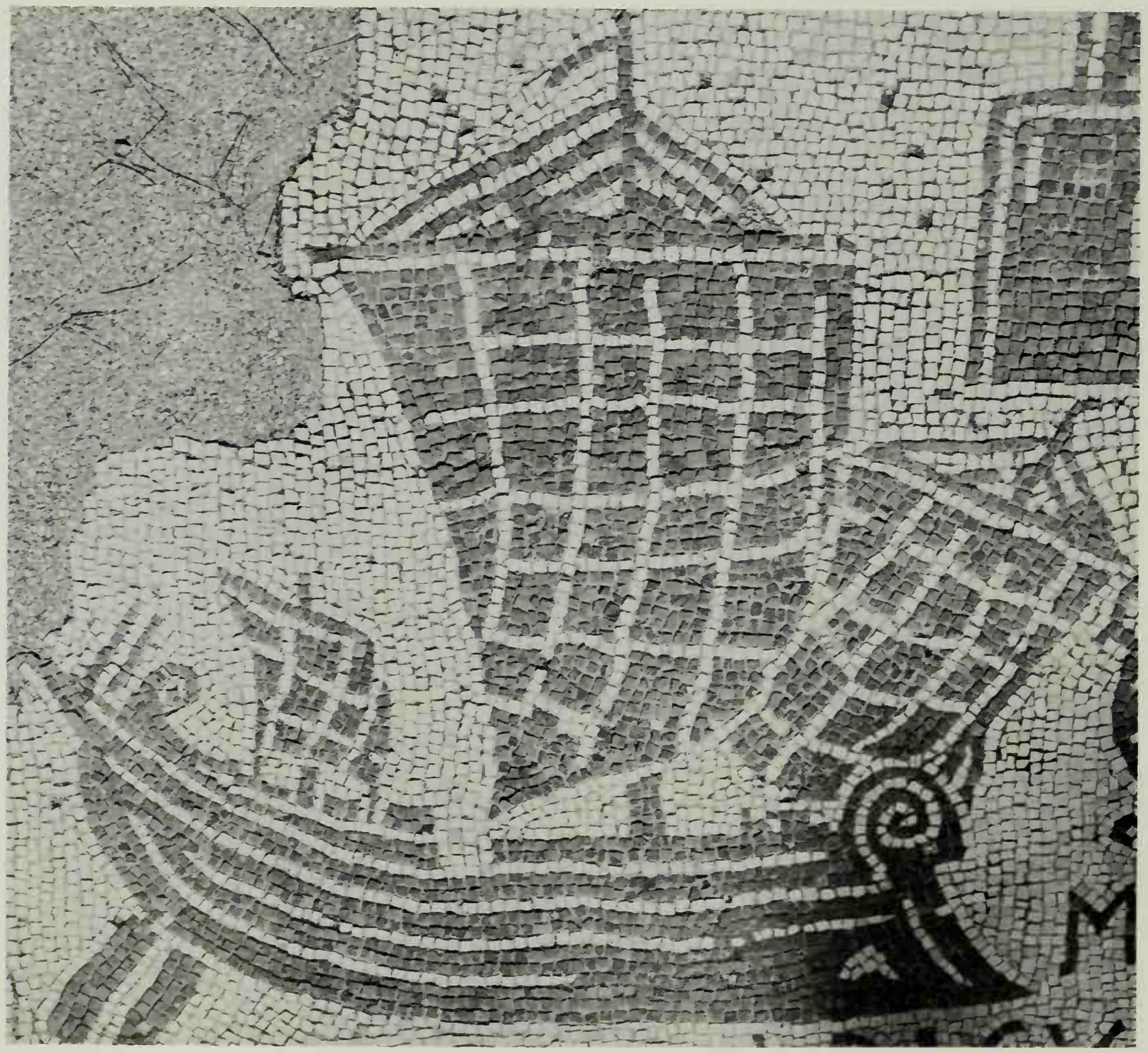

65. A big merchantman under sail; second century A.D.

66. Merchantman at the entrance of a harbor. A mosaic on the sidewalk outside the office maintained at Ostia, the port town of Rome, by Shippers of Sullecthum ([*Navic*]*ulari Syllecti*[*ni*]), a town on the coast of Tunisia; second to third century A.D. In the background is the harbor's lighthouse. The vessel is a big three-master.

67

68

69

SMALL CRAFT OF THE ANCIENT WORLD

67. Boat towed from a towpath along an inland waterway in the south of France, third century A.D.

68. Skiff in the act of warping a vessel into harbor; second century A.D. The towing line runs from the stern upward and off to the left. The steering oar is oversize to provide enough leverage to direct the clumsy tow. With the mast set so far in the bows, the boat must have carried some form of fore-and-aft sail, probably a sprit; see, e.g., illustration 71.

69. Harbor boat on a mosaic decorating the sidewalk in front of a shipping office at Ostia, the port town of Rome. Since the mast is designed to be unstepped and can't take, therefore, a permanent ladder, there is a series of cleats nailed to it for getting aloft. At the stern is a capstan. The ship on the right, though carelessly drawn the same size, is actually a seagoing freighter, and its cargo (one jar of which the stevedore has on his shoulder) is being transferred to the smaller boat to be brought up the Tiber to Rome.

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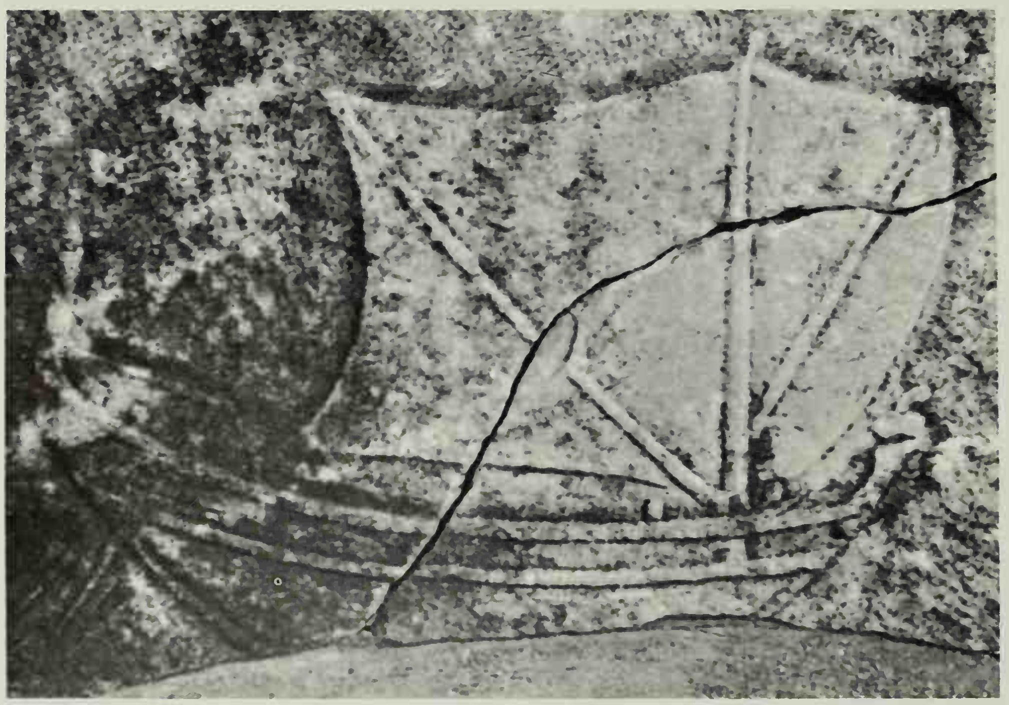
71

72



THE FORE-AND-AFT RIG IN THE ANCIENT WORLD

70. Boat of the second or third century A.D. rigged with the "Arab lateen."

71. A sprit-rigged small boat of the first or second century A.D.

72. Vessel of the second or third century A.D. traveling "wing and wing" under two spritsails.

73

74

73. Three merchantmen at the entrance to Portus, the harbor of Rome; third century A.D. Two boats (left and center) are racing out to rescue the boy (or man) who has fallen out of his skiff into the choppy sea. The sprit-rigged craft (center) has, in the process, come into danger of collision with a ship entering the harbor (right), and both are maneuvering frantically to avoid each other.

74. Detail of the foregoing showing the sprit.

more and bigger ships than any had ever had before or were to have afterward for the next fifteen hundred years. The vessels that handled government cargoes were commonly 340 tons burden, and those of the crack fleet Rome maintained to haul grain from Alexandria to the capital were no less than twelve hundred. An ancient writer, who inspected one of these giants, reported it was all of 180 feet long, forty-five wide, and forty-four deep in the hold.[1] There were perhaps one hundred of them in service at all times; very many centuries were to pass before a merchant fleet the equal of this sailed the seas. Circumstances occasionally called for individual ships of even greater size. The Egyptians had built big barges to haul obelisks down the Nile; the Romans, who had a passion for obelisks as civic monuments, built even bigger seagoing vessels to carry the massive stones across the Mediterranean to Rome, where many still stand today. The shaft now in front of St. Peter's is about 130 feet high and weighs, together with its pedestal, just under five hundred tons; the Emperor Caligula had it brought over about A.D. 40, and the vessel he used for the job was ballasted with eight hundred tons of lentils—a total load of thirteen hundred tons. When Pope Sixtus V's architect, Domenico Fontana, in 1585 moved the obelisk from its original location in Nero's circus to where it stands now, he used eight hundred men, 140 horses, and forty rollers, and the whole contemporary world broke into applause at the feat. But Caligula's seamen and engineers had taken the monument from Heliopolis near Cairo, barged it down the Nile, loaded it onto the ship, sailed it successfully across the Mediterranean, transferred it again to a barge to get it up the Tiber, and re-erected it at the point where Fontana found it.

For sea and bay and river there was, naturally enough, a variety of craft: canoes, skiffs, fishing boats, river boats, harbor boats, small coasters, and so on. Though most carried square sails, this was not, by any means, the only kind of sail Greek and Roman seamen set. They not only knew the fore-and-aft rig, but two varieties of it. One was the so-called "Arab lateen," the lateen with its lower corner clipped off to form a short luff; it's quite likely the true lateen was known as well. The other was the sprit, a rig so much at home in northern waters that finding it in the Mediterranean came as a considerable surprise; it had always been thought to be a Dutch invention which went no farther back than the fifteenth century. The sprit-rigged craft were for the most part small fishing smacks or the like, but there is a carving, done sometime in the third century A.D., that shows one which is much bigger. Three ships are depicted, neatly illustrating different types afloat at the time. The two on the outside are square-rigged; the one on the left has the traditional round hull, while that on the right has a projecting forefoot (it is not a ram, for a ram has no place on a merchantman, but a bow design found on many Greco-Roman craft ranging from tiny skiffs to big freighters). The one in the center is round-hulled and the same size as the others, but it carries a sprit-rig. The mast is stepped far up in the bows and the sail made fast to it by the luff, very loosely, as was the Dutch practice on occasion centuries later. A double-ended line ("vang" in the sailor's jargon) running to the tip of the sprit permits trimming of the peak; no vertical brails are visible since they have no place in such a rig.

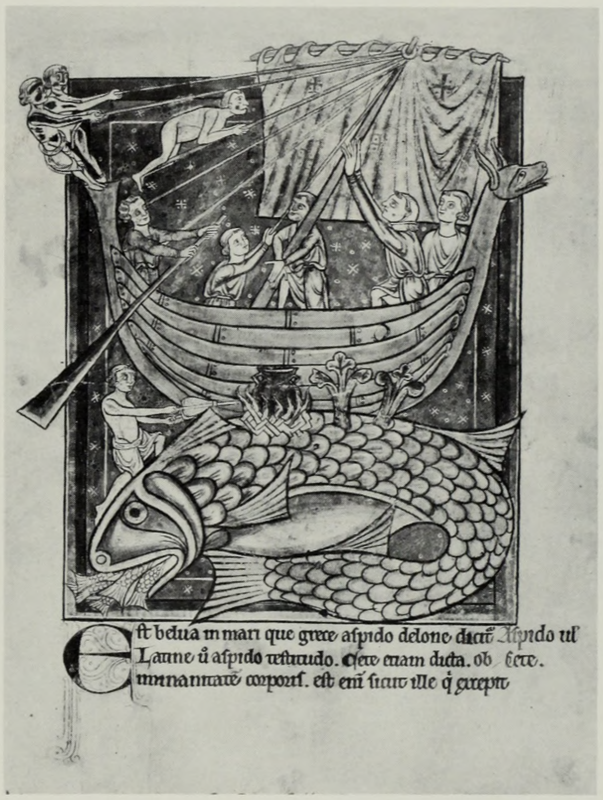
Illustration 73, p. 55

The varied craft, big and small, to be seen in Rome's harbors did not disappear when she fell. We shall see that they and their descendants continued to sail the Mediterranean for many a century.

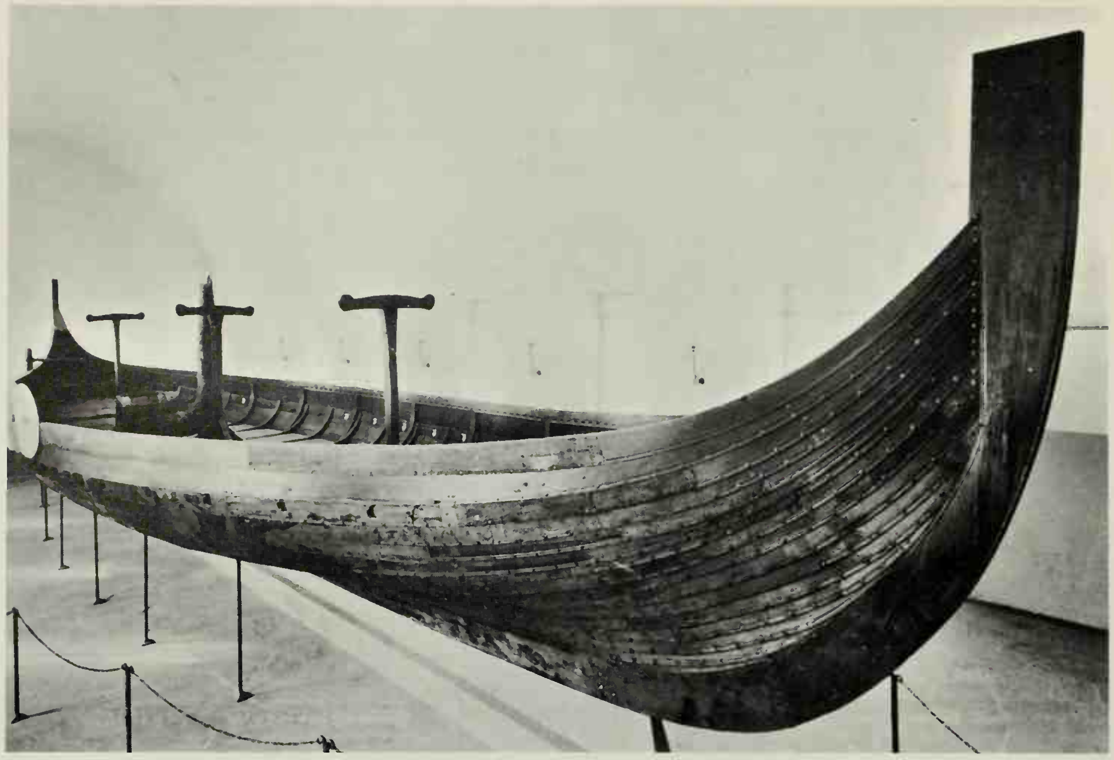
[1] St. Paul, when he suffered his celebrated shipwreck in A.D. 62, was a passenger on one of these great grain ships.

Part Two

THE GREAT AGE OF THE SAILING SHIP



75A



75B

75. The Gokstad ship as it now appears, reconstructed, in the Viking Museum, Oslo. Prow and stern have been left unfinished; originally they no doubt had carved decoration. You can clearly make out the rivets that hold the overlapping planks to one another, the oarports, the tiller socketed into the steering oar, the floor. The frames run only up to the beams; from that point knees, anchored on the frames, continue to the gunwale. The three stanchions on the centerline carried ridge-poles to hold up an awning over the amidships section. The box into which the base of the mast fitted is visible behind the middle stanchion.

CHAPTER FIVE

The Beginnings (A.D. 500–1450)

NORTHERN EUROPE

"THEY build their hulls with somewhat flatter bottoms than our craft to make it easier to go through the shallow depths of low tide and over the shoals; they build prow and stern up rather high to handle the size of the waves when a sea is running; and they use oak throughout to withstand any amount of violent pounding. Beams are of timbers a foot square made fast with iron nails an inch thick, and anchors are held by iron chain instead of rope. Their sails are of hide or softened leather instead of canvas, possibly because they have no flax or don't know how to use it, but more likely because they figure canvas won't stand up to the violence of ocean storms and the force of the winds there or drive such heavy vessels efficiently. In a clash with a fleet of these craft the only advantages our boats had were their speed and the fact that they were driven by oars; in every other respect the enemy's type of ship was better suited and adapted for these waters with their strong winds." So Julius Caesar described the vessels that faced him in battle in 56 B.C. off the northwest coast of France; he was out to subdue the Veneti, who lived in Brittany, and he had discovered that the only way to do it was to rob them of their control of the sea.

Strong winds, heavy seas, tides, shallows—Caesar's keen eye caught the key factors that shaped the boats of northern Europe and made them so different from the craft he was used to, those built for the almost tideless Mediterranean with its moderate summer winds. No examples of the ships he saw have ever been dug up—that would be too much to expect. But the next best thing has, a well-preserved specimen of a large boat of the third century A.D. found at Nydam in Jutland. It is no primitive affair but a beautiful example of the shipwright's art, nicely adapted to the conditions it had to meet. Over seven centuries were to pass before northern seamen introduced any radical changes.

The boat from Nydam is a recognizable relative of a modern dory—but an elegant, noble relative. It was clearly designed for offshore work, not the open sea: oars alone —fourteen a side—powered it; there is no sign of a sail. The hull is slender (length seventy-six feet, beam eleven feet), and though shallow (the depth amidships is only four feet), has graceful lines. There are three prime features that mark off this hull—and the hulls of all northern ships—from their brethren in the Mediterranean: it is double-ended, fitted with only one steering oar on the starboard (originally "steerboard") side, and clinker-built, i.e., the planks overlap each other like siding on a house. These overlapping planks weren't merely nailed or pegged to each other but riveted by iron nails capped with washers; in addition they were lashed to nineteen ribs. Add the fact that the planks themselves, as on the ships Caesar described, were of oak, and the result is a hull well able to stand up to the demands of northern seas.

In the eighth century A.D. those celebrated seamen, the Vikings, were already making naval history. We tend to think of them as a bunch of hit-and-run pirates. They were a good deal more than that. In search of trade they pressed up the rivers of Russia to the heart of the country. They spilled into Ireland, England, and northern France, to conquer territory and plant colonies. They discovered and settled Greenland—and then discovered and came within an ace of settling North America. And, when they did go out for plunder, their hunting packs were large enough to attack and lay waste whole communities. Viking kings who undertook major enterprises commanded fleets of impressive size. Godfrey of Denmark threw no less than two hundred ships against the coastal defenses of Holland about A.D. 810, and Sven Estridson sent 250 against England in 1069. No one dared challenge a Viking fleet—except other Vikings.

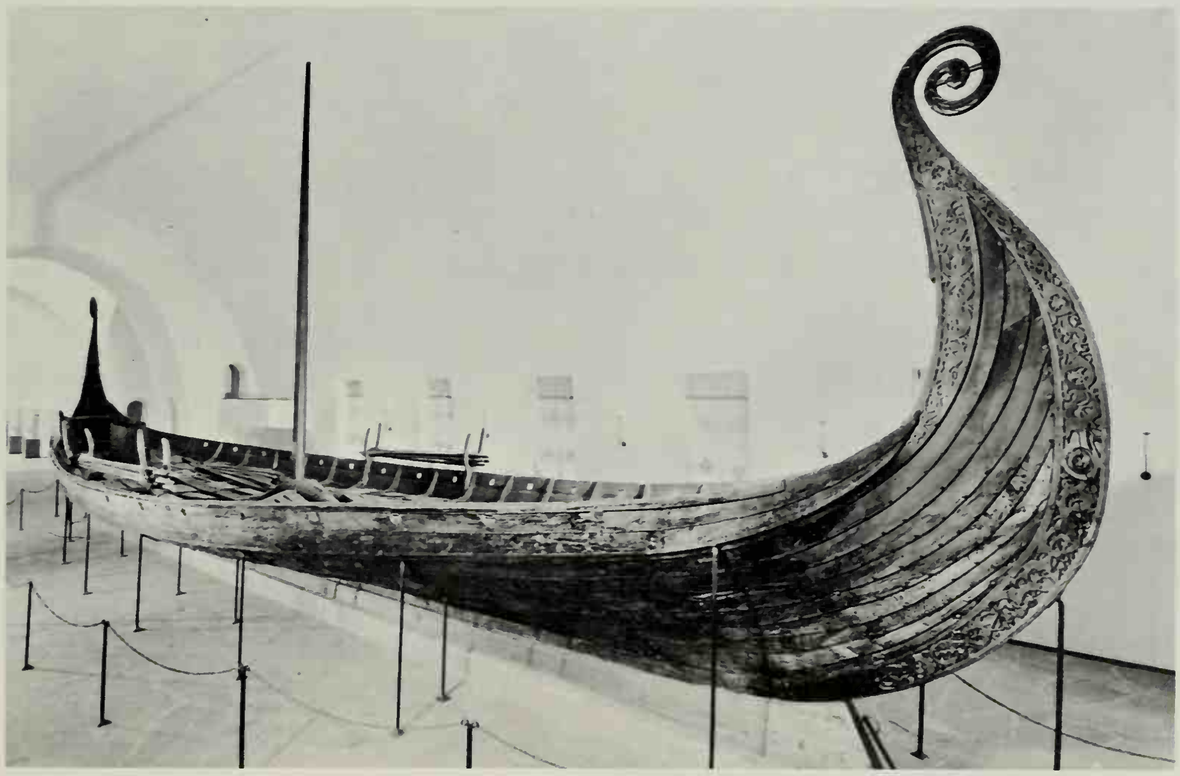
For many a Viking, the sea was, fittingly, his grave. If a lord died on land he sometimes arranged the next best thing: he had himself buried in an actual boat covered with a mound of earth. His family may have been unhappy about the expense of such a funeral, but we certainly are beneficiaries: a number of these graves have been discovered and, as a result, we have a very good idea of the craft that made possible the Vikings' amazing career.

Among the most famous tombs is one dated about A.D. 900 that was uncovered near Gokstad, not far from Sandefjord in Norway. It was excavated in 1880 and in it was found a boat well enough preserved to be carted to a museum in Oslo, set up there, and fully restored. It is striking how little change took place in northern craft in over five hundred years: the Gokstad ship is not much more than a seagoing version of the one from Nydam; it has the same general shape and is constructed in the same way. Since it was built for open rather than coastal waters it is considerably beamier and deeper, more strongly built and, most important, in addition to its oars carried a large square sail. Leif Ericsson might very well have used such a vessel to reach America; as a matter of fact, in 1893, a replica was sailed across the Atlantic to help celebrate the World's Columbian Exposition. It made the voyage handily in spite of continuous bad weather.

The Gokstad ship is seventy-eight feet over-all, sixteen feet, nine inches in beam, and six feet, nine inches deep amidships. Her oaken planks, as on the Nydam boat, are riveted together and lashed to ribs (seventeen, set three feet apart). There are sixteen oars a side, each about 17½ feet long. The Nydam boat, built for coasting, has oar-rests lashed to the gunwale. The Gokstad ship, built for open water, has oarports pierced in the hull eighteen inches below the gunwale and provided with ingeniously pivoted shutters on the inside to seal them when the ship was under sail. The beams, two feet above the keel, support a floor of loose planks. There are no signs of benches for the rowers; perhaps each lashed a sea chest to the floor and sat on it. On the starboard quarter is a ten foot steering oar made fast to the hull top and bottom, and turned by a horizontal tiller socketed in the handle; the captain who sailed the replica to America was enthusiastic about the performance of this rudder. The mast, of pine, was probably forty feet high, could be unshipped and lowered, and carried a square sail. No sail was found in the tomb but we know from Viking poetry that they were gaily colored, sometimes blue, sometimes red, sometimes striped red and white.

Though the Gokstad ship was a seagoing boat it was small as Viking craft went. The normal man-of-war had twenty oars a side, and thirty was not uncommon. In A.D. 1000

76



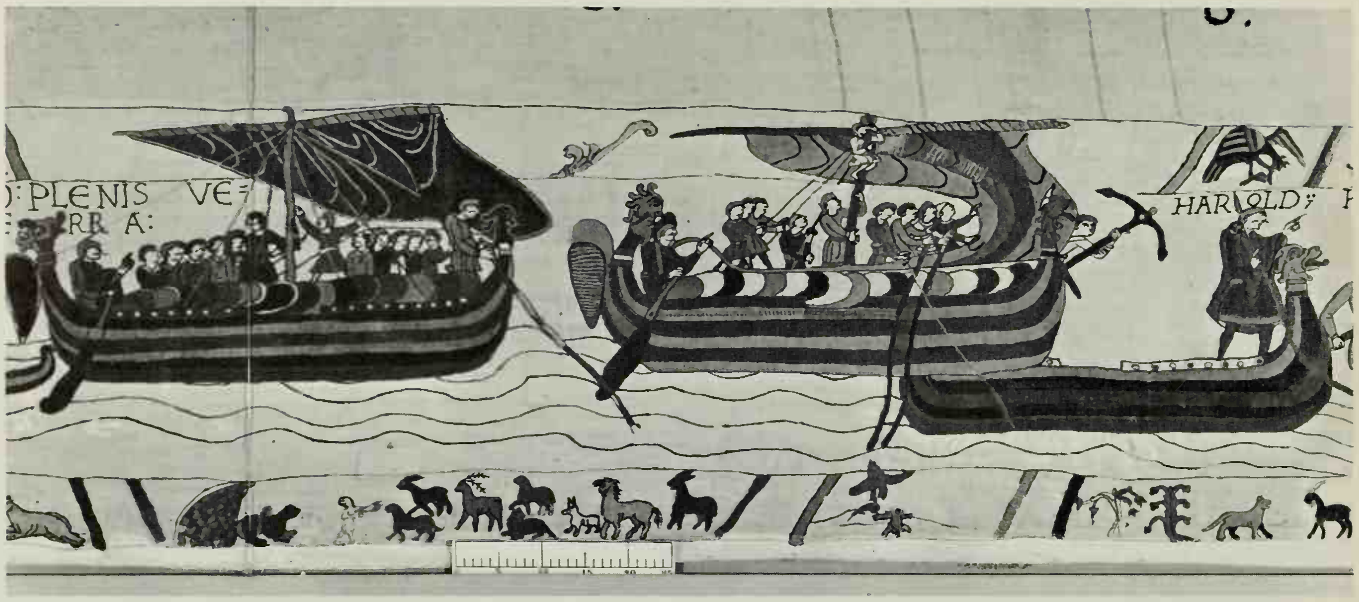
76A

THE OSEBERG SHIP, ABOUT A.D. 800

76. The ship when discovered in 1903 at Oseberg near the entrance to the Oslo Fjord.

76A. The hull, fully reconstructed, in the Viking Museum, Oslo. The Oseberg ship is smaller and not as sturdy as the one from Gokstad, and was probably meant for coastal work. The carving, on each side of the prow, is a superb example of Nordic art.

77



78

THE BOATS ON THE BAYEUX TAPESTRY, ELEVENTH CENTURY A.D.

77. One of Harold's ships (they have a break in the gunwale amidships; the Norman vessels have a straight gunwale); a hand forward sounds with a pole as the fleet approaches the coast of Normandy. These craft are very similar to the Gokstad ship—they even have the same number of rowers, sixteen to a side.

78. One of William's boats transporting the horses subsequently used in the Battle of Hastings.

Olaf Tryggvason added to his fleet the longest ship in Viking records, his famous *Long Dragon;* it had thirty-four oars on each side and probably ran all of 140 feet in length. On the other hand, the humble cargo boats that the Vikings used along their coasts weren't nearly as big or as graceful as their warcraft. Danish archaeologists have recently excavated a few examples dating about A.D. 1000. The biggest is about sixty feet long and almost fifteen wide.

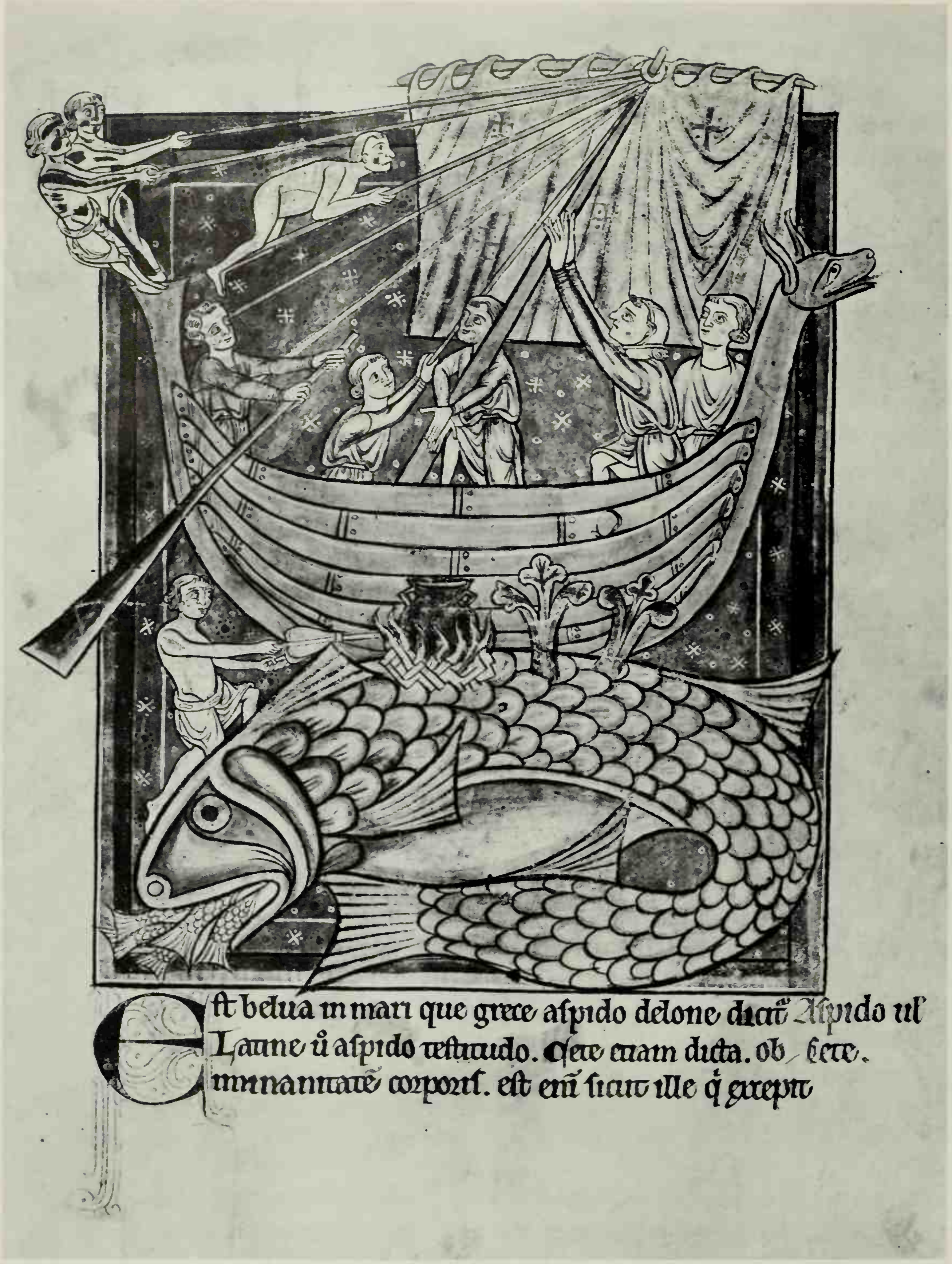
A century and a half later northern ships still hadn't changed. In 1066 William the Conqueror defeated Harold II of England at the Battle of Hastings. A few years after the event a group of ladies wove the famous Bayeux Tapestry, which gave Harold's story in pictures, including a shipwreck he once suffered off Normandy and William's invasion. The ladies were no naval architects, to be sure, but they had their husbands to consult, and their ships, though a little naïve, are nevertheless believable. And they are all the standard Viking type.

Finally, after eight centuries of marking time, things began to move. The Vikings lost their grip on the sea, organized maritime trade became possible, and merchants had to have something roomier than the likes of the Gokstad ship for the bulky cargoes that now crossed the water. Kingdoms arose in England and France, they of course had to be at each other's throat, so a need arose for boats to transport troops and to supply for their blueblooded officers something more in the way of accommodations than a hard-bitten Viking sea-lord's modest requirements. By A.D. 1200 the Viking ship had put on weight and was on its way to becoming the cog, the standard one-masted sailing vessel of the north for the next two centuries. She was still double-ended and clinker-built, but she now relied principally on the wind, and her oars were for auxiliary use only. She was shortened, her draught and beam increased and, when she went to war, castles were temporarily set up fore and aft, the forecastle to give marines a high platform for raining down missiles, the sterncastle to provide shelter for any brass hats aboard. The deeper, broader hull enabled her to sail against the wind as well as before it, so the rig too saw some improvement. The mast was now set up more strongly with shrouds bracing it against the thrust of winds from the side. Bowlines made their appearance, and with them a bowsprit: when a square sail is set toward the wind the leading edge—the luff—has a tendency to curl, and bowlines are lines tied to it and led forward to keep it flat; on the cog with its single big sail the bowlines had to be carried well beyond the stem to do the job properly, and the bowsprit supplied a point to make them fast to. (Another 250 years were to pass before bowsprits carried their own sails.) There also came into being at this time the device we use today for shortening sail, reefpoints, small pieces of rope hung in pairs in a horizontal line across the sail; the canvas is rolled up like a scroll and they tie neatly about the bundle.

Illustrations 79–83, pp. 63–67

By the thirteenth century two more all-important improvements had been made. First, after a delay of over several millennia, there was finally invented that simple yet superlatively efficient piece of nautical equipment, the stern rudder. Nobody knows who or even what country deserves the plaudits; all we can say is that it suddenly emerges in the north about this time. As a matter of fact, it or something like it was inevitable now that northern ships were built to sail into the wind. A vessel tends to heel on such a course; this was no problem to southern craft with a steering oar on each quarter (see below, p. 77)

79



TWELFTH-CENTURY VESSELS

79, 80. A miniature from a manuscript; also, a seal (the document it is on is dated 1437, but the seal had been in use for well over a century). Both ships are clinker-built double-enders, but they seem to be heavier and beamier than their Viking forbears. The mast is still made to be raised and lowered. The sail has three rows of reefpoints.

80

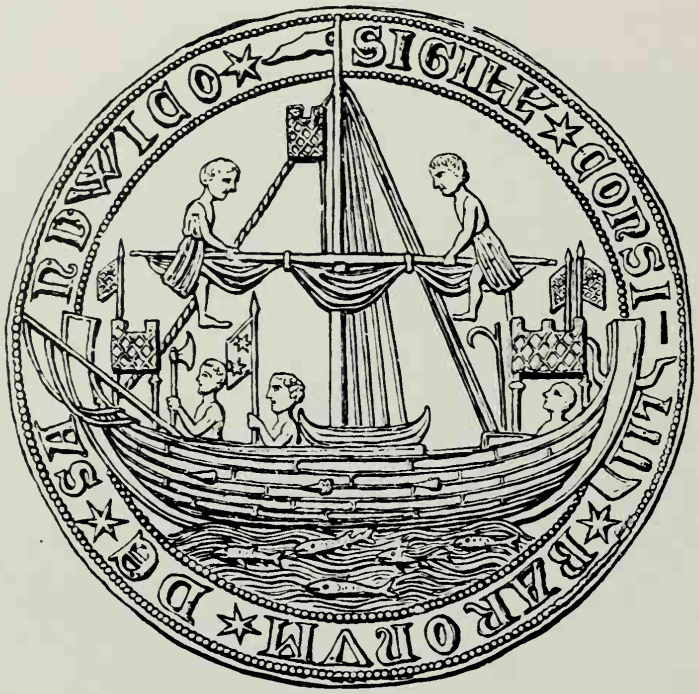
—a possible reason why the rudder never came out of the Mediterranean—but a northern vessel, if pressed down hard enough to port, might find its single oar clear of the water. With the advent of the new invention, northern craft ceased to be double-ended: the stern gave up its curve in favor of a vertical post which made hanging a rudder easier. The second improvement was to convert the castles from temporary additions into permanent parts of the hull. With this step the cog had achieved its final form, a stubby, clinker-built, one-masted vessel steered by a rudder and mounting castles fore and aft. Cogs weren't exactly things of beauty but they *were* exactly suited to their purpose, to meet the demands of northern seas and winds.

Illustrations 84, 85, pp. 67–68

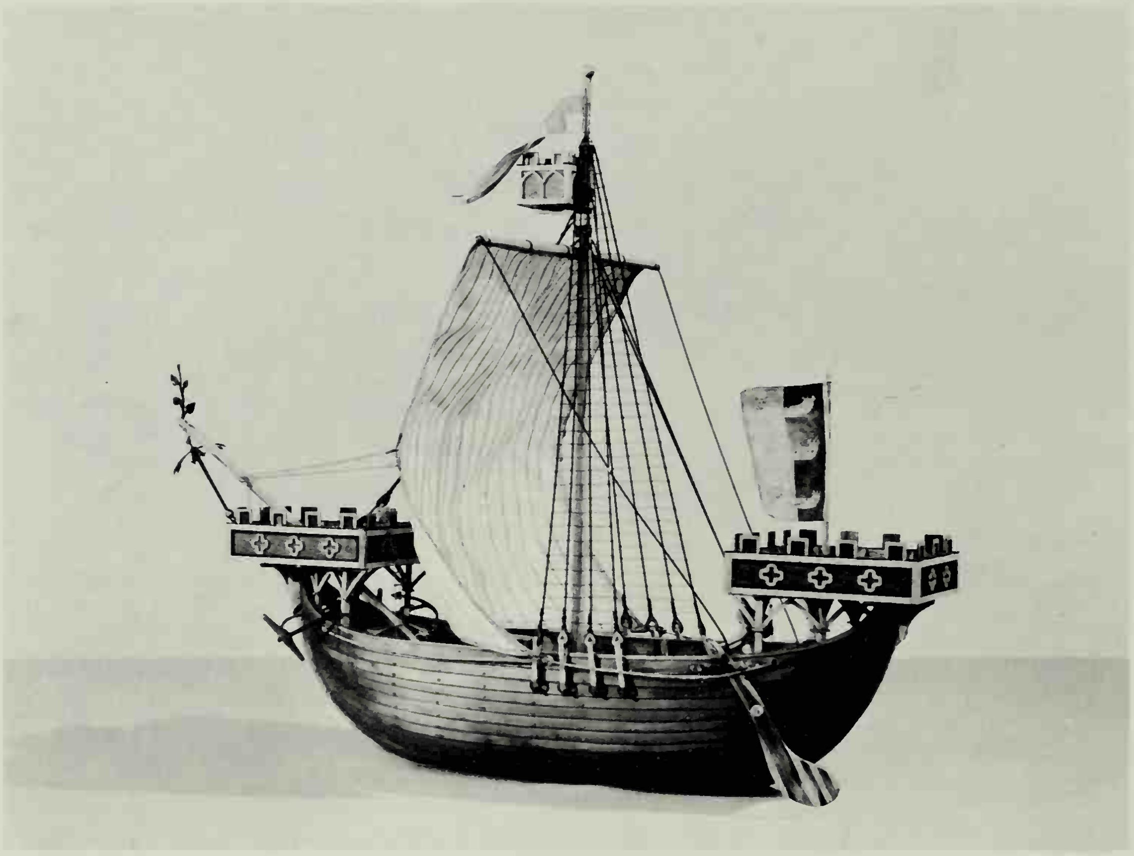
The cog was a ship of both peace and war. She plodded across the North Sea and English Channel carrying English wool, Flemish cloth, or Norwegian herrings. She lumbered into battle, coming to close quarters with an opponent so that her marines on their high platforms could rain down arrows, stones, pots of blinding quicklime, even soap to make the enemy's decks too slippery to stand on. In A.D. 1217 forty English ships sent to the bottom a French fleet of eighty that had come to invade; Matthew Paris, an English monk who wrote up the fight not long after, describes with understandable glee (and no doubt pardonable exaggeration) how his compatriots "buried the French under a rain of arrows, pierced them with lances, slit their throats with cutlasses, slaughtered them with swords, blinded them with quicklime, and punctured and sank their ships."

We have exasperatingly little information about the size of cogs. We're fairly sure about the proportions. The stubby cogs seem to have had an over-all length three times that of their beam, about the same as some of the Viking cargo carriers, and their depth in the hold apparently was one-half the beam. They never reached any great size. In A.D. 1299, for example, the ports of the south of England fitted out an expedition against Scotland. The largest ships were 240 tons manned by sixty officers and men, and the rest ran the gamut down to quite little fellows of sixty tons with a crew of twenty. Since the

81



82



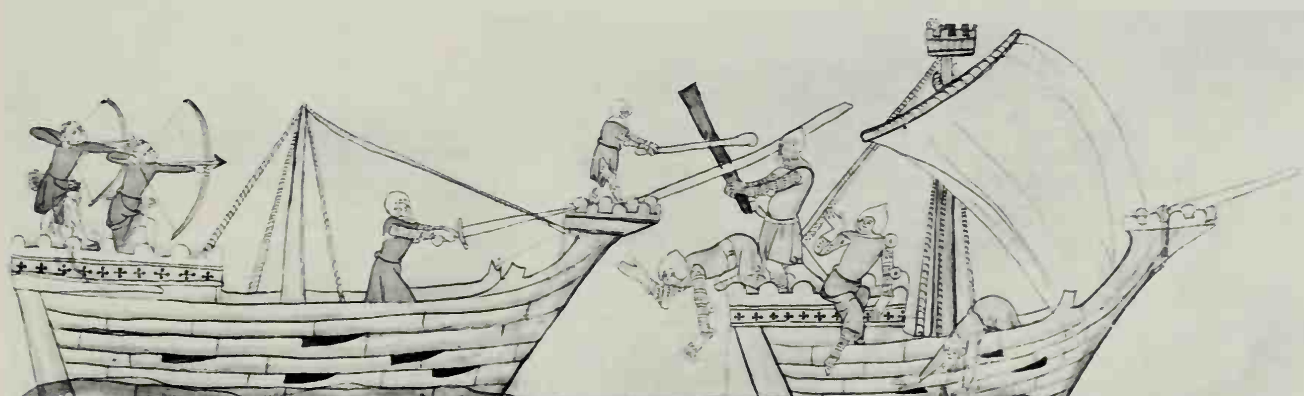
THIRTEENTH-CENTURY MEN-OF-WAR

81. Seal of the town of Sandwich, dated 1238. The ship shows important improvements over the craft of a century earlier. There are now castles fore and aft; in the sterncastle some lord, nose in the air, awaits the vessel's departure. The mast can no longer be unshipped and lowered but is set permanently in place and braced laterally by an elaborate set of shrouds. A bowsprit juts over the prow and, hanging slackly, are the bowlines to be made fast to the leading edge of the sail.

82. A modern model showing what the ship on the seal may have looked like.

83. A thirteenth-century warship in action.

83



84

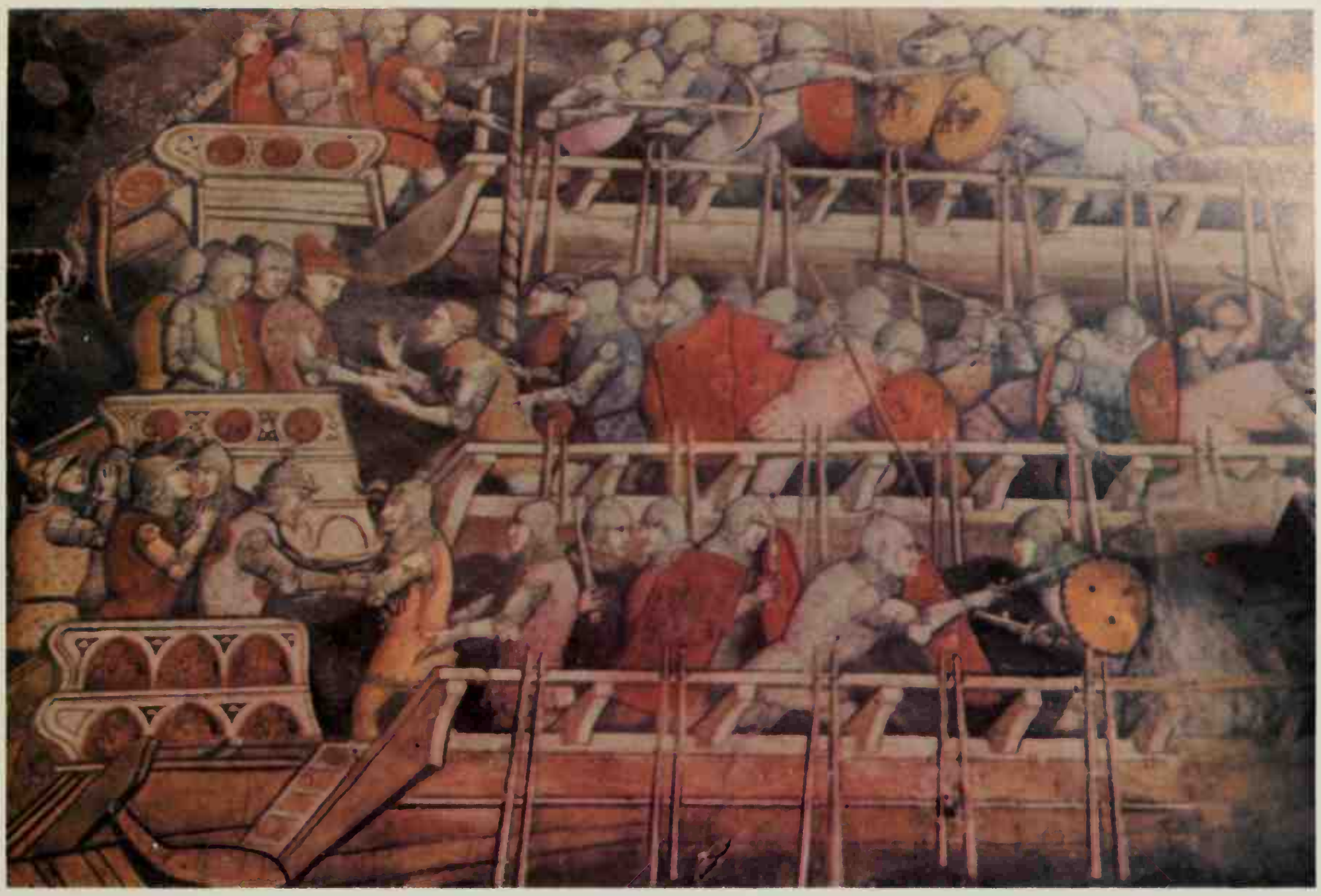
84. Fourteenth-century cogs in action. Prow and stern are no longer alike: the sternpost is straight and carries a rudder. The castles have been incorporated into the hull and the forecastle made the higher. The mast is capped with a top for lookouts—or, when in action, for archers and spearsmen.

85

85. Fifteenth-century cogs in action. These are examples of the cog in its prime, a stubby but massive and sturdy ship with a mast strong enough to support as many as four persons in its top. The sails carry reefpoints.

individual ships were small, the fleets were generally large. In 1340, Edward III met a force of 190 French and Genoese ships with two hundred of his own. In 1347 he launched an expedition to clear the seas as a preliminary to an invasion of France; he had no less than 745 ships with a total of 15,895 sailors (the figure doesn't include fighting personnel) aboard, or an average of twenty-one per ship. Apparently he had laid his hands on everything that would float because his actual men-of-war, that is, ships fitted with castles numbered only fifty.

In the course of the twelfth century northern craft occasionally made their way around Spain and into the Mediterranean. In 1189 the Third Crusade began and a whole fleet, from both sides of the English Channel, sailed through the Strait of Gibraltar. A century later cogs were a common enough sight in the ports of southern France and Italy. There they caught the eye of the Mediterranean sailor. He approved of certain significant features and took them over for his own vessels. It was a major step, one that was soon to lead to that queen of the seas, the full-rigged ship.



86

86. Galleys of about 1400 in action. The oar arrangement is *a zenzile* in units of two. The masts have apparently been unstepped and stowed away. The fight purports to be one between Venice and Frederic Barbarossa that took place in the twelfth century.

87

87. One of the standard large galleys in the Venetian navy during the fifteenth century. Though the picture was done between 1490 and 1495, the ship is a type that almost certainly had been in use long before. The oars are arranged *a zenzile* in units of three. The vessel has just made port and men are aloft furling the great mainsail. Very likely there was a smaller sail aft, but this presumably has already been furled and stowed away.

THE MEDITERRANEAN

Leaden skies and pounding seas had determined the design of northern Europe's ships. In the south the story is, appropriately, more romantic. Arabian spices, Chinese silks, mailed crusaders, ragged pilgrims, bluff Breton skippers, shrewd Italian traders—these are what shaped the craft that sailed the Mediterranean between A.D. 1000 and 1400.[1]

In the boisterous waters up north the galley had little part to play once the sailing ship was perfected, and it gradually receded into the background. But in the Mediterranean, where the summer weather is generally mild and calms are frequent, it not only continued in its traditional role but took on a new one: the Greeks and Romans had used galleys as men-of-war; Venice and Genoa and other great trading cities of the Middle Ages used them as merchantmen as well.

Until 1300 overseas commerce was still handled for the most part, as it had always been, by sailing vessels. Since the average cargo-carrier was big enough to take sizable loads and needed only a few dozen hands as crew, it was able to sell its space fairly cheaply. But if freight rates were low, insurance was high. The ships sailed a direct course over open water; if a storm came up, a skipper had no alternative but to ride it out. The small crews meant lower overhead—but also fewer fighters in case pirates tried to board. Furthermore, as time went on a new and profitable sideline, the medieval version of the tourist trade, came into being: transporting pilgrims to the Holy Land. Pilgrims could, and very often did, travel by sailing ship, but the long unbroken voyage in a vessel crammed with human freight that had to be bedded, watered, and fed, was no joyride. It was Venice, the greatest of the trading nations, which came up with a vast improvement: around 1300 she put into service the first merchant galleys. A galley kept away from open water and stuck to the coast. To the pilgrims this spelled comfort, since each stop meant fresh food and an uncramped night ashore; to the merchant safety, since the ship could run to land from storms; and to both ease of mind, since, instead of a handful of deck hands, there were a hundred and fifty husky rowers aboard to help repel attack. The same rowers, of course, made the passage fare on a galley far more expensive than on a sailing vessel, but it was worth it. Galleys turned out to be so safe that, after a while, shippers didn't bother to insure cargoes.

Compare Illustration 51, p. 41

Ever since the fifth century A.D., the standard oared ship of the Mediterranean had been the two-banked dromon. Then, shortly before 1300 or so, things began to happen.

First there was a modification of the seating arrangements for the rowers. In a dromon, the banks were both inside the hull, one above the other. Now a form of ship appears in which both are lifted up to a higher point in the vessel: the lower rowers, seated alongside the gunwale, pull oars pivoted upon it, while the higher, seated very much like the uppermost bank in a Greek trireme, pull oars pivoted on an outrigger.

It was the outrigger, making its appearance after an absence of many centuries, that triggered the next step, a revolutionary change marking an almost complete break with

[1] Even Santa Claus enters the act. St. Nicholas of Bari, to give him his formal name, worked many miracles. One of his most celebrated was saving a ship in distress. The subject became a favorite with Italian artists of the thirteenth to fifteenth centuries—and we have some fine paintings of contemporary ships as a result.

the past. The dromon, like the trireme and other ancient galleys, had its lines of rowers one above the other to enable them to row from a seated position and thereby produce a smooth, even stroke. Around A.D. 1300, all that went by the board: the rowers still pulled only one oar but, instead of being in two tiers, were all seated, side by side, on one level —and, until the oared warship left the seas for good in the nineteenth century, there they stayed.

In order to accomplish this reseating, all the oars now pivoted on the outrigger. Moreover, they were gathered into clusters, at first of two and later of three, and the oarsmen of each cluster sat on the same bench in echelon, *a zenzile,* to use the technical Italian term. Since this put the rowers well inboard of the outrigger, the oars hit the water at an oblique angle and had to be, therefore, very, very long, the way they are on a racing shell. On the largest type of galley in common use, those with three men to a bench, they were no less than twenty-nine to thirty-two feet in length. They had iron sunk in the handle to counterbalance the outboard portion and make them manageable; including the iron, each weighed about 120 pounds. With oars such as these, rowing from a seated position was out of the question. The men had to rise, place their left feet on a raised step in front of the bench to gain sufficient height to get the blade into the water, and then throw themselves back on the bench for the pull—all in perfect unison. The stroke was necessarily short and choppy and, ending as it did with the simultaneous fall on the benches of over 150 men, drove the ship through the water in a series of leaps. But this was the price designers were willing to

Illustrations 86, 87, 91, 92, pp. 69, 75

88

88. A galley as pictured in the middle fifteenth century. John VI Palaeologus, Emperor of Byzantium, leaves Constantinople to visit Italy. The emperor has taken his seat on the poop (the only quarters a galley had to offer), hands have gone aloft to unfurl the sails, and the time-beater is raising his stick to give the beat to the rowers. The vessel carries two lateens, and has two files of oarsmen along each side, one pulling oars pivoted on the gunwale, the other oars pivoted on an outrigger.

89 

89. A square-rigged vessel of the fourteenth century. *See page 74.*

pay for a hull that, lower and far less top-heavy than an ancient trireme's, was that much more seaworthy.

For most of us the word "galley" evokes the mental image of lines of half-starved slaves tugging desperately at tremendous sweeps and getting a thwack of the whip for their pains. There hadn't been any on ancient galleys and there still weren't any on these ships either; slave-oarsmen, long sweeps, whips, all belong to a much later age (see Chapter Eight). The *a zenzile* galley, in which each man handled an oversize oar and had to do it cheek by jowl with one or more teammates, demanded a crack crew, not half-starved slaves. In the Venetian navy the benches were manned by free citizens who discharged their obligation to their country by wielding an oar instead of a sword; in the merchant galleys the rowers were skilled labor who received good wages—and if they weren't paid off at the end of a voyage they milled around the doge's palace and yammered until the government took action.

Smaller galleys had two oars to a bench, but the standard craft in both navies and merchant marines had three. Generally there were twenty-five to thirty benches on a side, or a

90

90. A small open boat with a single lateen; twelfth century. *See page 76.*

total rowing complement of 150 to 180 men. The Venetians had a number of warships with four to a bench, which were not very important, and even tried out—but never went much farther than that—a dreadnought of five.

In addition to oars, galleys carried a full spread of sail. Like most Mediterranean ships of the age they were lateen-rigged. Usually there were two masts, on the biggest craft three. *Illustrations 87, 88, pp. 69, 71* As on a modern ketch or yawl, the foremast carried the largest sail; it was an enormous piece of canvas spread by a yard that was sometimes longer than the ship itself. Since there was no way of shortening sail, each vessel carried a selection of smaller sails to use when the wind made up. The galleys traveled under oars as little as they could; whenever and wherever possible they sailed. On a man-of-war the rowers were saved for battle, and on a merchantman they were used the way a motor is on an auxiliary yacht, for getting in and out of harbor or for making a point in the teeth of a foul wind.

War galleys were slender, light, and, since the rowers were on one level, low in the water. Those with three men to a bench, for example, were 120 feet in length, fifteen feet in the beam, and a mere five feet from keel to deck. The underwater ram, which had been so prominent a feature of Greek and Roman galleys, was replaced by a pointed beak that served as a boarding bridge. Naval fights began with an artillery barrage of Greek fire (above, p. 42) until the end of the fourteenth century and of cannon fire after that and, whenever possible, continued with a boarding attempt. Even after naval guns were perfected, a galley's best weapon was still a hard-bitten boarding party who would rush along the beak once it jutted over an opponent's deck, leap, and have it out hand-to-hand with the enemy.

Compare Illustration 144, p. 120

Merchant galleys were heavier and beamier. The dimensions, for example, of the typical ship that made the long run from Genoa to London and Holland were

length	133¾′
beam	19¾′
depth	8⅘′
length of foremast	79⅕′ (circumference: 6′)
length of foreyard	107½′ (circumference: 3¾′)

Illustration 95, p. 78

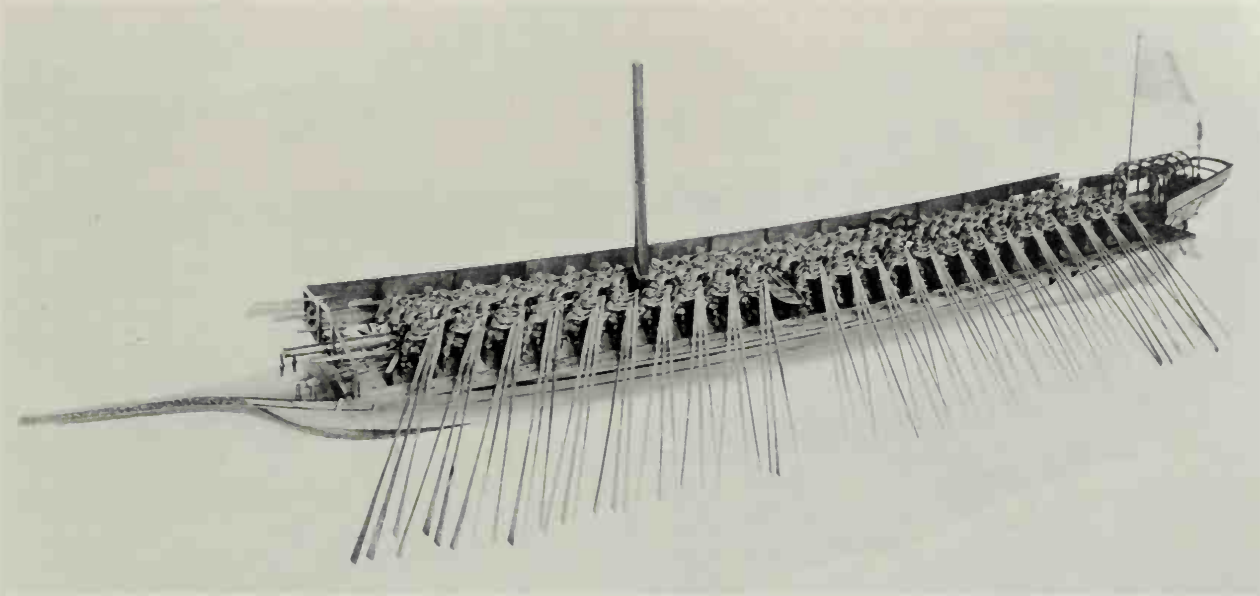
Since a galley's hold was merely the few feet between the planking over the bilge and the underside of the deck, the cargo capacity was limited: 140 tons was an average figure. No matter: little enough room was needed to accommodate a fortune in silks and spices. On the galleys carrying pilgrims to the Holy Land, the pious were packed in precisely like sardines, as many an eyewitness graphically testified. They were assigned oblong strips of space on the planking above the bilge: shoulder to shoulder they lay, their pates against the bulkhead and their feet against their gear which was piled along the centerline of the deck. With almost one hundred people wedged in this way, the place was stifling; with only four small hatches to give light, it was practically pitch dark; and right in the midst of everything was "the well for the bilge water. . . . A most loathsome smell arises from it, a smell worse than that from any closet of human ordure." And let's not forget to add to the picture the effects of seasickness. The poor pilgrims did enjoy one advantage: they could pry up a floorboard and cool their wine in the damp sand that was carried as ballast.

Nobles or other VIPs were quartered aft where there was an extra cabin below the captain's. They even had, at the stern, the "place necessary for purging the body" (everybody else used a pair of bottle-shaped contraptions, generally on each side of the beak —or any handy spot along the rails; the agile could crawl out on an overhanging oar). Forward of the cabins, on the starboard side, was the ship's galley and the pen for the livestock carried to furnish fresh meat. In the forepeak was a small chamber for the bow watch. In between was an indescribable clutter of benches, rowers, oars, spare spars, casks, chests, and so on.

Enough about galleys. Now for the sailing ships.

Illustration 89, p. 72

Greek and Roman mariners had known the lateen rig but had used it only on smaller craft; their big freighters all carried square sails. The mariners of the Middle Ages departed from this tradition. Though they still built square-rigged craft and, under the proper weather



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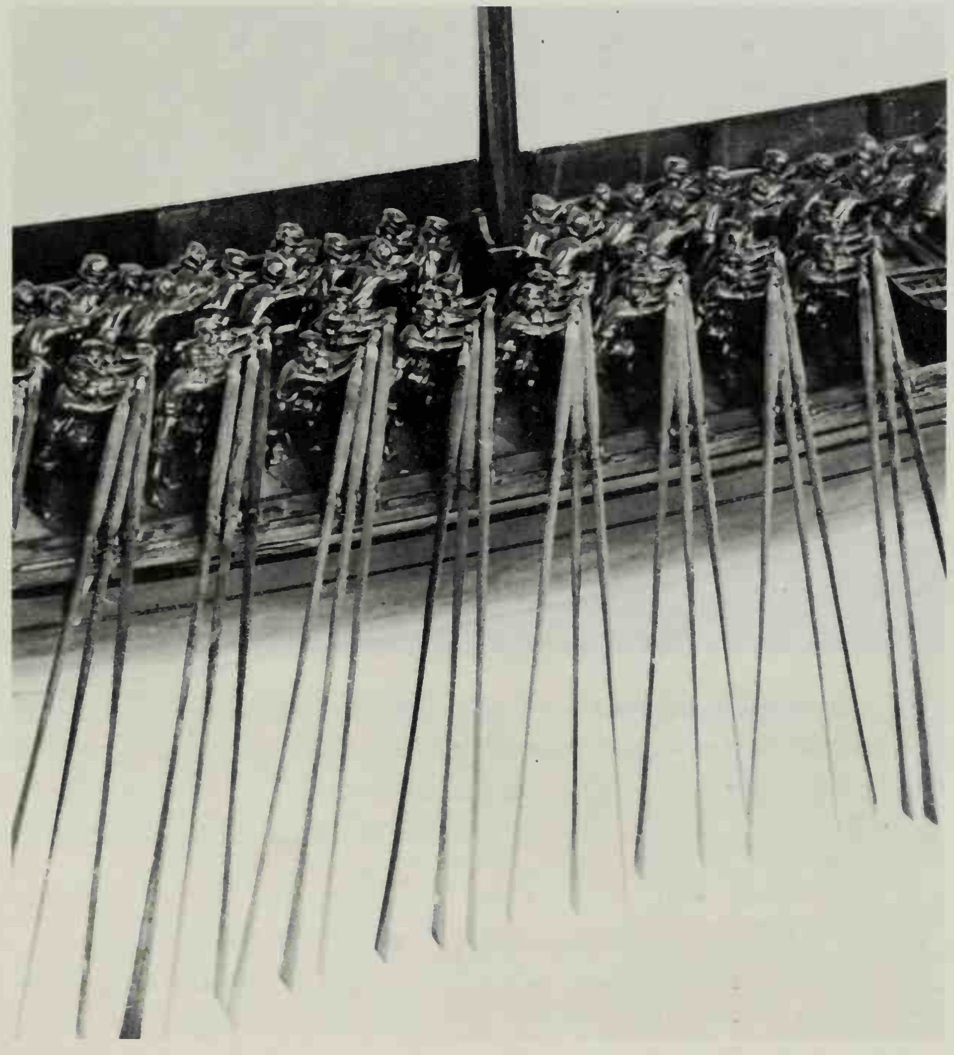


92

91. Modern model of the standard Venetian *a zenzile* galley of the fifteenth and early sixteenth centuries. The port parapet has been removed to show the details of the rowing arrangements. The framing that rises above the oarsmen on the starboard quarter is the kitchen.

92. Detail showing the rowers in the act of placing the left foot on a step in order to gain the height necessary to plunge the blade into the water; to deliver the stroke they threw themselves back on the bench.

93

93. A two-masted lateener of the middle of the fourteenth century. The prominent castle on the poop has been joined by two other equally prominent structures housing the steering oars.

conditions, even set a square sail on a galley (e.g., with the wind dead aft, they used to douse the big lateen, remove the awning that protected the rowers from sun and rain, and hoist it instead; it made an enormously wide, very efficient square sail), their favorite was the lateen.

Illustration 90, p. 73

They used the lateen rig for vessels of all sizes, from little boats with one mast to big freighters with as many as three. As on the galleys, the foremast carried the largest sail. The standing rigging was the same as it had been in Greco-Roman days, i.e., shrouds set up each on a block and tackle so they could be easily cast off—necessarily so, since tacking a lateener at times involved casting them off—and, since the shrouds couldn't carry ratlines, there was a ladder abaft the mast to enable the hands to go aloft. The steering apparatus

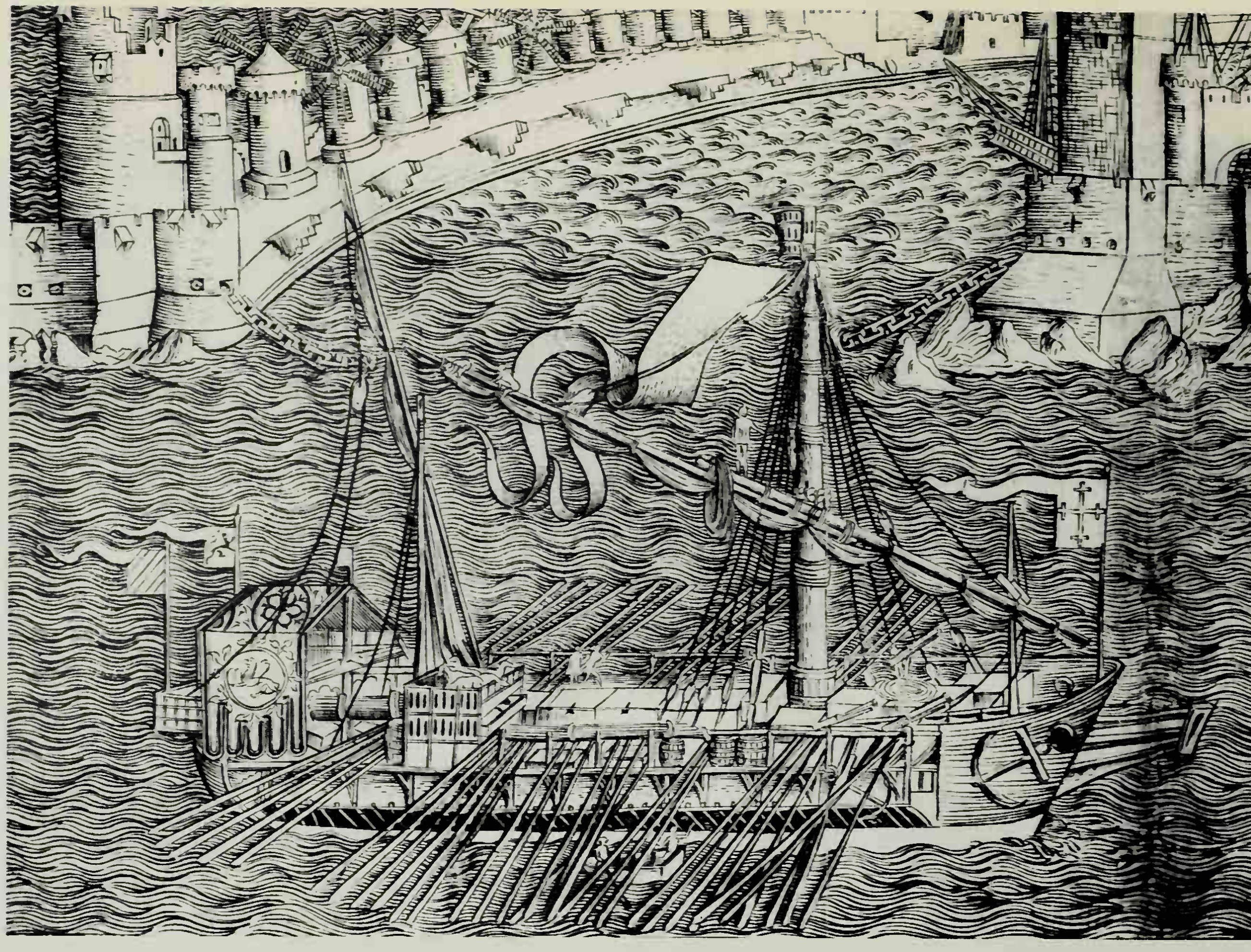

94

94. Painting of the early fifteenth century. In both this and illustration 100 the northern influence is complete: the hulls are heavy and well-rounded, there are superstructures fore and aft, the stern rudder has replaced the steering oars, and the rig consists of a single lofty and powerful mast with a tall square sail. The bowsprit carried no canvas; its purpose was to receive the outboard ends of the bowlines. *See page 82.*

hadn't changed either; as on the most ancient Mediterranean ships, it was still an oversize oar on each quarter.

The freighters of this period, though smaller than the leviathans the Romans used, could still reach respectable size. During the Third Crusade in 1191, the fleet of Richard the Lion-Hearted ran into an Arab three-master that, Richard's chronicler reports, had fifteen hundred souls aboard—no small ship even if we take the figure with a few grains of salt. Actually there's no need to. The *Oliva* and the *Paradisus Magnus,* as contemporary documents show, were average ships on the Genoa–Syria run about A.D. 1250; the first carried a crew of seventy-five and had berths for no less than eleven hundred pilgrims, the other a crew of one hundred and space for six hundred tons of cargo. Note the distinction. Shipowners were perfectly willing to handle both types of cargo, human and bulk; it was the merchants who objected. They made the voyage along with their wares, and limited strictly the number of living creatures, human or animal, that could ride with them. Though at nighttime they had their own quarters (temporary wooden shacks each was permitted to put up on the gangways between poop and prow), they spent the day and ate their meals on deck, and they weren't anxious to share too much of this space with gamy fellow travelers.

95



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97

95. A large merchant galley of the kind used to carry pilgrims to the Holy Land; late fifteenth century. The oars are arranged *a zenzile* in units of three. The ship is far heavier and beamier than a man-of-war, and the decks are cluttered with all the gear and stores needed for the voyage. The square structure on the starboard side houses the galley and the pen for the livestock. *See page 74.*

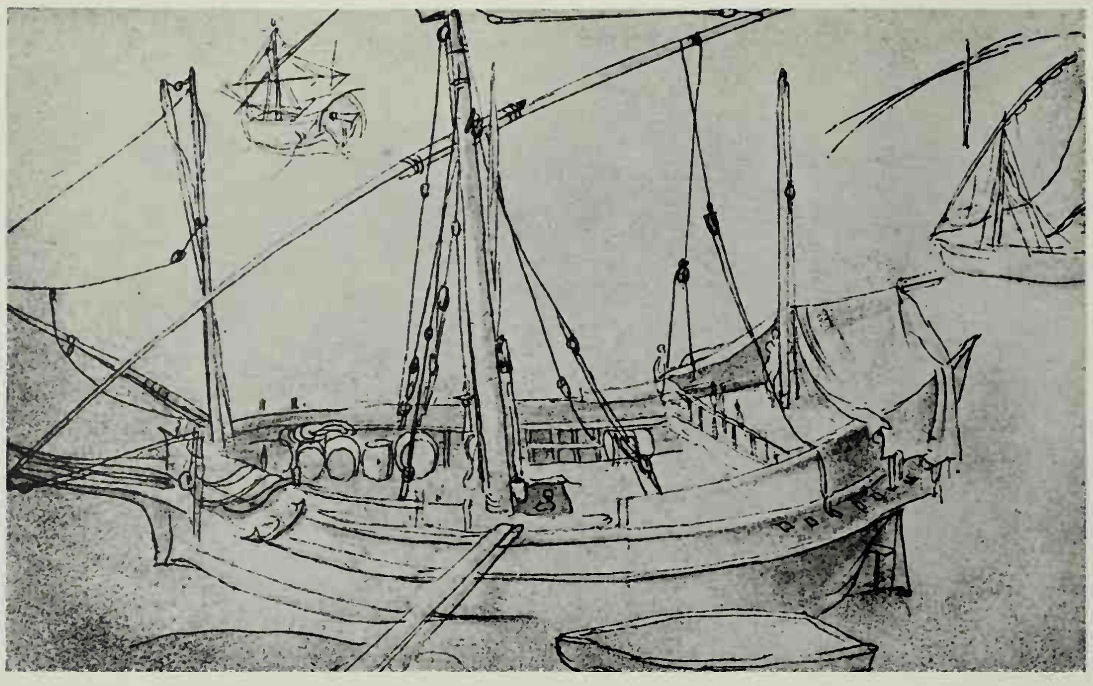
96. A big single-masted lateener. The picture, although done in the fifteenth century, is modeled on a famous original of the thirteenth by Giotto. The artist is more careful with his human details (e.g., the passengers' reaction to the state of the body in the coffin) than his nautical details. He has painted the shrouds, for example, in slapdash, helter-skelter fashion but, in spite of this, he has made it clear that they were rigged in the southern fashion, with block and tackle.

98

97. A three-masted lateener of the thirteenth century. The foremast carries the largest sail, as was usual for lateen-rigged craft of this period.

98. A big single-masted lateener of the fourteenth century. This beautifully executed piece of sculpture represents a vessel whose hull, with its heavy, well-rounded shape and prominent castles fore and aft, shows unmistakable northern influence. The sail is lateen, or possibly a lug with a short luff. The shrouds are set up with block and tackle and, since they can't carry ratlines, there is a ladder abaft the mast for getting aloft. Some of the crew are hauling desperately at the tack rope—the only line left to haul on, since the halyard and vang have parted and are streaming heavenward in the wind. The distinctive strips running from prow to stern along the sides are waling pieces, heavy timbers that girdle the ship and strap it horizontally. The square projections are the butt ends of the deck beams (there are two decks) which, in southern fashion, are brought through the sides.

99



100

99. A three-masted lateener.

100. Illustration in a manuscript of the early fifteenth century.

101. A vessel of about 1400 with a stern rudder. This picture, done about 1406, illustrates the transitional period when the new stern rudder was replacing the traditional steering oars. Of these two square-riggers, one has the new, the other the old, steering gear.

101

On the *Oliva,* the *Paradisus Magnus,* and others like them, the lateen rig raised a problem. As ships get larger, so, of course, do their sails. As mentioned above, the yard of a lateener's mainsail can be longer than the vessel itself. In 1268 Louis IX of France, as part of his preparations for the Eighth Crusade, ordered the shipyards of Genoa to build him some sailing vessels to serve as transports. The ships were seventy-five feet over-all, the foremasts seventy-six feet, five inches high—and the foreyards ninety-six feet long. Every time the vessel made sail, those yards had to be wrestled up the mast. Since lateens have no reefpoints and the only way to shorten sail is to substitute a smaller for a larger, every time the weather made up, down the yards had to come—and handling a vast sheet of thundering canvas and a wildly gyrating spar the size of a telegraph pole is not exactly child's play.

A solution came from the north. The Crusades brought to the Mediterranean not only northern soldiers and pilgrims but northern skippers and pirates as well. From 1300 on they sailed past the Strait of Gibraltar in their stubby clinker-built cogs with the prominent castles fore and aft, the newly introduced stern rudder, and the single mast carrying a great square sail. Sharp-eyed shipwrights of Genoa and Venice were quick to spot the advantages of these features and take them over. The rugged lapstrake construction, so useful in stormy northern seas, they felt served no purpose and they stuck to the age-old southern technique of setting the planks edge to edge and of running the deck-beams right through

Compare Illustration 85, p. 68

the sides. But the heavy, well-rounded hull, the castles fore and aft and, of course, the stern rudder they wholeheartedly approved. Then they made an even more revolutionary change: on larger ships they switched from the lateen to the square-rig. It was almost but not quite a step back to Greek and Roman times. The ancient mariner had used a stubby mast and wide sail; his descendant of A.D. 1400 preferred a lofty mast and a tall sail. The new rig wasn't as fast as the old, and was less efficient on the wind (although better before it). But it had one advantage that clinched matters. The sailing ships of this age belonged not to the navy but the merchant marine, they were in service to make money—and the new rig was cheaper. It took a small army of deckhands to work a big lateener but, on a square-rigger where the yards were one-half the size to begin with and didn't have to come down and go up again every time sail was shortened, far fewer men were needed. In the thirteenth century a Venetian lateener of 240 tons burden had a crew of fifty able-bodied seamen; a century later a square-rigger of the same capacity needed only twenty.

Illustration 94, p. 77

The first ships rigged in the new fashion had, like their northern models, only one mast. But the Mediterranean mariner was used to more than one; he had handled lateeners with as many as three. Before long, Italian shipwrights were turning out two- and three-masted versions of the square-rig—but this brings us to a step in the history of the boat so important and far-reaching that it deserves its own chapter.

CHAPTER SIX

The Full-Rigged Ship

"AT EIGHT o'clock, August 3, 1492, we left the bar at Saltés. Under a strong sea breeze we sailed south for 60 miles, that is 15 leagues, before sundown, then southwest, and then south by west, which was the course for the Canaries." So wrote Columbus his first night at sea on the *Santa Maria.*

In 1400 a ship like the *Santa Maria* didn't exist. The square-rigger was then still plodding along under her one great sail. Less than a hundred years later she sported not one but six and, with them, had made her way to America, had doubled the Cape of Good Hope, and was soon to circle the globe. Her deeper, beamier hull steered by a rudder at the stern was the first step that made all this possible; the next was the breaking up of her single unwieldy piece of canvas into more manageable units. Once this was accomplished, the oceangoing sailing ship was a reality, and all that was left to do was introduce refinements. John Paul Jones or Horatio Nelson would have felt uncomfortable skippering the likes of an English cog; they would have been pretty much at home on the quarterdeck of the *Santa Maria.*

It was the sailors of the south who got things moving. For centuries they had handled two-, even three-masted lateeners. So, when they set about improving the northern cog that they had taken over, one of the first things they did was to put another mast in it: they stepped a mizzen in the stern. At first it was a very short stick carrying a small lateen sail; its principal job was to aid the maneuvering of the vessel, not add to its drive. The mainsail they left as big as ever but instead of reefpoints (cf. p. 63) they used "bonnets" to shorten it: they made the lower portion detachable; this, the "bonnet" to give it its English name, was merely laced onto the sail proper so that, as soon as the wind made up, it could quickly and easily be stripped off.

Mediterranean sailors redesigned the hull of the cog from stem to stern. Over the forecastle they set a distinctive triangular projecting bow—the "carrack" bow as it's called. The forecastle itself they also treated in a distinctive manner: they built it to rise from the waist not in an abrupt step but in a gradual slope with an open arched entrance. They gave the hull plenty of "tumble-home," i.e., curved the sides inboard so that the ship was broader at the waterline than at the upper deck, and they added vertical wooden fenders to protect the curving timbers. The castle aft they left lower than the forecastle, as was the tradition, and built it square, letting it squat not too elegantly upon the horizontal curve of the stern. Over the top they spread an awning against the fierce Mediterranean sun.

Compare Illustration 120, p. 98

So far so good. But there was still room for improvement. An additional sail had been successfully added aft; why not try one forward? So another mast was added, a short stick stepped as far in the bows as possible since its function was to carry a headsail, a small square sail that would keep the vessel's head off the wind or help lever it over in coming

102

102. A Mediterranean two-masted square-rigger of about 1400. A storm so sudden that the crew had no time to shorten sail by stripping off the bonnet has struck the vessel and split the mainsail, and the passengers are desperately jettisoning cargo in an effort to lighten ship. Bowlines on tackles made fast to the bowsprit run to the farther side of the mainsail. The mizzen is very small, and its mast too light to carry a top.

about. The one-master had now become a three-master, the cog had become the carrack, to give the new ship-type the name it generally goes by.

And now came the moment when the southern sailor was able to discharge a debt. He had borrowed the cog from the north; as soon as his three-masted version made its appearance in northern waters, seamen there recognized its advantages, and promptly adopted it for their own use.

There were still some finishing touches to be put to the carrack. It still depended chiefly on its great mainsail for drive; obviously, better use could be made out of the two auxiliary masts. Within a few decades both were made longer and heavier to carry larger sails that would help move the vessel as well as maneuver it, and a topsail was added above the main, thereby permitting the main to be reduced in size. On certain big ships the mizzen was used exclusively for drive, and a second mizzen, the bonaventure, was added abaft it to take over aiding the steering. *Illustration 110, p. 89*

In the north the new three-masters stayed relatively small: men-of-war rarely ran much over six hundred tons (about 120 feet from stem to stern and forty feet in beam), and merchantmen rarely over four hundred (about one hundred feet by thirty-three feet). But in the Mediterranean, particularly in Venice to meet the demands of her burgeoning sea power and trade, carracks grew to great size. By 1500 Venice's standard sailing men-of-war were between

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104

103, 104. Carracks of the late fifteenth century. The foremast has increased in height and carries a larger sail. Above the mainmast top is the yard for a main topsail.

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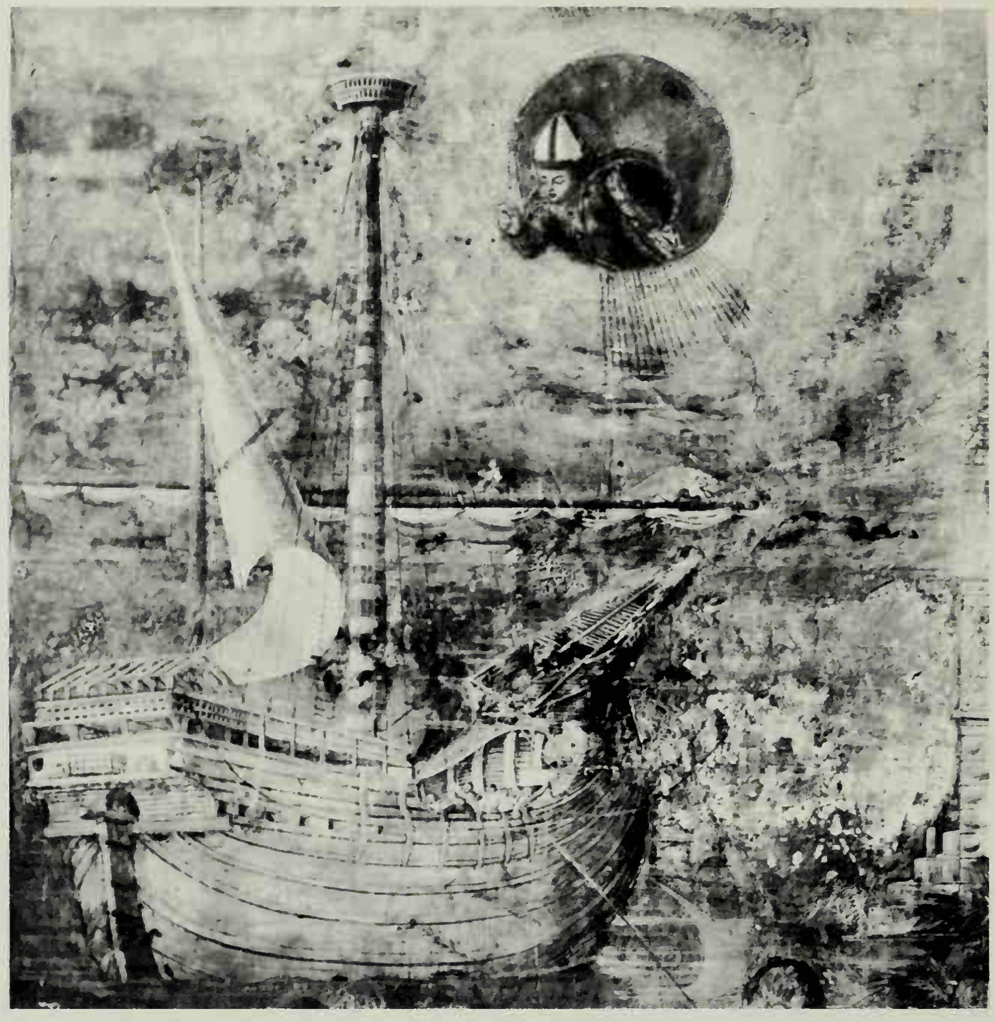

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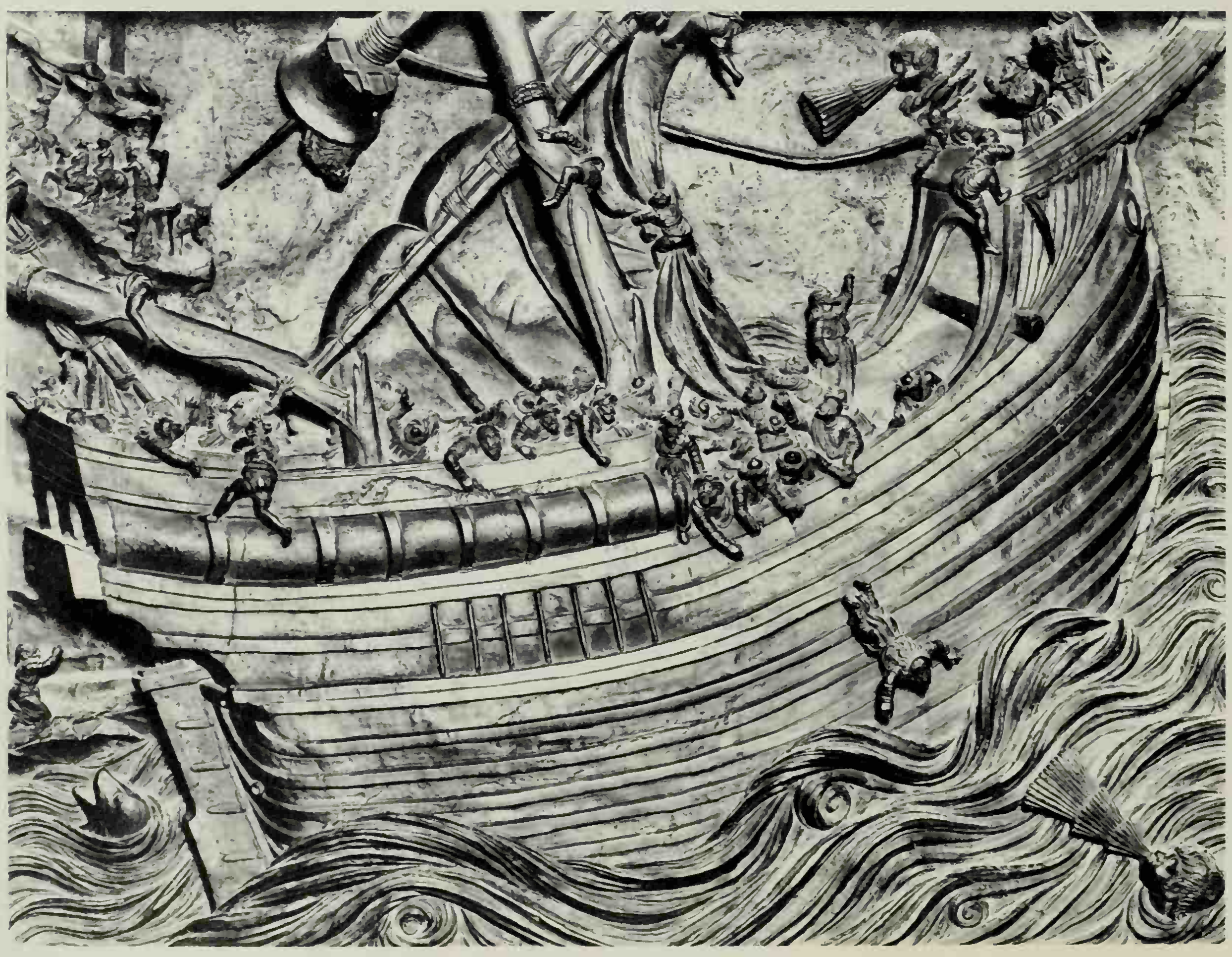

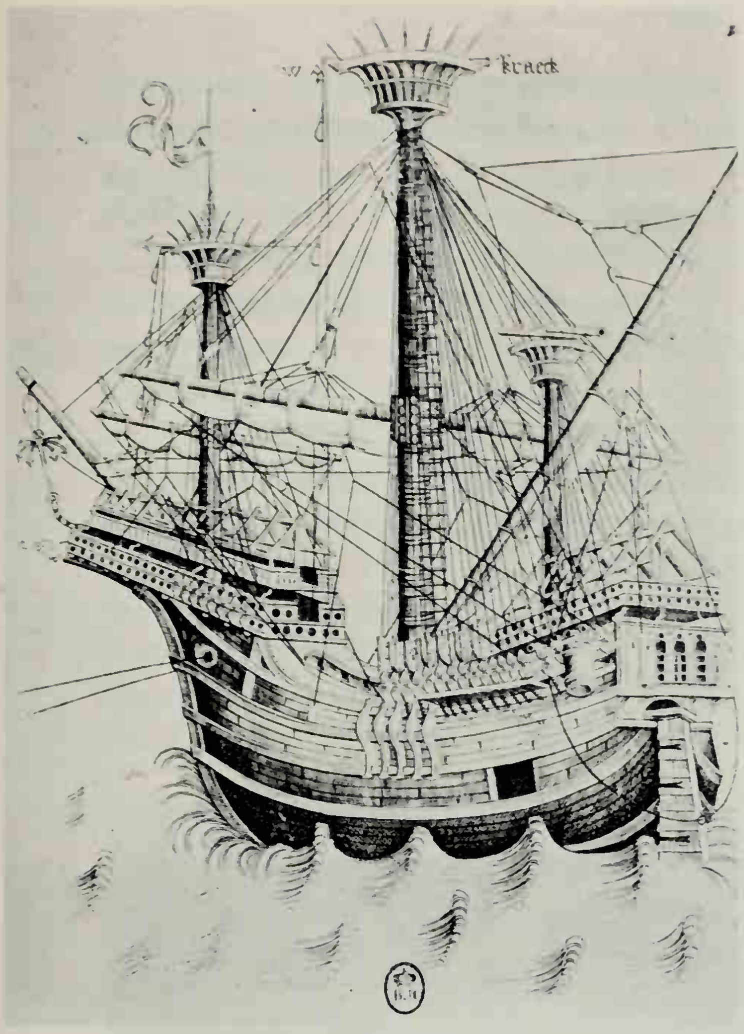

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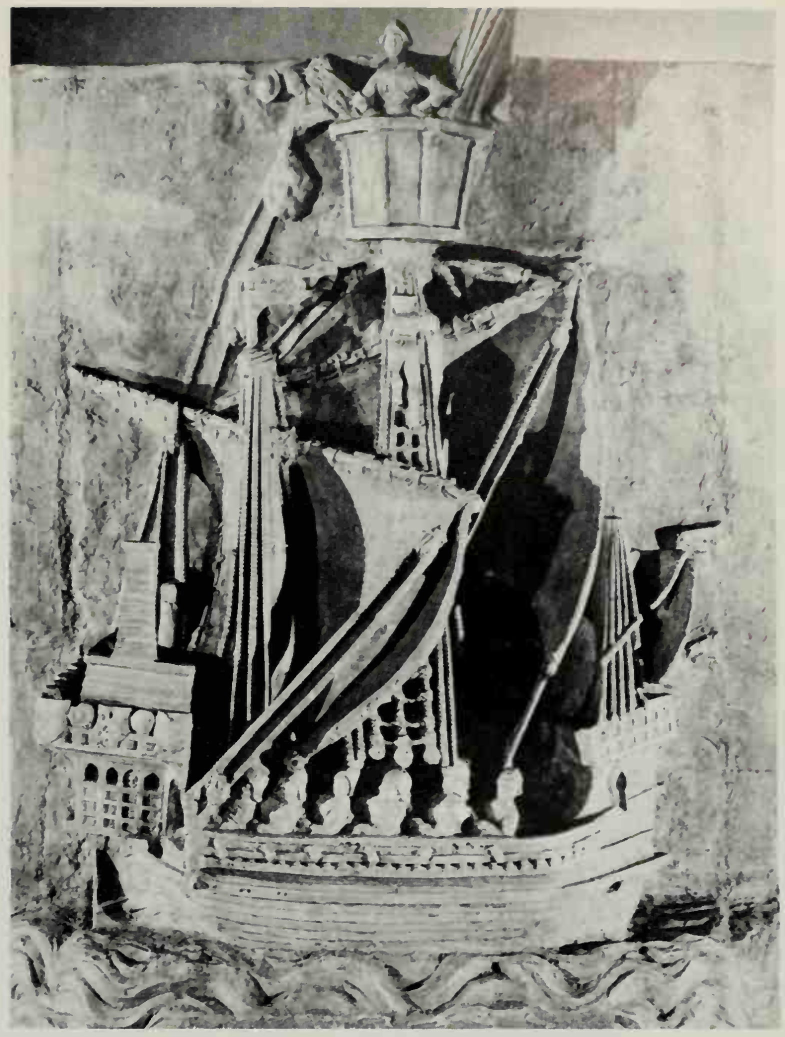


108

105. A big Mediterranean two-masted square-rigger of about 1450. The bow is the triangular "carrack" type, the forecastle slopes down to the waist and is entered through an arched opening, the sides curve noticeably inboard and are protected by vertical wooden fenders, and the sterncastle is topped by a frame to support an awning. The lofty mainmast carried a large, tall mainsail; the lateen mizzen is by now considerably larger than the one shown in the previous picture.

106. A three-masted carrack of the second half of the fifteenth century. A dramatic representation of a vessel on the brink of disaster. This carrack is much like the ship in the previous picture except that it has three masts; far up in the bows is a short foremast. The mizzen seems of good size, probably heavy enough to support a top.

107. Detailed representation of a carrack of the second half of the fifteenth century. The meticulous artist has shown a number of interesting features: the scaffolding for the awnings on the castles; the hoists for bringing ammunition up to the tops (all three masts are heavy enough to have tops); the "parrels" or oversize bead necklaces that enable the yards to run up and down the masts; the ladder abaft the mainmast, typical of Mediterranean ships; the barrel hung over the quarter to serve as a toilet; and—two new features—guns in the sterncastle and a gallery along the stern.

108. A northern three-master of the fifteenth century. The sail plan is the same as on a Mediterranean carrack but the rigging is different: there is no ladder running up the mainmast since the shrouds, permanently set up, carry ratlines. The marines in the main top are ready for action: they have bundles of javelins and, traveling up the ammunition hoist, are two bags bulging with stones or the like.

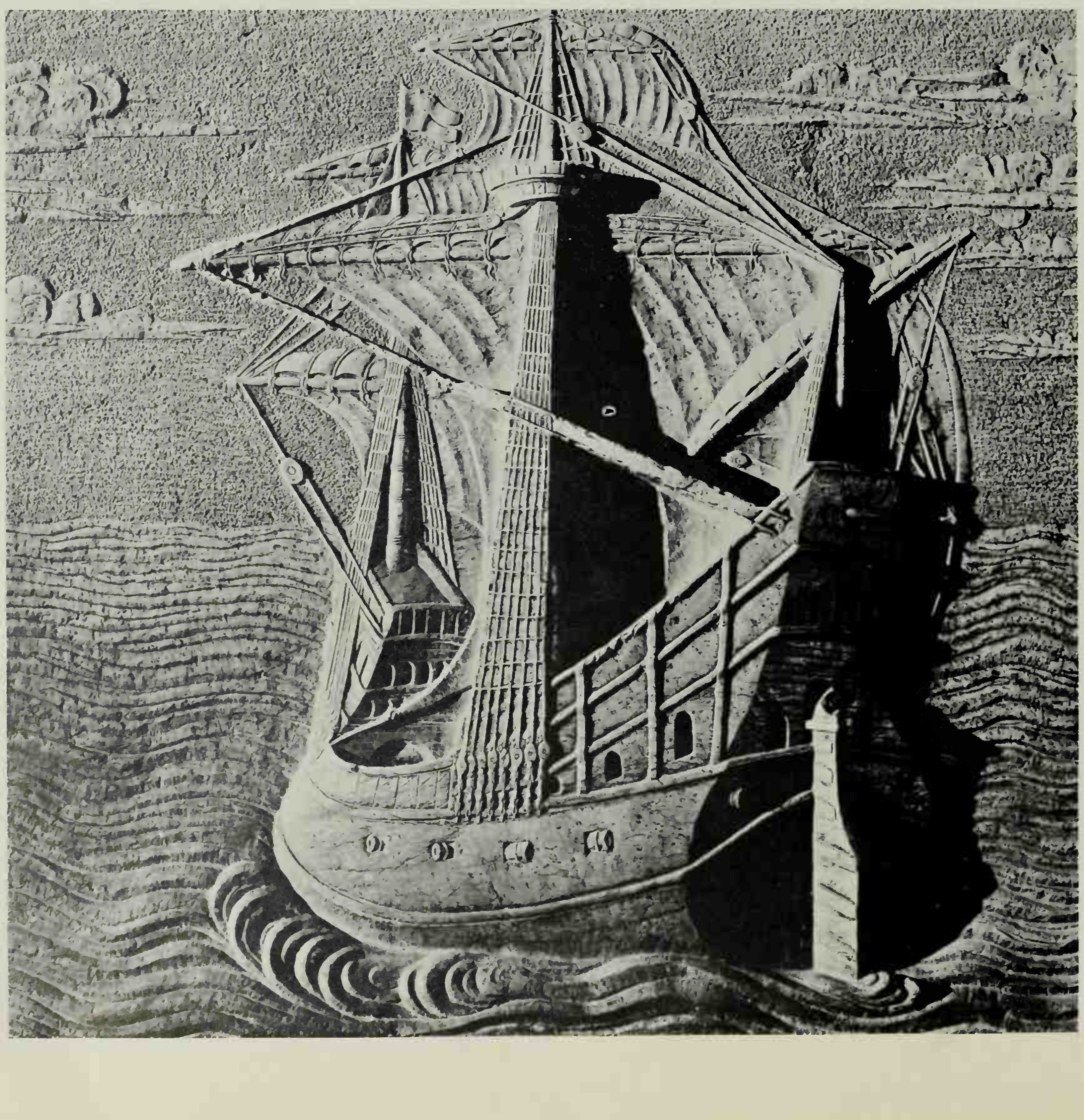
twelve hundred and fifteen hundred tons, and eighteen hundred was not unheard of. Her average merchantman was a six hundred-tonner (140 feet long over-all and thirty-eight feet in beam), and one thousand-tonners were not uncommon, dimensions that oceangoing freighters in the north didn't reach for another two centuries. These big ships sailed all year round instead of laying up for the winter as heretofore and, with their capacious holds, were able to cut by 25 per cent the freight rate prevailing at the beginning of the century.

About the middle of the fifteenth century another step was taken that completed the basic rig of the square-sailed vessel: a small sail was hung under the bowsprit. It was a simple addition but one that had important consequences. This bowspritsail now served as headsail, and the foresail was thus released for use as a driver. So the foremast was moved farther back, was made longer since it could be set up more solidly in its new location, and had a larger foresail hung on it with a foretopsail above.

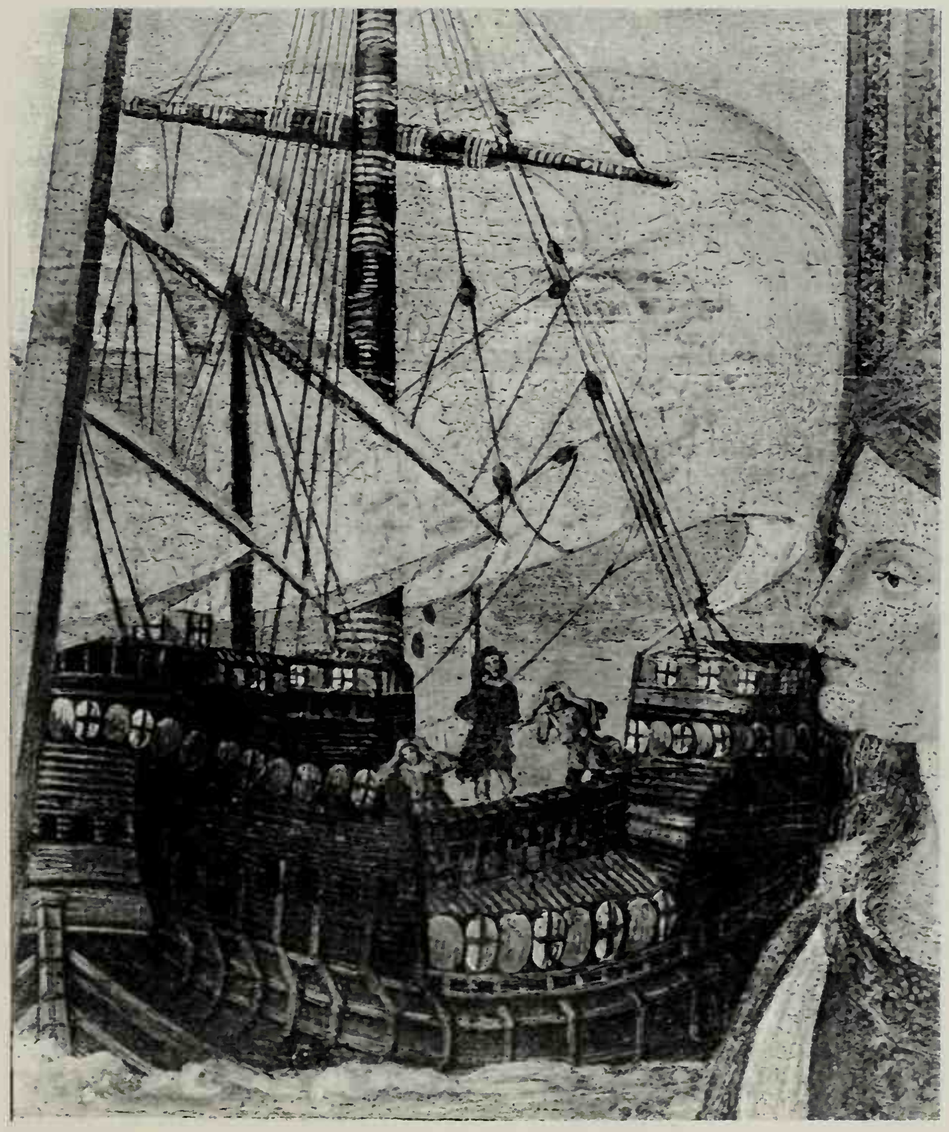
Compare Illustration 115, p. 94

The full-rigged ship had come into being. There were six pieces to its basic suit of sails: bowspritsail, foresail, and foretopsail, mainsail and maintopsail, mizzen. Five were enough to get Columbus to America (the *Santa Maria* had no foretopsail); the six brought Da Gama to India, Magellan around the world, and the ordinary merchantman on its rounds for the next two centuries.

109



From Columbus's diary and the notes of other early travelers to America we know a little about life aboard these ships that pioneered on the ocean. The helmsman, helped out by other huskies when needed, manipulated a horizontal tiller; the wheel lay centuries in the future. Since the tiller ran straight out from the top of the rudder-post, his station necessarily was below; all he had to go by was the compass, orders shouted from the quarterdeck, and the general feel of the ship. The skipper navigated by dead reckoning, that is, by ruling off his compass course on a chart and simply marking off his best estimate of the distance he had covered; the chip log had not yet been invented, and astrolabes, quadrants, astronomical tables, and the like were mostly for professors of astronomy. Ship's time was kept by a half-hour sandglass, and one of the ship's boys' duties was to be on hand without fail to turn it. The men slept on the planking—the hammock was one of the things Columbus brought back from the New World—and ate mostly biscuits, olives, cheese, and salt-fish, plus, when weather permitted, one hot meal of salted meat a day at noon prepared in the tiny open firebox. There were no lavatories; officers and men simply hung jerry-built commodes over the rails fore and aft.



110

109. A monster Venetian carrack of the sixteenth century under sail.

110. A large carrack of the fifteenth century with mizzen and bonaventure mizzen.

111 

111. A large caravel of the sixteenth century, square-rigged on the foremast and lateen-rigged on the other three. The craft on the left with the standard six-sail rig has a distinctly heavier, higher, and broader hull. Pictures of earlier caravels are rare; the numerous models of the *Nina* and *Pinta* (and the *Santa Maria*, for that matter) are largely conjectural.

As the *Santa Maria* sailed along, two escorts danced beside her—and had trouble holding back so as not to lose the plodding flagship. They were the caravels *Nina* and *Pinta.* The full-rigged ship was the fifteenth century's chief contribution to the history of sailing vessels; the caravel was runner-up.

Early in the century the Portuguese had begun nosing their way along the west African coast, an area of difficult currents, foul winds, and exasperating calms. What they needed was a vessel that was light enough to stay near shore and move in light airs, and that was also able to sail close to the wind. Their solution was the caravel, a small, slender-hulled ship carrying three lateen sails. It was ideal for voyages of exploration; *Nina,* for example, was Columbus's favorite craft. For the long haul downhill before the easterly trades Columbus rerigged his two caravels, replacing the lateens on fore and main with square sails. The switch was a wise one: in the next century a large type of caravel made its debut, one which, to combine efficiency both off and on the wind, added a square-rigged foremast to the three with lateen sails.

With the contribution of the three-masted carrack and the caravel, the Mediterranean sailor had, in a sense, shot his bolt: he was to add little more to the main current of the history of the sailing ship. The next important steps were taken by English, French, and Dutch seamen. And major steps had to be taken, for an important new factor was clamoring for attention—guns.

CHAPTER SEVEN

Men-of-War

FROM CARRACK TO GALLEON

IN 1356 the French sent out a fleet with a few guns aboard. Some two decades later, in a sea battle between Genoa and Venice, guns were not only aboard, but saw actual use. By Columbus's time, naval artillery was becoming standard equipment on all warships. The next century was decisive. When the Spanish Armada met the English fleet in 1588, though both sides missed most of their shots, they settled one thing: a warship could no longer be an armed transport to bring marines close enough to get at each other's throats; it had to be a floating platform for guns.

The earliest cannon, the "serpentines," were useless against an enemy's hull but more effective than arrows, javelins, lime pots and the like against his personnel. They were mounted on top of the sterncastle. Then heavier pieces were added, massive breech-loading affairs which, made of iron bars welded together and girded by hoops, could weigh half a ton; these were placed in the waist, firing over the topmost wale, the "gunwale." Later, still others were added inside the fore- and sterncastle, their muzzles protruding through rough openings. In 1501 a Frenchman named Decharges got the idea of cutting ports in the hull itself to place cannon on the lower deck. With this the pace of change quickened.

For one thing, northern ships ceased being clinker-built; from now on they followed the southern practice and were constructed "carvel" fashion, that is, with the planks placed edge against edge to give a smooth surface. This made for a stronger hull—a matter of some importance, now that it was being punctured for cannon; besides, it was easier to fit lids to ports cut in a flat surface.

For another, in order to mount a bigger broadside, the north, again following the lead of the south, went in for longer and heavier ships. Men-of-war of over six hundred tons were no longer a rarity. As a matter of fact, each country opened all the stops to produce at least one naval showpiece. In 1514 the English launched the *Henry Grâce à Dieu,* a thousand-tonner bristling with guns—they were mostly small but there were over 180 of them—and towering aft with a sterncastle four decks high. The French countered in 1527 with the *Grand François:* she was long enough to have five masts (three mizzens), was manned by a crew of fifteen hundred, and had room for such amenities as a chapel and a tennis court. She was too ambitious a project; a tempest put her *hors de combat* in harbor before she ever saw open water, and she was cannibalized for house timber. In 1532 the Swedes produced the *Elefant,* forty feet in beam, 174 feet from stem to stern, and 279 feet over-all (she obviously had enormous overhangs fore and aft).

And cannon meant, finally, the parting of the ways for men-of-war and merchantmen. As late as the end of the sixteenth century, ships were still doubling as one or the other; it

112

112. A fifteenth-century man-of-war armed with guns in the waist and on the forecastle.

113

113. Early sixteenth-century carracks bristling with guns. In the foreground is the French *Cordelière* and, behind her, the English *Regent.* During an English attack on Brest, both ships caught fire.

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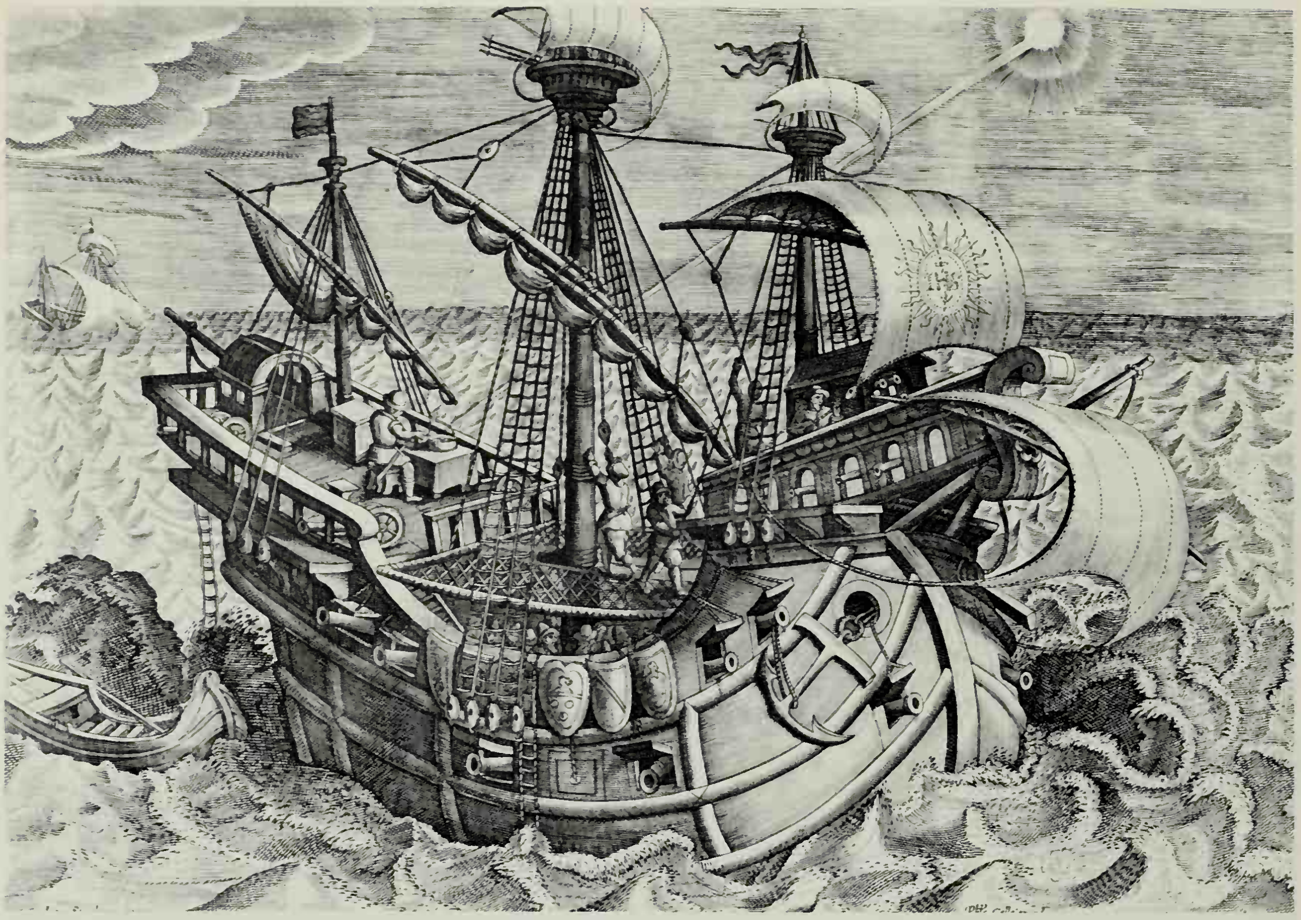

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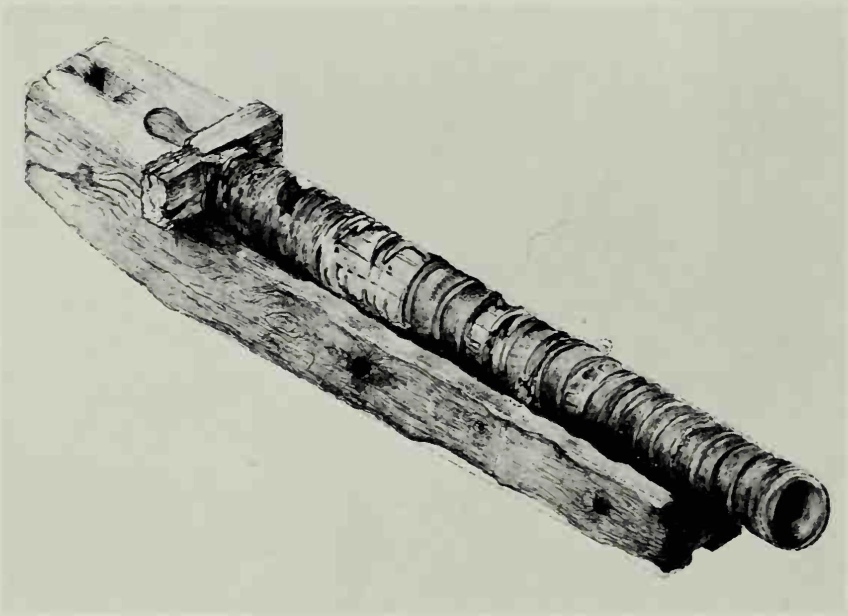


114. Drawing of a breech-loading gun salvaged from the wreck of the *Mary Rose,* which went down off Spithead in 1545. The gun, made of welded iron bars girded by hoops, is 9′ 8″ long, with a caliber of about 8″. There was no way to train, elevate, or depress it.

115. A heavily armed sixteenth-century carrack. With its rounded lines, forecastle higher than sterncastle, and triangular prow, the ship is much like the carracks of a century earlier. The guns, however, reveal its age. Firing through ports in the hull are four pieces, two heavy on the broadside and two medium forward. The waist is lined with medium pieces (their ports are cut in the bulkhead, not the hull). The forecastle bristles with light pieces, and there are three light pieces mounted on land carriages on the poop. The nets spread over the waist are protection against boarders, missiles, falling spars, and the like.

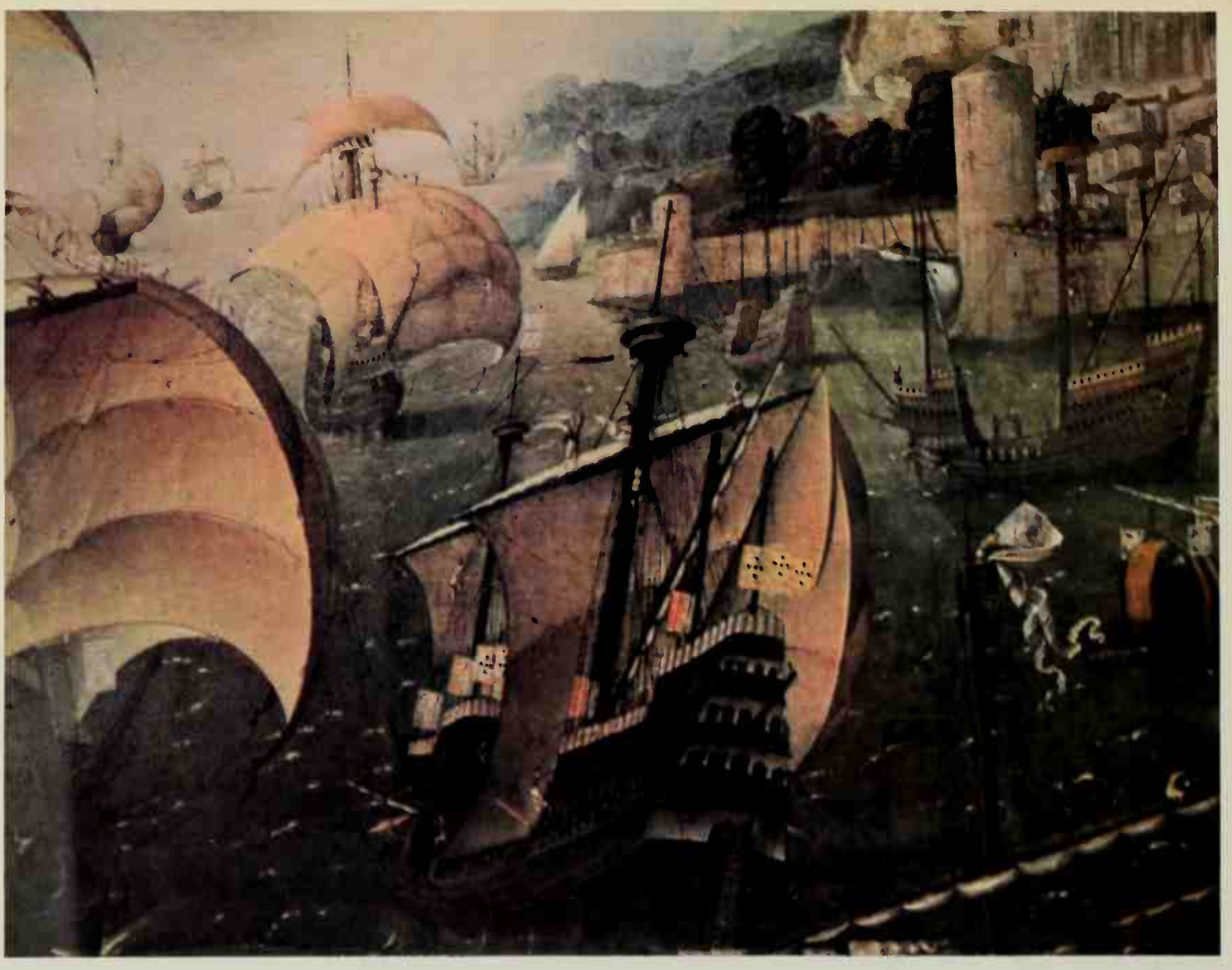
116

116. The *Henry Grâce à Dieu* as rebuilt in 1545. In this contemporary drawing the proportions, particularly the height, are exaggerated, but the distinctive features are clear: rounded hull with its bulging carrack prow, solid sterncastle, and square stern; the rig with yards for twelve sails; the guns, particularly the main battery—two rows firing through ports in the side.

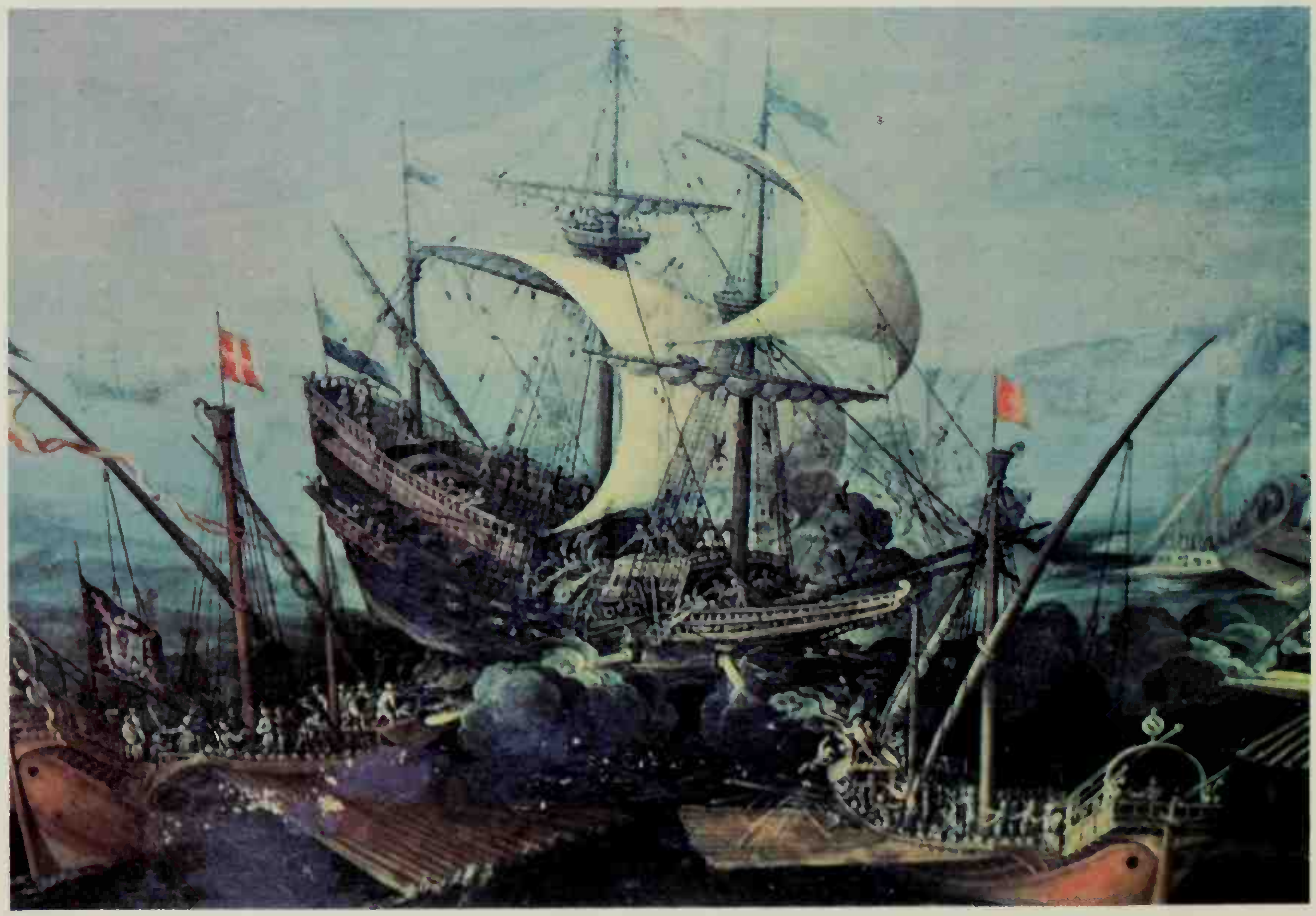
was simply a matter of what they were loaded with, guns or cargo. But after that time a warship was a vessel whose decks were for guns and nothing else.

Now that ships were bigger and heavier, the six sails of the basic rig weren't enough to move them efficiently; more were needed. The *Henry Grâce à Dieu* had no less than twelve. On fore and main, above her topsails, she carried a third tier, topgallants (the topsails that are "gallant," i.e., make a brave show high above the regular topsails). The mizzen acquired two more tiers, a topsail and a topgallant, both lateen like the sail below them, and the bonaventure mizzen one more, a lateen topsail.

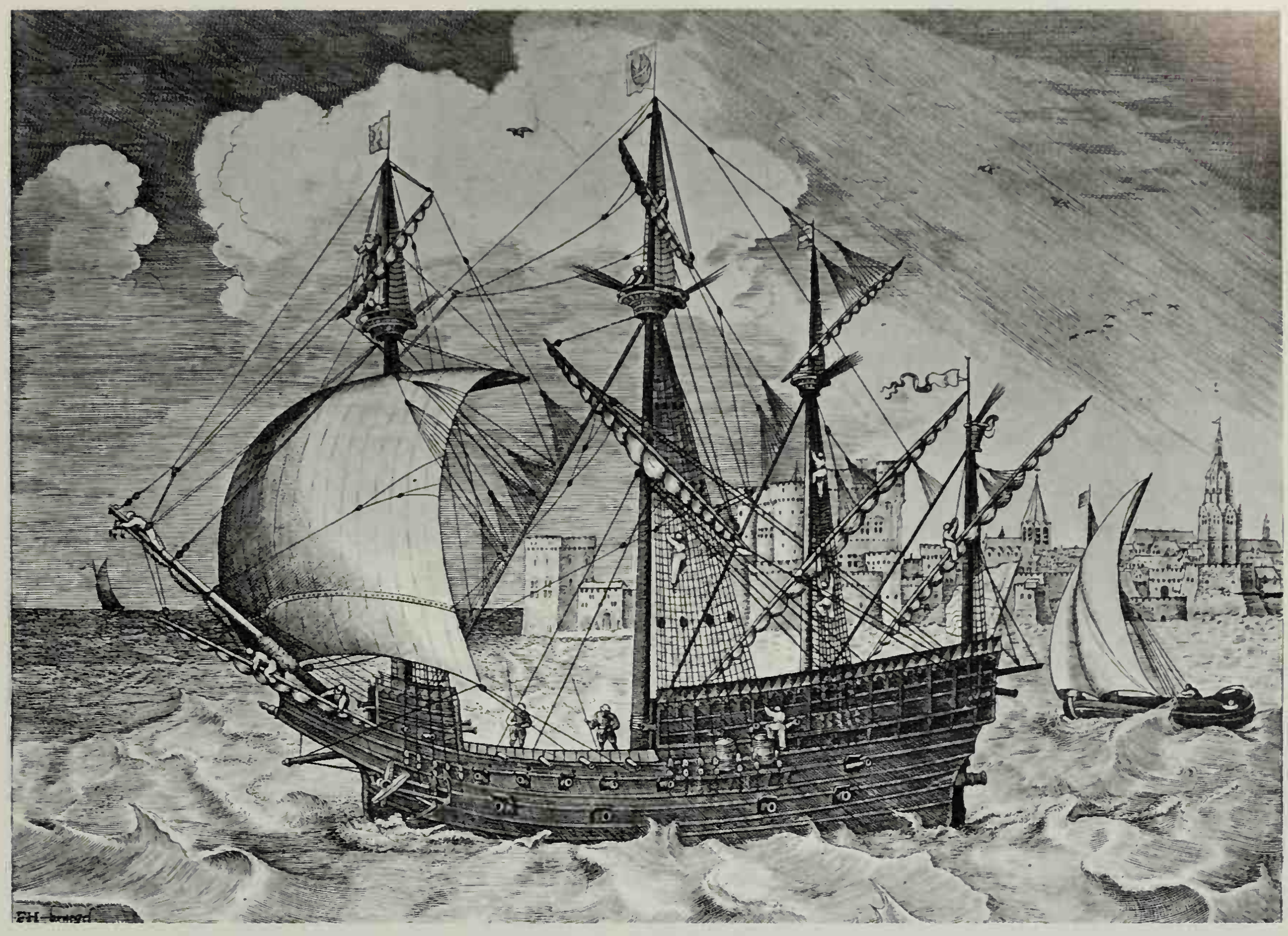
Hulls still kept the distinctive carrack prow, but it was no longer the lightly built projection of the last century. It had put on weight, had become a lofty triangular forecastle bulging over the stem. Aft rose a second imposing castle almost as high as the one forward, a solid block that started at the mainmast and overhung the stern. The planks of the hull were no longer brought around to end in a hemisphere but chopped off to form a square stern. The decks did not run from stem to stern as in modern vessels; each section—bow, waist, stern—had whatever decks, set at whatever heights, it needed.

117 

117. Portuguese carracks of the early sixteenth century. The triangular forecastle bulges over the prow, and a poop deck adds still another level to the sterncastle. The ship has the basic six-sail rig (the spritsail, used for getting under way, was normally carried stowed in the bows) plus a bonaventure mizzen.

118 

118. A Dutch warship of the early sixteenth century in action against Spanish galleys. *See page 100.*

 119

119. A Flemish galleon of the middle of the sixteenth century. The vessel is readying for action: supplies of darts are stacked in the tops, cloths have been spread over the waist as protection against missiles and falling spars, men are setting more sail and stowing the spritsail (compare illustration 117). The forecastle is low and set back from the prow, which now ends in a beak. The sterncastle has two solid decks from the mainmast aft.

In July 1588, off Eddystone Rock in the English Channel, the two greatest fleets of sailing warships the world had ever known squared off. On both the English and Spanish sides the big units were a relatively new type of man-of-war—the galleon. It had made its debut about the middle of the century when warships gradually gave up the bulging, top-heavy carrack features to put on a new "galley-like" look. And the finest galleons by far—faster, more maneuverable, better gunned—were the English.

For ten years before the great battle Sir John Hawkins, the celebrated privateer and seaman, had been in charge of designing and building Elizabeth's navy. Hawkins knew from sad experience what it was to skipper a poor ship. The *Jesus of Lubeck,* in which he sailed from England to Africa (for slaves; to Hawkins or any other sixteenth-century skipper they were just another cargo—and more lucrative than most) and then to Mexico in 1567, was a merchantman that Henry VIII had bought from German shippers twenty years earlier; it was hard to tell which was worse, the way she leaked or the way she rolled. He set himself the goal of making Elizabeth's men-of-war the finest afloat. Galleons were so called because they had something of the galley about them: they had some of its slimness and, instead of the bulging forecastle of the carrack, had a lower structure set back of the bows, which were now prolonged into a sharp, galleylike beak. Hawkins made his galleons even longer and slimmer than usual—the longer the ship, the more guns it could mount on its broadside; he sharpened the old 3:1 ratio of length to beam to 3½:1, even 4:1. He cut down the forecastle further. His ships were designed to fight with cannon, not boarding parties; towering castles had room for only light guns, and they made a vessel topheavy. He had to leave most of the sterncastle—after all, the officers had their quarters there—but he reduced its bulk: instead of two or three decks in solid layers from mast to stern, he made each shorter than the one below—half-deck, quarter-deck, poop—so that the vessel's sides rose aft gradually. Along the quarters and stern ran open galleries, latrines for the officers but, officers being officers, handsomely built and decorated (the men used the beak; "head," as the ship's lavatory is called in the jargon today, is a shortening of "beak-head"). The superstructure was painted in bright colors laid on in geometrical patterns. Hawkins even made a major improvement in the rig. Up to now topmasts had been fixed permanently in place and, when the weather turned ugly, their weight aloft was a dangerous burden. He introduced what was perhaps originally a Dutch invention, a topmast that could be detached and sent down on deck when advisable. All the sails were cut, as they had been for

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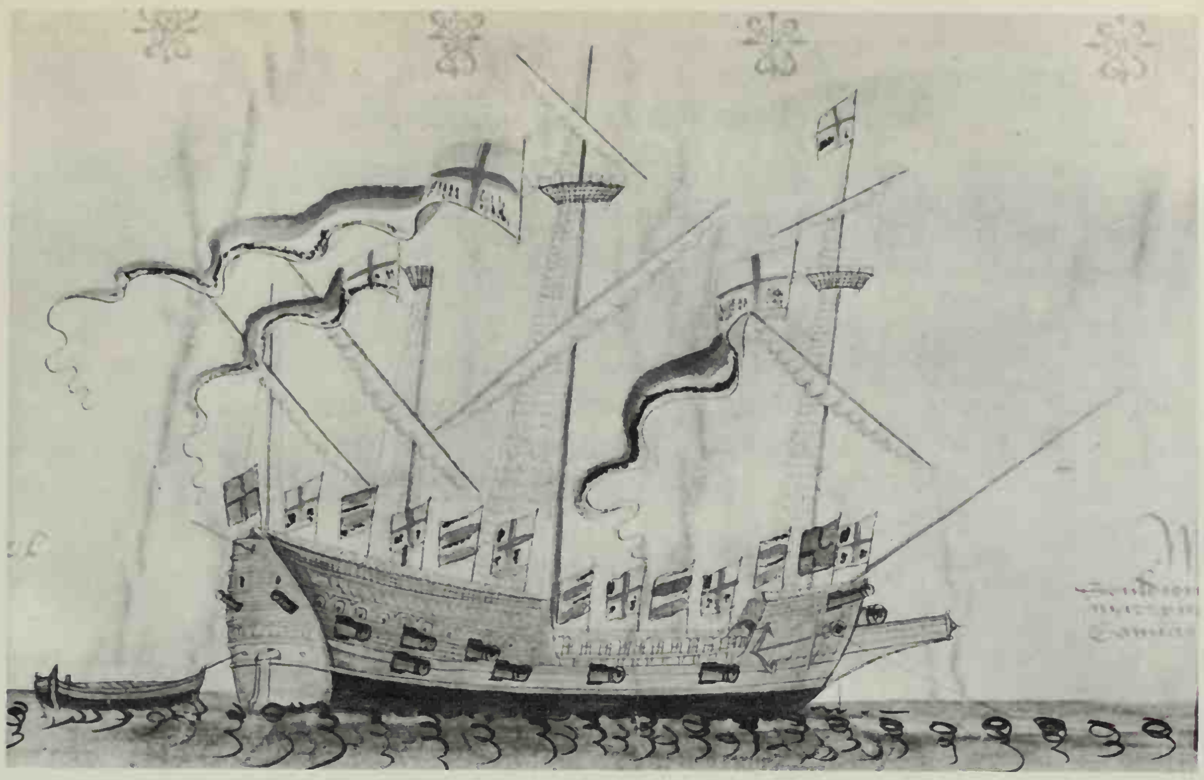

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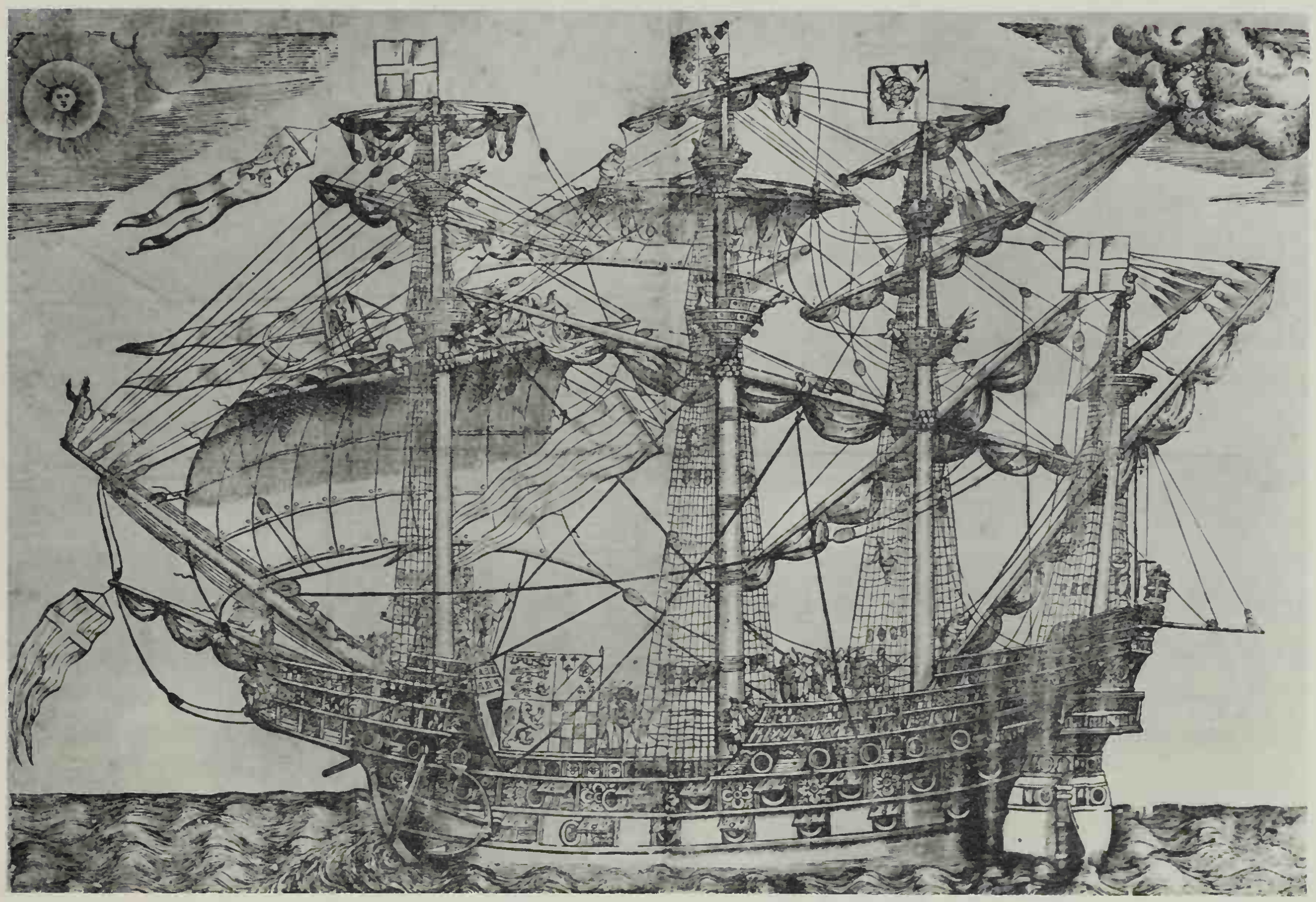


122

120. A Flemish galleon trailing a galley; same date as illustration 119. The guns in the after end of the forecastle, covering the waist, are light pieces loaded with shot for use against boarding parties. The gun visible under the cloth in the waist is mounted on a land carriage.

121. The *Grand Mistress,* an English galleon built in 1545.

122. This picture, made soon after the defeat of the Armada, is generally taken to be of the *Ark Royal,* flagship of the English fleet. Even if not the *Ark Royal,* the ship is a fine example of a galleon of the times with its beak, low forecastle set back of the prow, stern rising in steps, quarter- and stern-galleries, and two lines of guns firing through ports in the hull. She is fully rigged with twelve sails, square on fore- and mainmast, lateen on mizzen and bonaventure mizzen.

Illustration 117, p. 96

centuries, with a deep pouch; topsails and topgallants in addition flared out, being much wider along the foot than the head. For shortening sail the foresail and mainsail carried two bonnets (see above, p. 84) and, for increasing sail when the breeze was light, a drabbler could be added, an extra strip laced onto the foot of the bonnet.

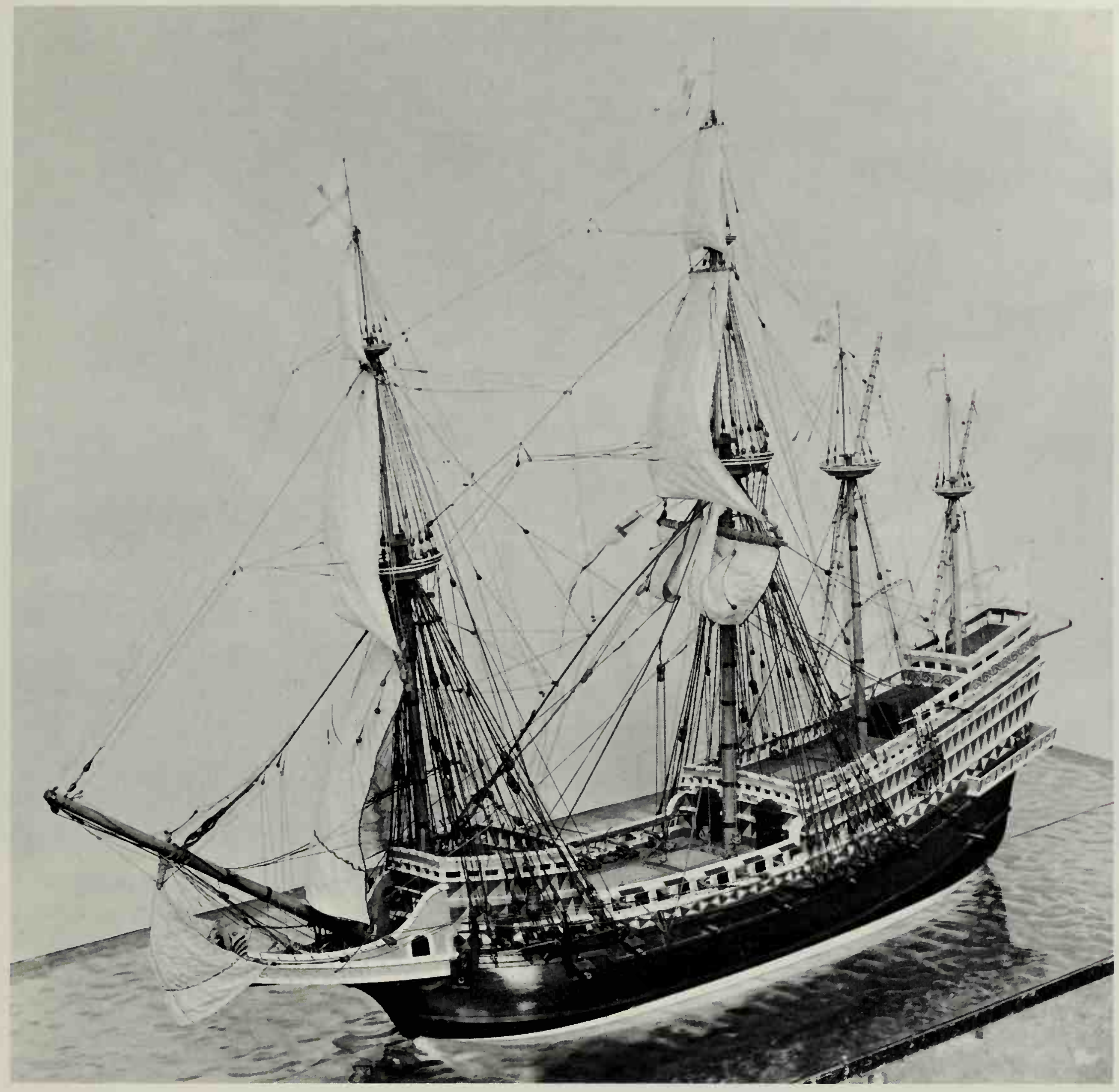
But even more important than hull and rigging was the galleon's armament. Efficient brass muzzle-loading cannon replaced the iron breech-loaders that were as likely to damage the gun crew as the enemy; iron was the better metal—a brass piece throwing an iron ball wore out quickly—but the foundries weren't yet up to casting and boring a gun from it. And long-barreled cannon, capable of throwing an eighteen- or a nine-pound ball for almost half a mile with fair accuracy, gradually drove out most of the miscellaneous light pieces and the stubby smashers that heaved a ball thirty to sixty pounds but heaved it neither well nor far. The *Triumph,* the giant of the English fleet, over one thousand tons in burden, had forty-two cannons of which seventeen were long-range eighteen-pounders and eight long-range nine-pounders. The *Ark Royal,* the newest ship, eight hundred tons in burden, mounted fifty-five, including twenty-four long-range pieces. And so it went throughout the first-line ships. As a result, the English were able to stand off and pound the "invincible" armada whose guns included too many short-range smashers.

On August 8 the cannon ceased thundering: the Spanish were fleeing—and both sides had run out of ammunition. Very few Armada ships were victims of gunfire: the English gunners were wild and, when they did get on target, they did no mortal damage; at ranges of three hundred to seven hundred yards a ball either bounced off a warship's tough hide or made a neat round hole that was no trouble to patch. But in spite of all this, Hawkins' slim, heavily armed galleons had proved themselves; the next 150 years were to see improvement, not fundamental change. A workable instrument had been created; now men had to learn how to work it. Admirals had to learn fleet tactics, skippers the most effective distance for a broadside, and gunners how to aim a cannon. Above all, the lords of the admiralty had to learn how to make life endurable for the crews. On a big battleship, over four hundred men were crowded into an unbelievably small amount of space; after a couple of weeks at sea all too often they were eating spoiled food, drinking tainted water, and breathing the gases from unventilated stinking bilges. Far more Spaniards and English died from disease in July and August 1588 than from each other's guns.

SHIPS OF THE LINE

To hit with the heaviest possible guns from the closest possible distance—this had been the lesson of the battle with the Spanish Armada. All navies took it to heart: the galleon grew into a bigger, heavier vessel with more and more ugly muzzles peeping from her hull—and to make up, as it were, for losing the natural beauty of her graceful lines, she was given makeup: a crust of gorgeous decoration.

From 1600 to 1700 and then on a reduced scale to 1800, when the business of running a navy became too serious for such fripperies, warships were aglow with gilded carving. The favored area was the sterncastle. This was officers' country—the proper place for them in a sailing vessel where the helm was aft and where, from the vantage point of the poop, the officer of the watch could con the whole ship and all the canvas; it was the coming of



123

123. Modern model of an English galleon. The dimensions used were those of the *Elizabeth Jonas* as rebuilt in 1597–98: burden 684 tons; length from stem to stern 142′; beam 38′; depth of hold 18′. Armament (all brass): smashers—four thirty-two- and twenty-four-pounders; long guns—eighteen eighteen-pounders, fourteen nine-pounders, ten six-pounders.

steam that moved the officers forward—and, where officers were, naturally the chief decoration had to be. In the first half of the seventeenth century the quarter galleries were closed in by an elaborately carved screen. Stern galleries were now out of fashion but the after face of the sterncastle was given elaborate decor instead; in Dutch ships, for example, a prominent picture in paint or gilded relief illustrating the vessel's name was put there (taffrail, our naval term for the top of a ship's stern, comes from *tafareel,* Dutch for "picture"). The after end of the hull was chopped off square, galleon-fashion, except on most large English vessels, where it was gracefully rounded.

The sixteenth-century galleon, though it moved well, didn't maneuver well—there was room for improvement in the rig both fore and aft. Fore, the spritsail was too low down to

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124. The Dutch flagship *Aeolus* rams the *Nuestra Señora de la Vega* as the Dutch defeat the Spanish off Gibraltar, April 25, 1607. *Nuestra Señora de la Vega,* with the lofty sterncastle and open quarter- and stern-galleries of the galleon, is the older ship. *Aeolus* has such new features as closed quarter-galleries and, on the stern, a row of highly ornamented windows topped by a large picture.

be an effective headsail; something higher was needed. So, shortly after 1600, a spritsail topsail was added and a puny mast stuck on the bowsprit to carry it. This matchstick couldn't be stayed properly and was constantly snapping, yet it hung on for over 150 years, not only until a proper solution to the problem—triangular headsails—was reached but even after; seamen can be unbelievably conservative. Aft, the mizzenmasts weren't proving as useful as they should be: the lateen mizzen helped the steering, but lateen topsails didn't add much drive. In 1611 the English tried out a square topsail, and it worked so well that within a decade the lateen topsail—and the bonaventure mizzen with it—became a thing of the past. All full-rigged ships now had just three masts square-rigged everywhere except for the lower course of the mizzen; the lateen here was too useful to the helmsmen to be changed. The newly introduced mizzen topsail had no yard available below to spread its foot as all the other upper sails did, so one had to be added for the purpose; the French called it the *vergue sèche,* the "barren yard," since it carried no sail of its own.

Lovely carving was all very well, improvement in the rig even better but, after all, cannon were the be-all and end-all of a man-of-war; the bigger the ship, the more and heavier

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125. The *Sovereign of the Seas,* England's monster (172½′ × 46½′ × 19′) one hundred-gun three-decker launched in 1637. The galleon beak is still very prominent but the sheer of the ship is much straighter than a galleon's: the forecastle has been flattened out, and the sterncastle is no longer toweringly tall. At the tip of the bowsprit is the tiny spritsail topmast with the spritsail topsail furled on its yard. Above the topgallants on fore- and mainmast are the royals, also furled. There is only one mizzenmast, and it carries a square topsail (note that the yard spreading its foot carries no canvas) and a square topgallant (furled). The chainwales—the point where the shrouds were made fast to the hull—of the fore- and mainmast are set rather low; this and the rounded stern distinguished English men-of-war from those of other countries for nearly a century.

the guns she could carry. And the most effective place to carry them was on the broadside. So forecastles were flattened out, sterncastles started to come down—the sheer of the ships, in other words, was gradually straightening out—and hulls were made longer and beamier: the biggest vessels could now accommodate three decks lined with guns firing through ports. In 1637 the English launched the greatest man-of-war of the times, the *Sovereign of the Seas,* 172.5 feet long on the gun deck and 232 feet over-all, 46.5 feet in beam, and 19.3 feet in the hold. She had one hundred guns on three decks: thirty-two-pounders on the lower, eighteen-pounders on the middle, nine-pounders on the upper. To help move her, a topgallant was added to her mizzen and a fourth tier of canvas—royals—to fore- and mainmast. The royals were exceptional; they didn't come into common use for another century and a half.

Illustration 139, p. 115

So, by about 1650, the galleon had evolved into a three-masted warship almost completely square-rigged, decorated with elaborate carving and, in the biggest versions, mounting up to one hundred guns.

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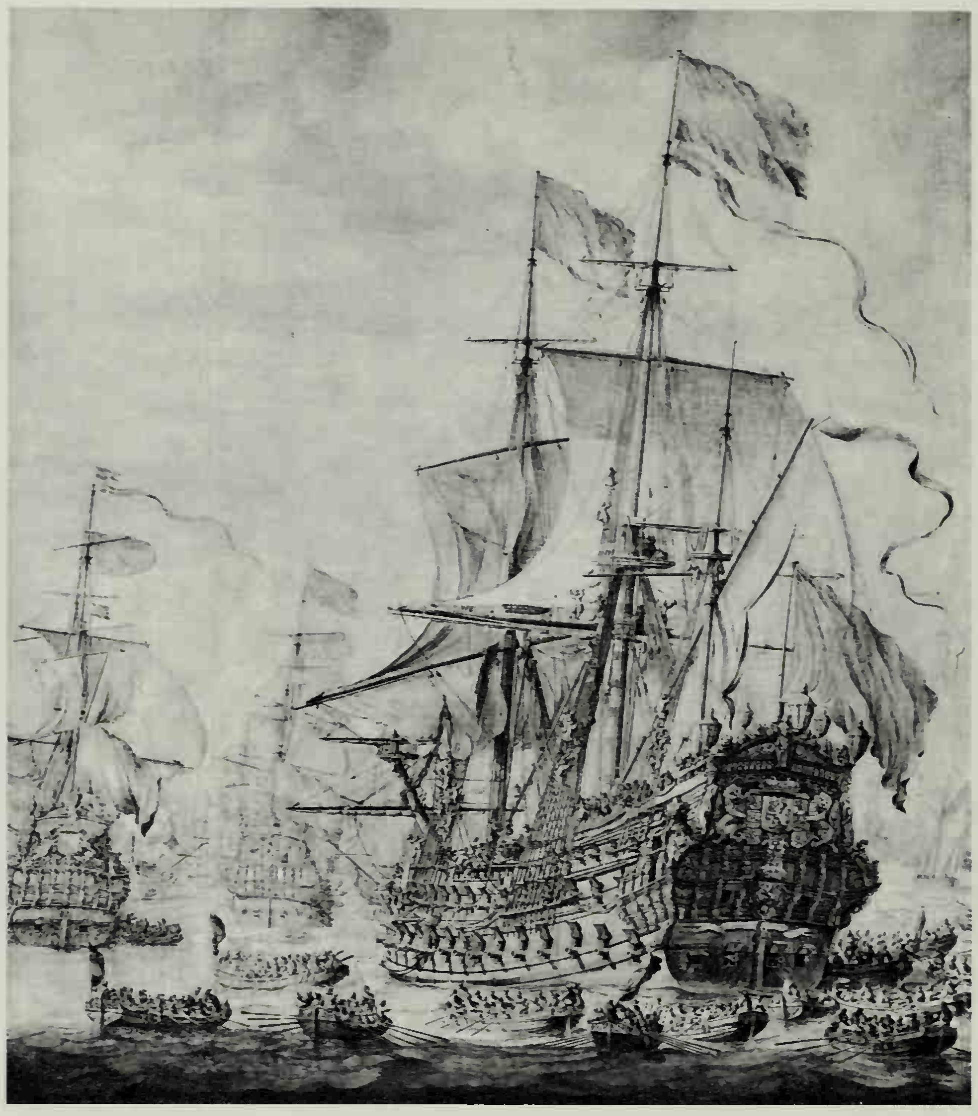
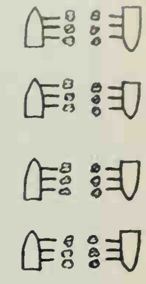


126. *De Zeven Provinciën,* flagship of the Dutch fleet during the victorious Four Days Battle (June 1666) against the English, was an eighty-gun two-decker approximately 152½′ long, 40′ broad, and 15¼′ deep in the hold. The last dimension, because of Holland's shallows, is considerably less than in heavier armed English third-rates. The drawing was done by Willem van de Velde the Elder. The two van de Veldes, senior (1611–93) and junior (1633–1707), were probably the greatest of the many fine Dutch marine artists of the seventeenth century. They were officially employed by the Dutch Navy until Charles II lured them away for the English Navy. Their representations of ships are not only beautiful but scrupulously accurate.

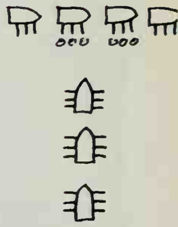
"We must fight in a line, whereas we fight promiscuously, to our utter and demonstrable ruine: the Dutch fighting otherwise (and we, whenever we beat them)." So grumbled Samuel Pepys, for years a high-level administrator of the English Navy, in his celebrated diary under the date of July 4, 1666.

Until the great battle against the Armada, cannon-firing warships fought much like schoolboys in a gang scrap: each ship picked an opponent and squared off. The Spaniards, by dint of fine seamanship and careful drilling, had maintained a well-disciplined defensive order which gave little chance for haphazard individual duels. They forced the English to do something about tactics and, on the spur of the moment, the high command divided the fleet into four squadrons so the ships could at least attack in a pack. A few decades later the Dutch, by then a great naval power, introduced a fundamental naval tactic—one that lasted up to the atomic age—to sail into battle in a line-ahead formation. And this introduced some order not only into the fighting but into the fighting ships as well.

When you fought in a line the ship ahead protected your bow, the ship behind your stern, and your broadside was free to trade blows with the opponents. So long as an admiral prevented an enemy from taking his line at right angles (breaking through it, or the famous "crossing the T") and thereby getting a chance to pour murderous broadsides into his vulnerable prows and sterns, victory would go to the side with the heavier guns (or better gunners). This meant that *all* the ships in the line had to have the strength to trade punches; if a flyweight of twenty guns found itself sailing past a heavyweight of one hundred, the issue was foregone. So there came into being the "ships of the line," units big enough to take a place on the firing line.



All navies at this time—say about the middle of the seventeenth century—adopted the practice of classifying their warships, dividing them into "rates" based on size and on number of guns, from first-rates down to sixth-rates. The first-rates were the showpieces, the super-dreadnoughts, monsters mounting one hundred guns; no nation had very many of these. Second-rates were dreadnoughts, not quite as big or as heavily armed as the first-rates. Both these classes saw more duty in harbor than at sea; they usually came out only for important actions. The standard ship of the line was the third-rate, originally a vessel of at least fifty guns but quickly beefed up to between seventy and eighty. The remaining three rates were the smaller craft that took care of the day-to-day duties which occupy so much 127 of a navy's time and energy: escort, blockade, reconnaissance, carrying dispatches, ferrying personnel.

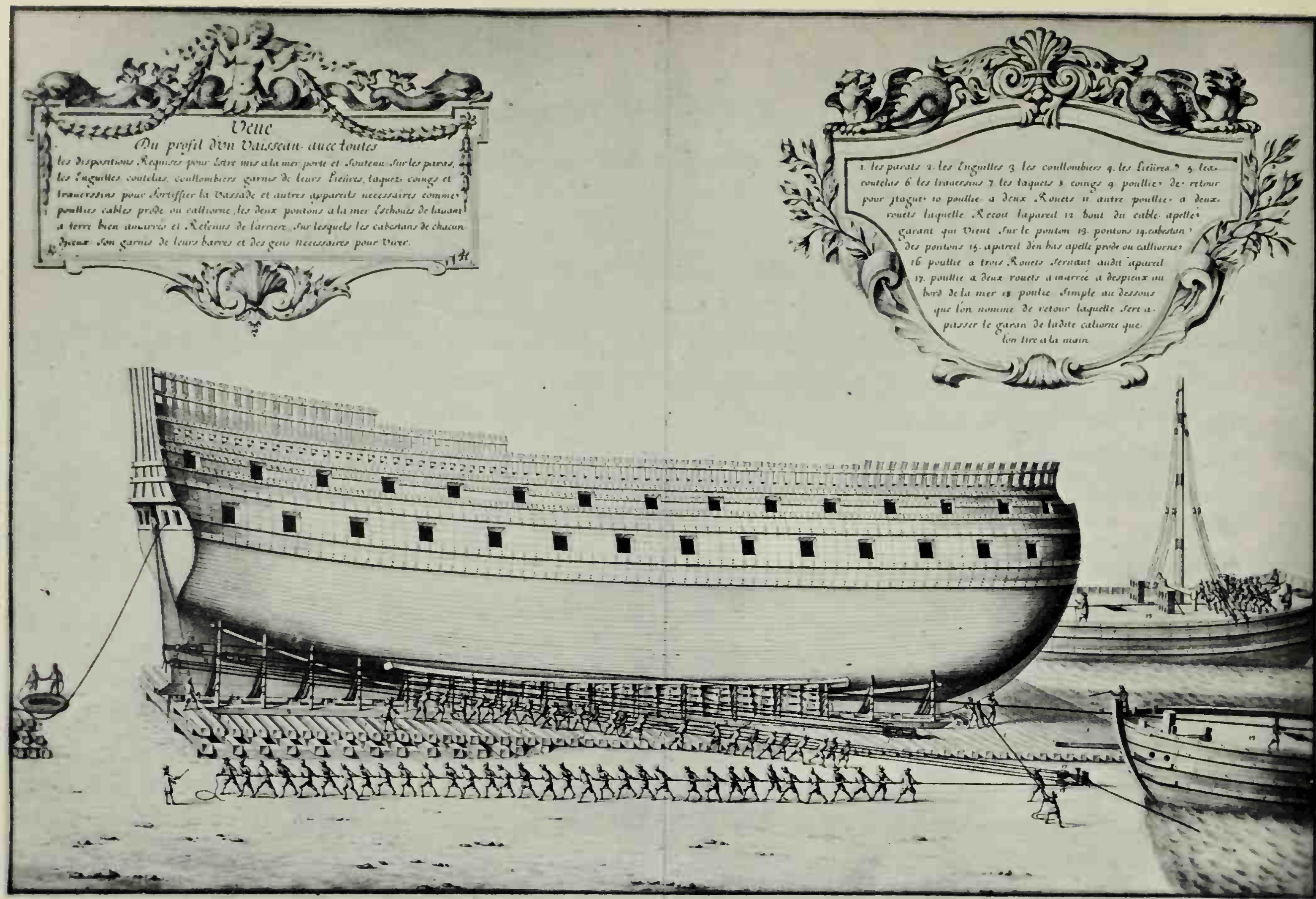


From 1652 to the end of the century, the Dutch and English and French were deep in a three-cornered fight for supremacy on the seas. Under the pressure of wartime necessity each side mothered important contributions to the sailing warship.

The Dutch contribution, as mentioned earlier, was in seamanship and tactics. As designers of ships they were somewhat handicapped by the shallowness of the waters about their home ports. In order to keep down the draught of their vessels, they went in for heavy two-deckers of eighty guns or better—very fine ships in their class. When, toward the end of the century, they tried to squeeze in three decks, the results weren't nearly as successful.

The masters of ship design were the French. Under the able direction of Louis XIV's indefatigable lieutenant, Jean Baptiste Colbert, who ran the navy from 1669 to his death in 1683, the French turned out men-of-war so fine that, whenever captured by other navies, particularly the English, they were immediately used as models.[1] It was the French who saw clearly that the warship was, in effect, a gun platform—and the more stable a gun platform is, the better it is. So they built bigger and broader hulls and cut down the number of cannon. The English, on the other hand, recklessly filled their ships with artillery. To fit in three decks of guns, for example, they were obliged to punch open the bottom ports at a point so low that these were not only useless but a positive danger. When the weather made up, they could neither be opened nor kept watertight, and leakage meant, at the very least, wet gunpowder. French craft not only kept the lowermost ports much higher above water

[1] The situation was one-sided: English prizes in French hands were a liability. When a French fleet had to take to its heels, time and again the only units overtaken were former English vessels.



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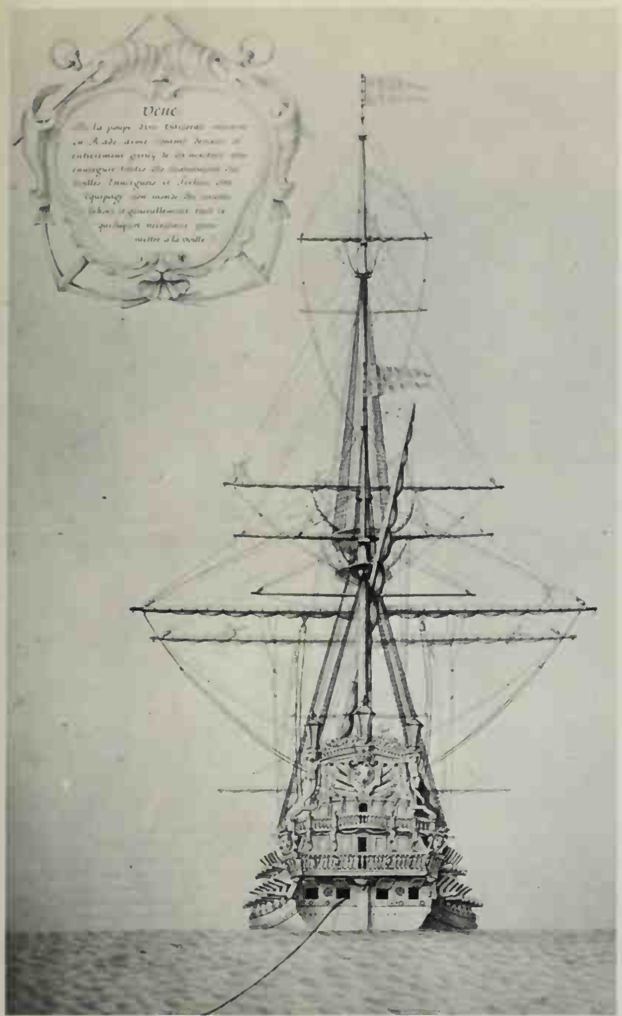
level but, with their broader beam and sturdier build, were much stiffer: they could bring their broadside to bear when the leeward broadside of a heeled-over English vessel was pointing at water and the windward at sky.

The French had forged to the forefront of design even before Colbert took over their navy. A year after England had produced the *Sovereign of the Seas,* they launched the *Couronne* which, though just about the same size, had but two decks and carried only seventy-two guns. Thirty-odd years later, a French two-decker of seventy-four guns (a number adopted so widely it came to be almost standard for third-rates in the eighteenth century) was the same size as an English three-decker of ninety; a century later French two-deckers of eighty guns were as big as English three-deckers of one hundred.

By 1700 England had become top dog on the sea and, in order to stay there, was continually taking French designs and trying to go them one better. And so, thanks to the French, the various English rates steadily grew bigger while the number of guns they carried either remained the same or grew smaller. Here, for example, are some figures for English third-rates, the ship of the line par excellence:

Year	*Name*	*Length of Gun Deck*	*Beam*	*Depth in Hold*	*Guns*	*Crew*
1719	*Cornwall*	158′	44′	18′	80	600
1768	*Egmont*	168	47	19	74	600
1785	*Theseus*	170	47	20	74	600



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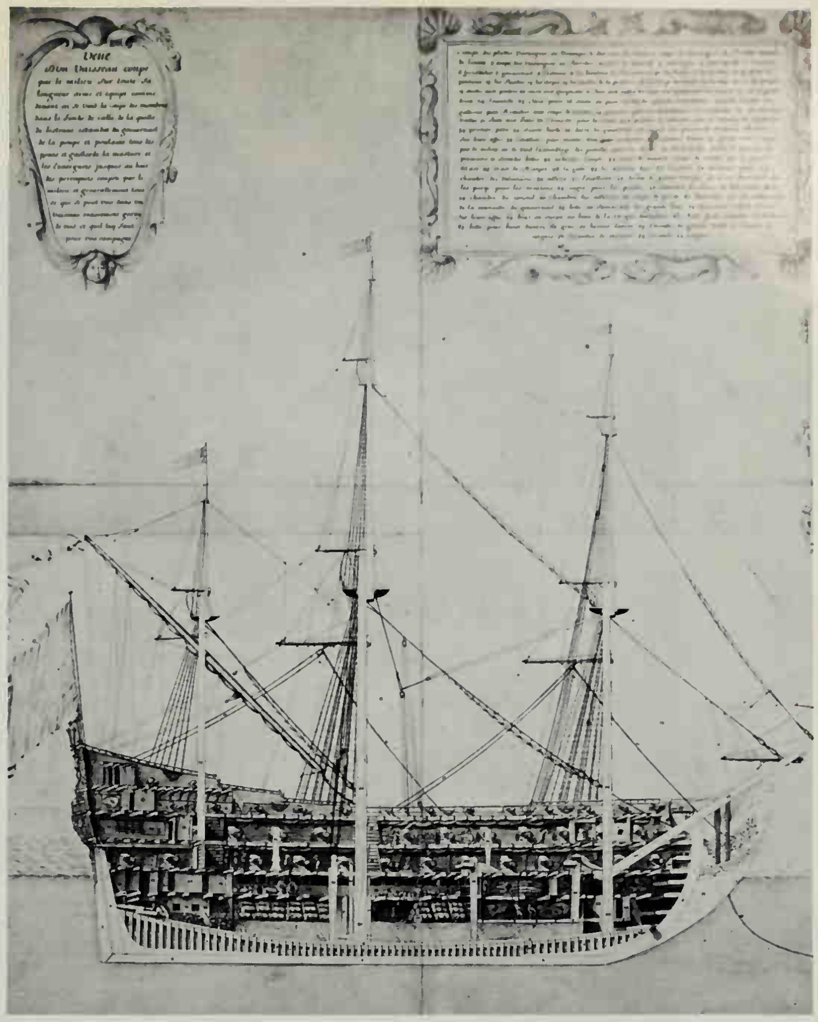

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128–30. Three of a set of seventeenth-century drawings illustrating the construction of a French man-of-war: the hull going down the ways; stern view of the completed vessel; longitudinal cut showing the interior.

The guns, of course, had grown heavier along with the ships. The *Cornwall* was a three-decker carrying thirty-two-pounders on the lower deck, twelve-pounders on the middle, and six-pounders on the upper. Sixty-six years later *Theseus,* a two-decker, had thirty-two-pounders on the lower, eighteen-pounders on the upper, and nine-pounders on the quarter-deck and in the forecastle. Moreover, *Theseus's* guns were of iron—things had gone full cycle: Elizabeth's galleons had sported new smooth-bore, muzzle-loading brass guns, far more efficient than the old iron breech-loaders; a century later Colbert had to force each ship to accept at least a few of the outmoded iron guns (his canny captains insisted on trying them out before mounting them) and, a century after that, ships were back to iron again; founding had improved to the point where the brass muzzle-loader could be duplicated in iron—and iron cost one-third the price.

The one class kept from unlimited growth was the first-rates: their size was held down by the nature of a wooden ship. If a wooden ship goes beyond a certain length, she will sag at the ends when she rides the crest of a wave, or droop in the middle when she crosses the hollow between two successive waves. The *Commerce de Marseille,* a great 120-gun vessel, the pride of the French navy at the end of the eighteenth century, was 208 feet long on the gun deck, and that was about the limit. It so happened that, at the beginning of the nineteenth century, ingenious and powerful systems of cross-bracing were introduced which would have made possible a considerable jump in size, but by then steam, iron, and General Paixhans' explosive shells had the grave of the wooden man-of-war half dug.

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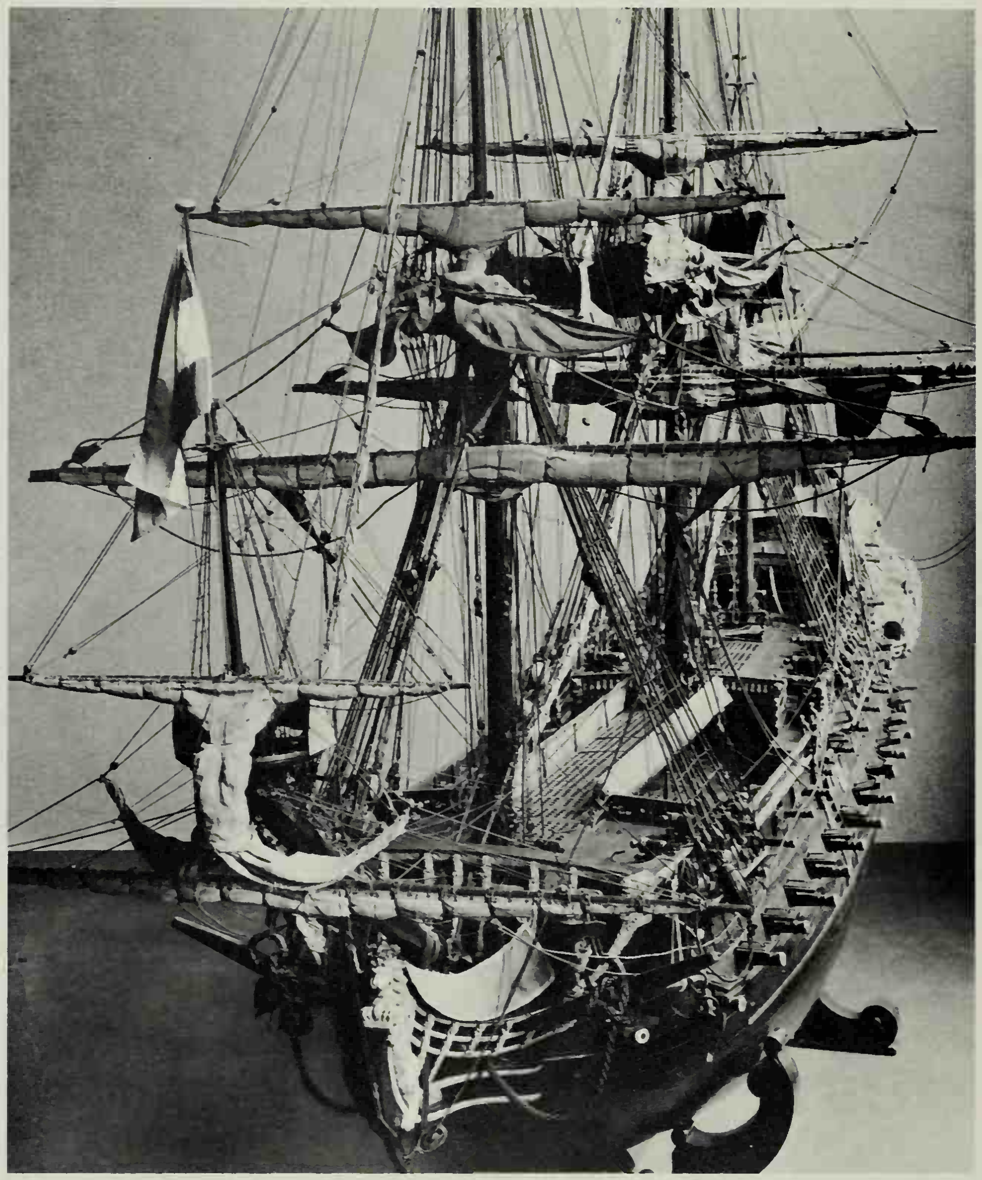


A DUTCH TWO-DECKER OF 1698

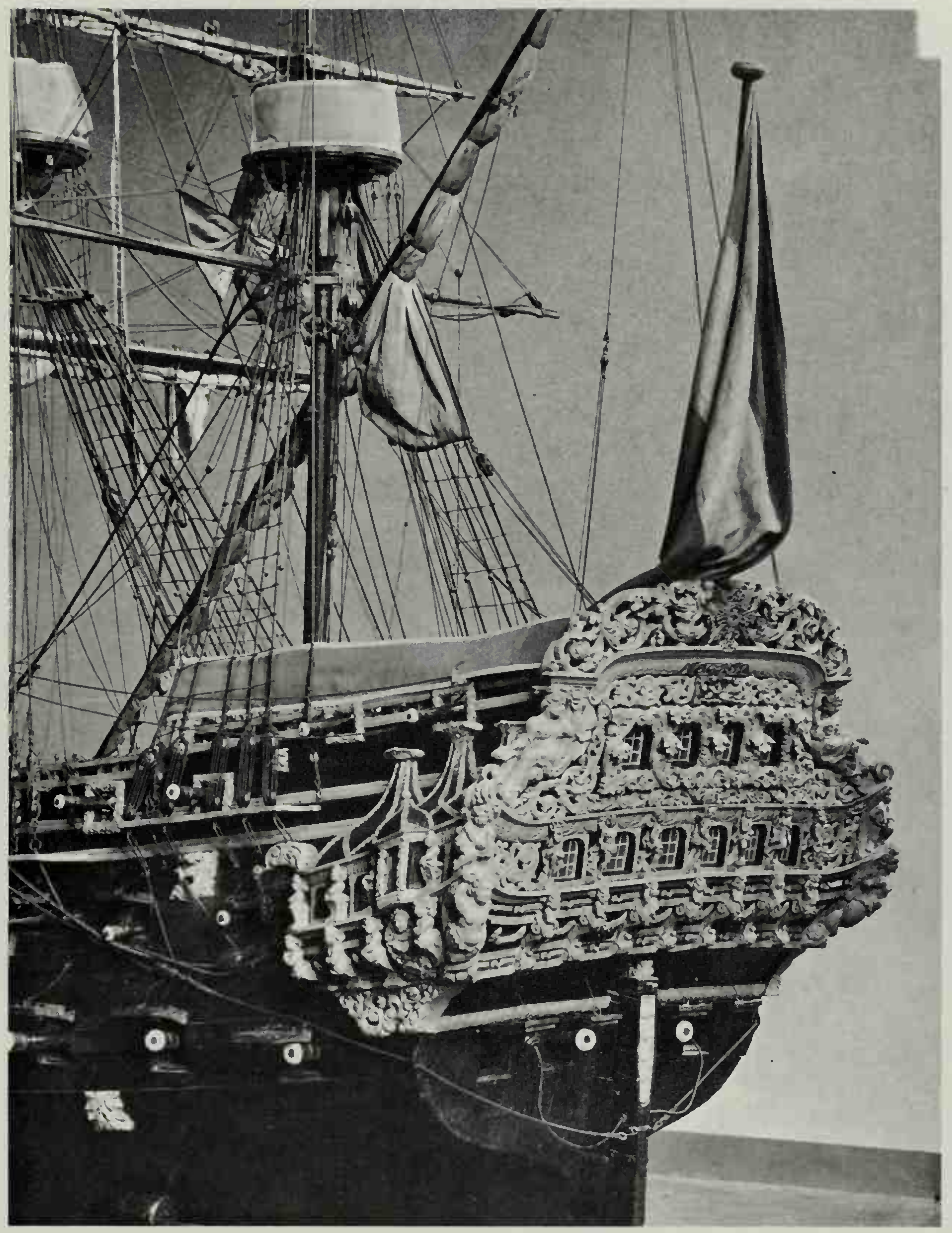
131. Contemporary model, made in 1698. Four staysails are visible, furled about their stays; there is a fore topmast staysail but as yet no jib—the ship still has the puny spritsail topmast.

132. Detail of the stern. The picture, once so prominent on the after face of the sterncastle, has been replaced by a crust of carving.

Vessels were bigger—but they were also more maneuverable. There were two key reasons for this: first, the steering wheel finally made its appearance, and second, fore-and-aft sails were added to help out the square sails.

The steering wheel, in effect a small winch operated by a hand wheel, is a simple enough mechanism, yet it took ages to get itself invented. The clumsy earlier devices lasted until 1710—and in places even hung on for another forty years. A new method of mounting the rudder also helped. Up until 1700 or so, shipwrights cut the rudder head off short and the tiller ran out to it through an open hole in the hull, a good big one to allow for lateral movement; naturally, in a following sea water sloshed through happily. After 1700 they let the rudder head run up through a tight hole in the underside of the stern-

Compare Illustration 162, p. 137



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castle where this jutted past the hull, the tiller joined it inside the sterncastle—and the after part of the ship was a lot drier as a result.

The fore-and-aft sails started to come in shortly after the middle of the seventeenth century. On the stays that braced the masts longitudinally, staysails began to blossom, small triangular or quadrilateral sails that, aligned with the keel, were a great help to a square-rigger's performance on the wind. The most important made its debut a little later, toward the end of the century—the jib, set on the jib-boom, a short prolongation of the bowsprit. The Dutch had invented this efficient headsail in the fifteenth or sixteenth century and used it on their small craft ever since; it finally made its way into larger ships and was an immense improvement over the spritsail topsail on its matchstick mast. The jib and other staysails forward put a strong upward pull on the bowsprit (the square spritsail, hung underneath, had pulled it downward), so the bobstay came into being, a stout stay that anchored it firmly to the hull.

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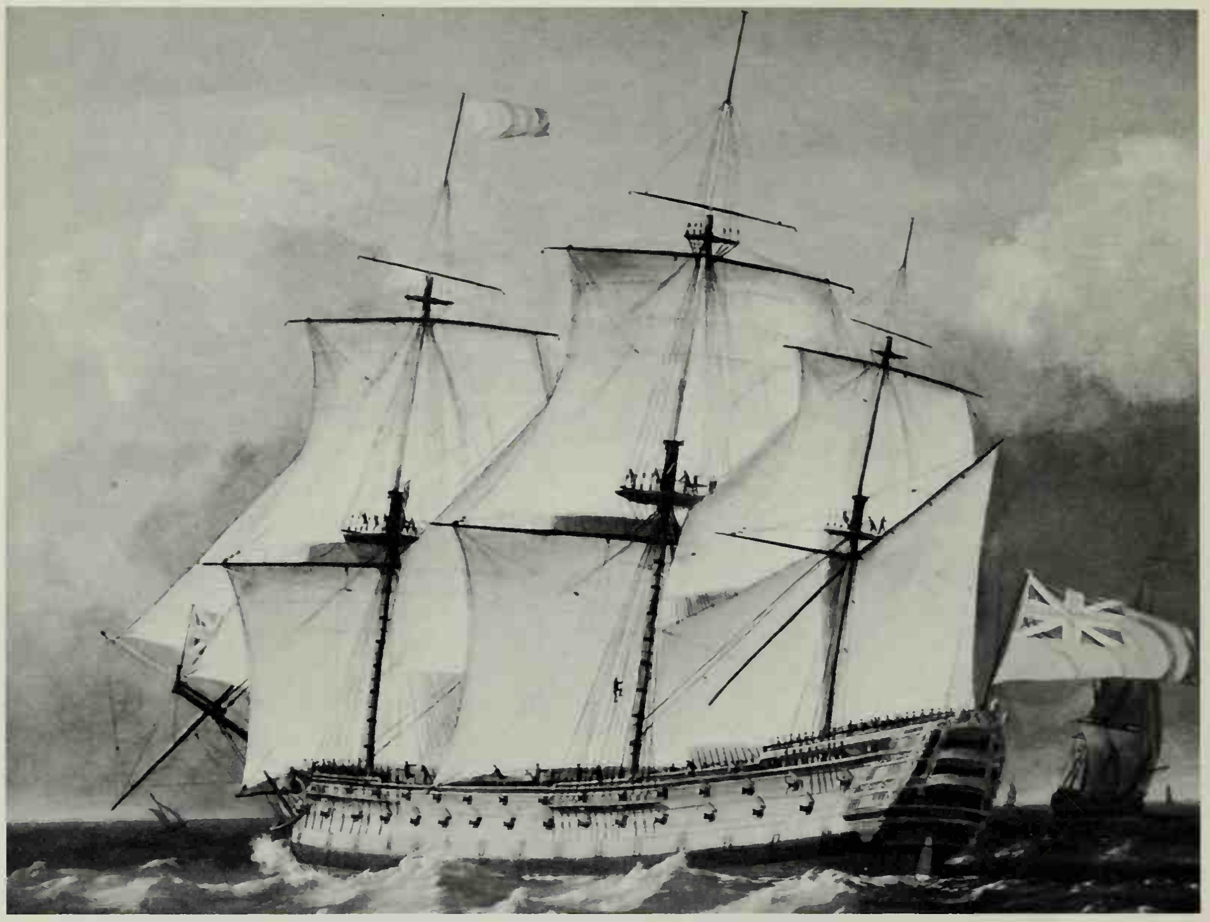

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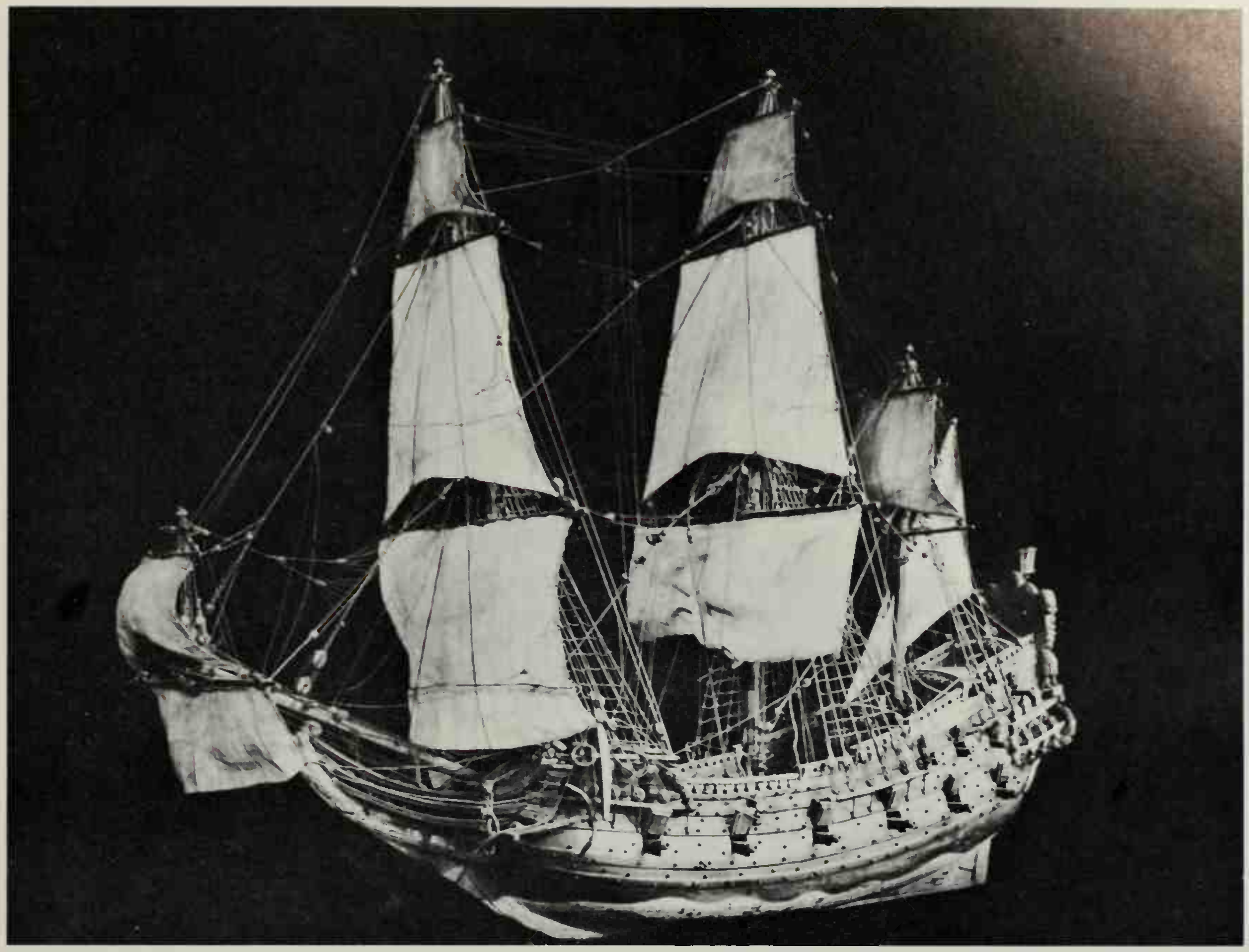

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133. Nelson's famous *Victory,* launched in 1765, as she looked in 1792. The ship is sailing on the wind with jib and four staysails set. A bobstay holds down the bowsprit against the upward pressure from the headsails. The portion of the lateen forward of the mizzenmast has been cut away but the yard is still intact. At this time open stern galleries were again à la mode; when the *Victory* was rebuilt between 1800 and 1803, the fashion had changed and her stern was closed in.

134. The *Constitution* entering New York Harbor in 1931. Launched in 1797, she was just under 175′ on the gun deck, 43′6″ wide, 14′3″ deep in the hold, her burden was 1576 tons, and her armament consisted of thirty twenty-four-pounders on the gun deck and twenty to twenty-two thirty-two-pound carronades on the forecastle and quarterdeck.

135. Contemporary model of a Dutch seventeenth-century pinnace, the prototype of the sloop of war. These rather small, speedy vessels were used to carry dispatches and transport personnel. *See page 116.*

There was considerable improvement aft to match the changes forward. About 1750 or so the triangular section of the lateen that jutted forward of the mizzenmast was cut away —not the yard, just the canvas; the long yard was a useful replacement for a shattered spar— leaving a quadrilateral sail. Then, sometime between 1750 and 1800, even the yard went, a gaff stiffened the head of the quadrilateral, a boom (eventually) spread its foot, and the erstwhile lateen mizzen had become the "driver," in form much like the mainsail of a gaff-rigged yacht. Once the lateen yard had been taken away, the "barren yard" above it need be barren no longer; a sail, the crossjack (cro'jack) was hung on it and the mizzenmast was, for the first time since the full-rigged ship had come into being, square-rigged from top to bottom.

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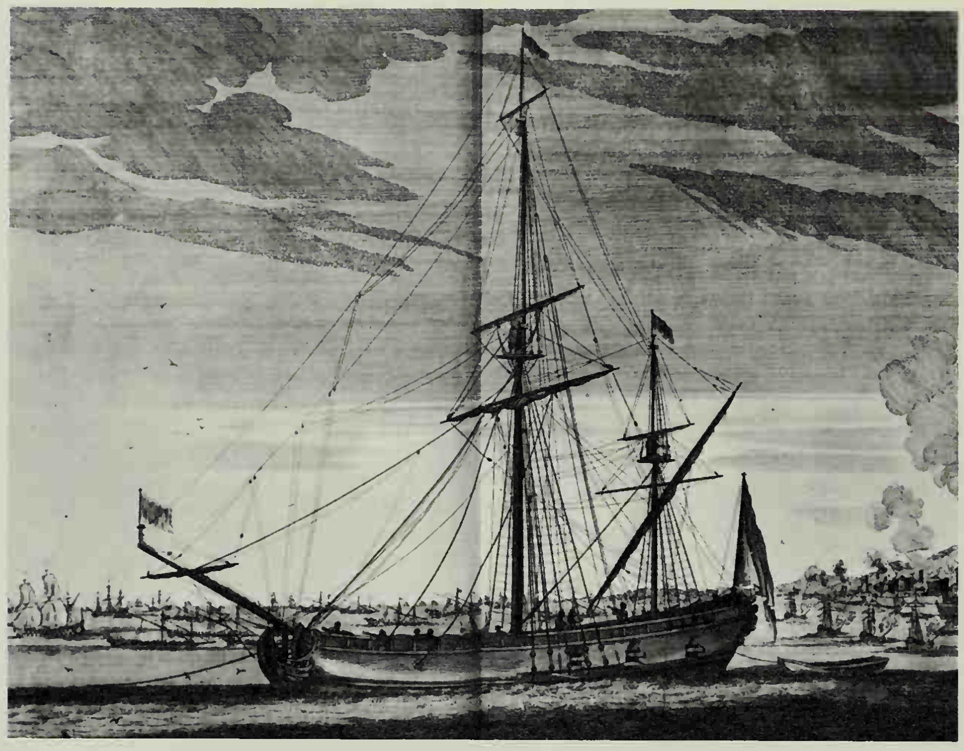

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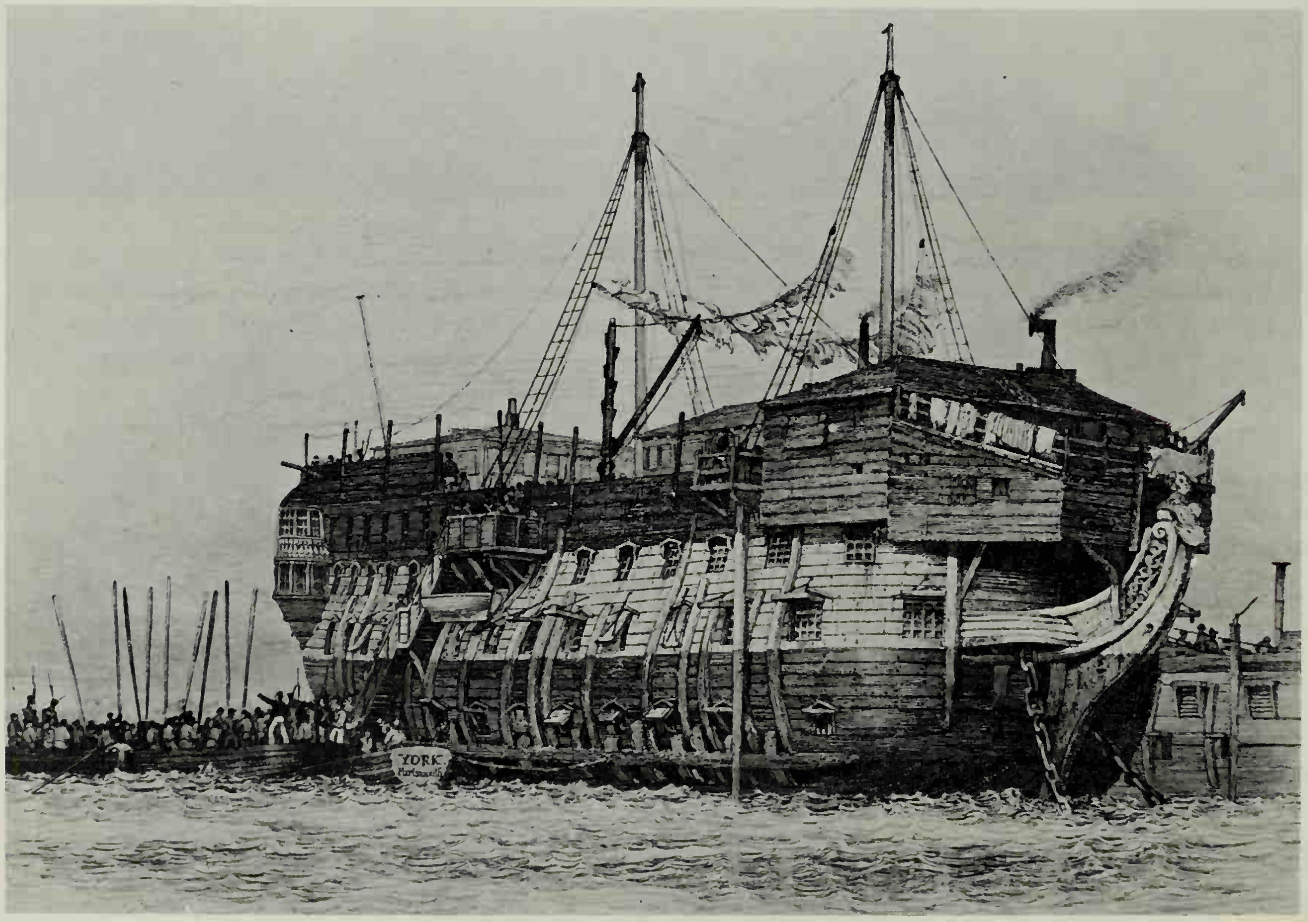

136. A bomb-ketch of the late seventeenth century. The foredeck has been left clear for the bulky mortar that fires the bomb. The artist has shown a few of these vessels in action in the lower right. *See page 116.*

137. Some old sailers never die. An etching by Cooke: "Convicts go aboard a prison-ship in Portsmouth Harbor." These rotting, dank, filthy hulks of outmoded eighteenth-century warships made prisons that suited the penal ideas of the first half of the nineteenth century.

The eighteenth century saw a number of other improvements before it closed. Sails were now cut with far less pouch than before (above, pp. 98–100), and the upper sails no longer flared out so exaggeratedly toward the foot. For shortening sail, bonnets bowed out and reefpoints were revived (above, p. 63); for increasing sail, drabblers disappeared and studding sails (stu'ns'ls) came in fashion, rectangular pieces of canvas set lengthwise on little yards alongside the courses and topsails of the fore- and mainmast. And most full-rigged ships now carried royals, so called because they were once the exclusive property of the *Royal Sovereign,* as the *Sovereign of the Seas* was named after a rebuilding in 1659.

Compare Illustration 182, p. 153

Compare Illustration 125, p. 103

But what good were lethal lines of guns and towering tiers of canvas if the planks that held them up and the men that worked them were rotting away? In the sixteenth century, when ships were relatively few and the service they saw sporadic, this was a nagging problem but nothing more. In the eighteenth century, when vast funds were invested in navies and thousands of lives were involved, it was deadly serious. Noxious gases from vile-smelling bilges ruined the timbers below and the lungs above. Ships on duty in warm waters came back with their bottoms riddled by the marine borer. Ships on duty for extended periods in any waters came back with their crews decimated by scurvy. The Portuguese cold-bloodedly used to send three complete crews on the carracks that went to India (below, p. 133); it was the only way to be sure of having enough able-bodied hands to sail the vessels back.

The timbers received aid before the men did. Sir John Hawkins had tried smearing the bottom of his galleons with hair and tar and then covering it all with a sheathing of elm boards. Toward the end of the seventeenth century shipwrights got around to putting on lead sheathing—which the Romans had done a millennium and a half earlier (above, p. 48)—but, since the lead didn't mix with the iron bolts of the hull, corrosion was rapid. Finally, by the end of the eighteenth century copper sheathing plus copper bolts below the waterline not only did a good job of protecting the outside of the planks against the borer but, by collecting less marine growth than wood did, added to speed.[2] The inside took as long to solve. The bilges remained cesspools until early in the eighteenth century when efforts were started to introduce fresh air into a vessel's bowels. Finally, in 1751, Stephen Hales, an inventive English physiologist, devised wind-driven ventilators combined with hand-driven air pumps that helped considerably.

But the worst problem of all had nothing to do with the ships. Foul gases took years to rot timber but scurvy could rot men in a matter of months. Just about the time that Dr. Hales was introducing fresh air into the bilges, Dr. Lind was introducing fresh lime juice into the crews. James Lind, a Scottish physician, established that scurvy was connected with a lack of fresh fruit or vegetables; crews were given lime juice regularly (hence the name "limeys" for British sailors), and the scourge disappeared overnight. When Cook dropped anchor in Plymouth on July 25, 1775, he brought back 117 of the 118 men he had left with over a thousand days before; a few decades earlier the mortality from scurvy would have been 50 per cent. Cook not only fed his crews lime juice but

[2] John Paul Jones had requested copper sheathing for *Bonhomme Richard* in 1779 but, like so many other things he asked for, didn't get it. Since the newly built *Serapis* had it, he was up against superior speed as well as guns.

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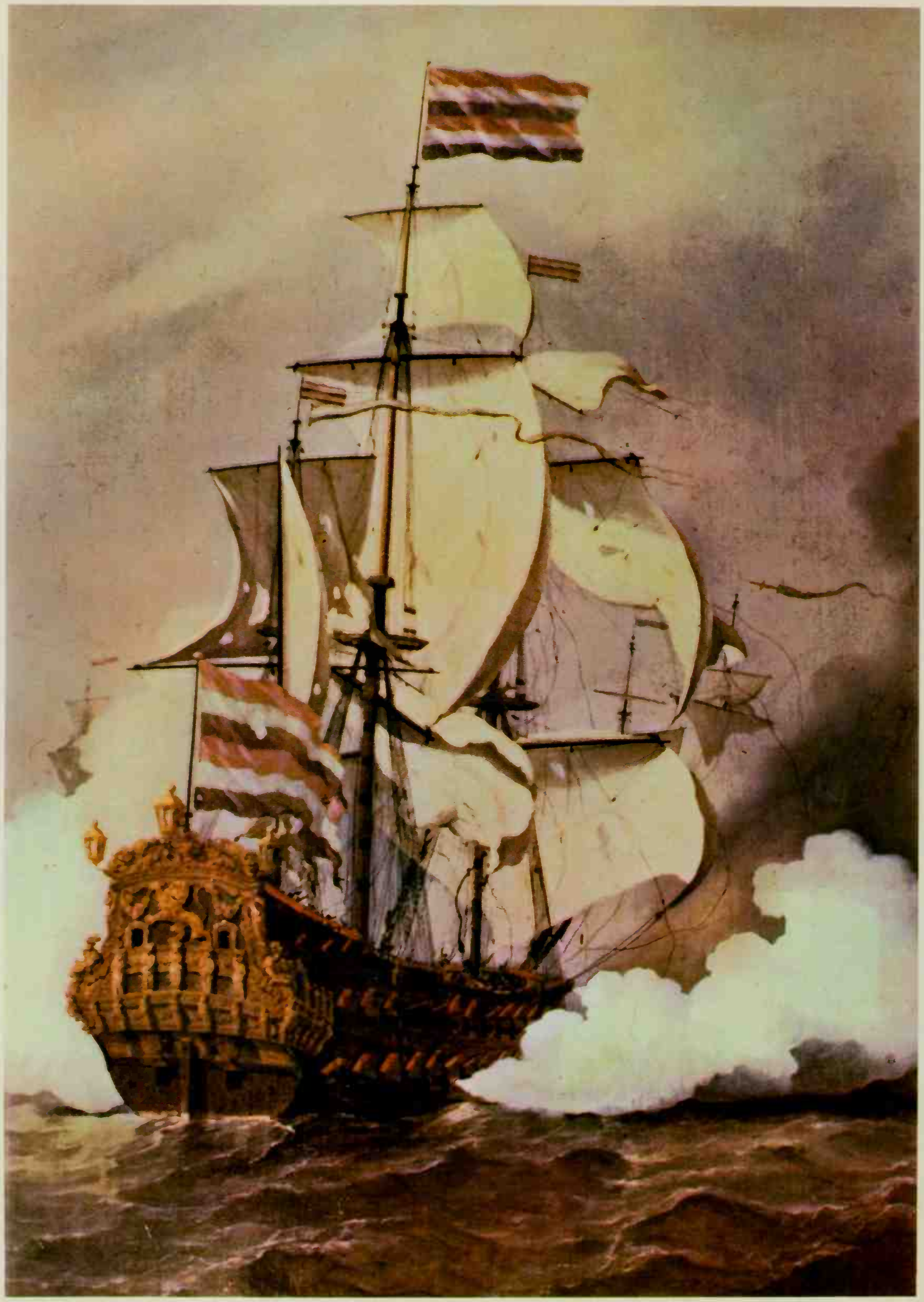
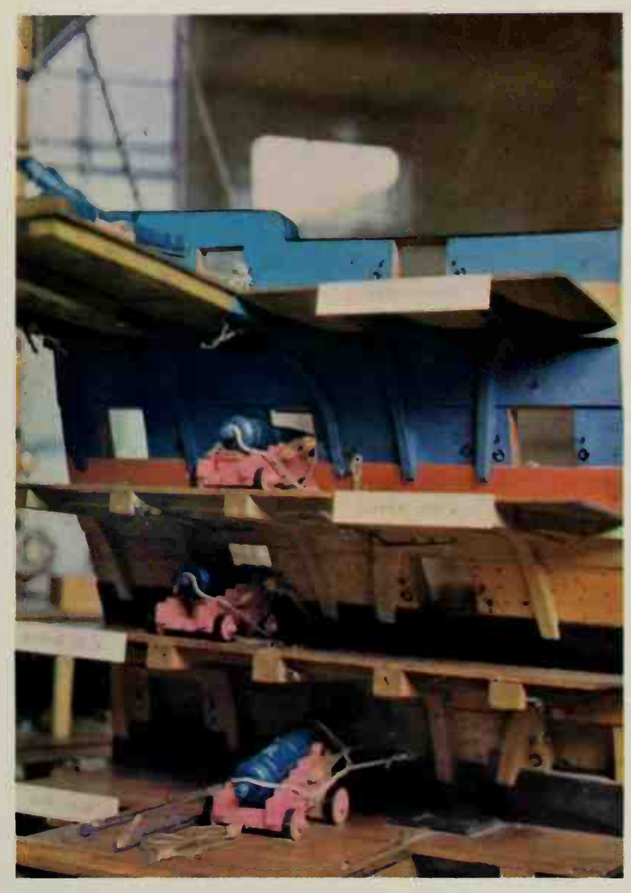


138. The Dutch *Gouden Leeuw* ("Golden Lion") 165½′ long and 42′ wide, in action during the Battle of Texel, a bloody, indecisive contest between the Dutch and English in August 1673. *See page 105.*



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139. The guns of a three-decker. Those on the upper two decks are shown run out and ready for action, that on the lowermost deck secured and lashed fast. Each gun has a tackle aft for running it inboard and tackles on each side for running it out. The heavy horizontal cable helps take up the recoil.

140. The *Victory* today in Portsmouth Harbor, restored to look as she had at the Battle of Trafalgar in 1805. At that time she was 186′ long on the gun deck, 51.5′ wide, 21.5′ deep in the hold, her burden was 2162 tons, and her armament consisted of (gun deck) thirty thirty-two-pounders, (middle deck) twenty-eight twenty-four-pounders, (upper decks) forty-two twelve-pounders and two sixty-eight-pound carronades.

also fresh fruits and vegetables when available; he had no compunctions about enforcing his dietary laws with the whip if any moss-grown shellbacks wanted to stick to the delights of biscuit and jerked beef, and this no doubt was one of the reasons for his splendid record.

With the coming of the nineteenth century, the last of the fripperies were eliminated, and warships became grim-looking artillery platforms. The beaks which went back to galleon days, the "tumble-home" which went back even earlier (and only served to make a vessel topheavy), the flat surfaces aft, all went by the board. Prow and stern now were rounded; the construction was stronger, and it gave room to mount more guns. The sterncastle went the way of the forecastle, and the waist, up to now more or less open, was covered over to make a continuous deck from stem to stern, and a high, sturdy bulwark girdled it completely. As if to atone for the curved, baroque carving that had lasted so long, hulls now received geometrically designed paint jobs that gave them a zebra-like or checkerboard effect. Horatio Nelson went in for alternate bands of yellow and black (the black between rows of guns) and black port-lids. This combination, with the substitution of white for yellow, enjoyed a great vogue.

The nineteenth century brought a new navy to the fore—the American. Its strength lay not in heavy ships of the line but in frigates, a smaller man-of-war whose duties a century earlier had been carried out by fifth-rates and, a century later, were to be carried out by cruisers.

Frigates (the sailing warships, that is; a type of galley and merchantman also had the same name) were developed about the middle of the eighteenth century. There existed at the time certain small two-deckers mounting twenty-four guns, only four of which were on the lower deck. These ships were redesigned, the lower guns were removed, and the result was the frigate, a fast, seaworthy two-decker with all its guns on the upper deck. The early French versions (1765) carried twenty guns and were about 120 feet long; the early English (1757) carried twenty-eight and were 128 feet long. By 1812 America was building the magnificent frigates that made such a reputation for themselves in the war against England, forty-four-gun vessels almost two hundred feet long on the gun deck.

Illustration 134, p. 110

Next in size to the frigate was the sloop of war, or corvette as it was called in the French navy. The sloop of war has nothing in common with the sleek sloops you see in the marinas today; it was a square-rigger, in the first half of the seventeenth century usually two-masted but thereafter three-masted with the same rig as its bigger brothers. It generally carried between ten and twenty smaller guns. John Paul Jones' famous *Ranger* was a sloop of war; she had three masts, carried even royals and studding sails, was ninety-seven feet on the gun deck, and mounted eighteen nine-pounders.

Illustration 135, p. 111

A vessel about the size of sloops of war, but fitted for one single purpose was the bomb-ketch. The French devised it to help in attacking land fortifications. Among the varied merchantmen used by the Dutch was the galliot, a sturdy, beamy two-master which, like a modern ketch, had a mainmast and mizzen, but no foremast. As a result there was a lot of open deck space forward. In 1679 Bernard Renau de Eliçagaray got the idea of mounting here a large mortar, one that would throw a two hundred-pound bomb. He built five *galiotes à bombes* and used them with great effect during the siege of Algiers in 1682, and the bomb-ketch thereafter found a place in most large navies.

Illustration 136, p. 112

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141. Two royal English yachts, painted in 1674. Yachts of the time were treated to the same gorgeous carving and gilding as regular naval vessels. Left the *Ann*, right the *Kathryn Ann*.

CHAPTER EIGHT

Warships under Oars

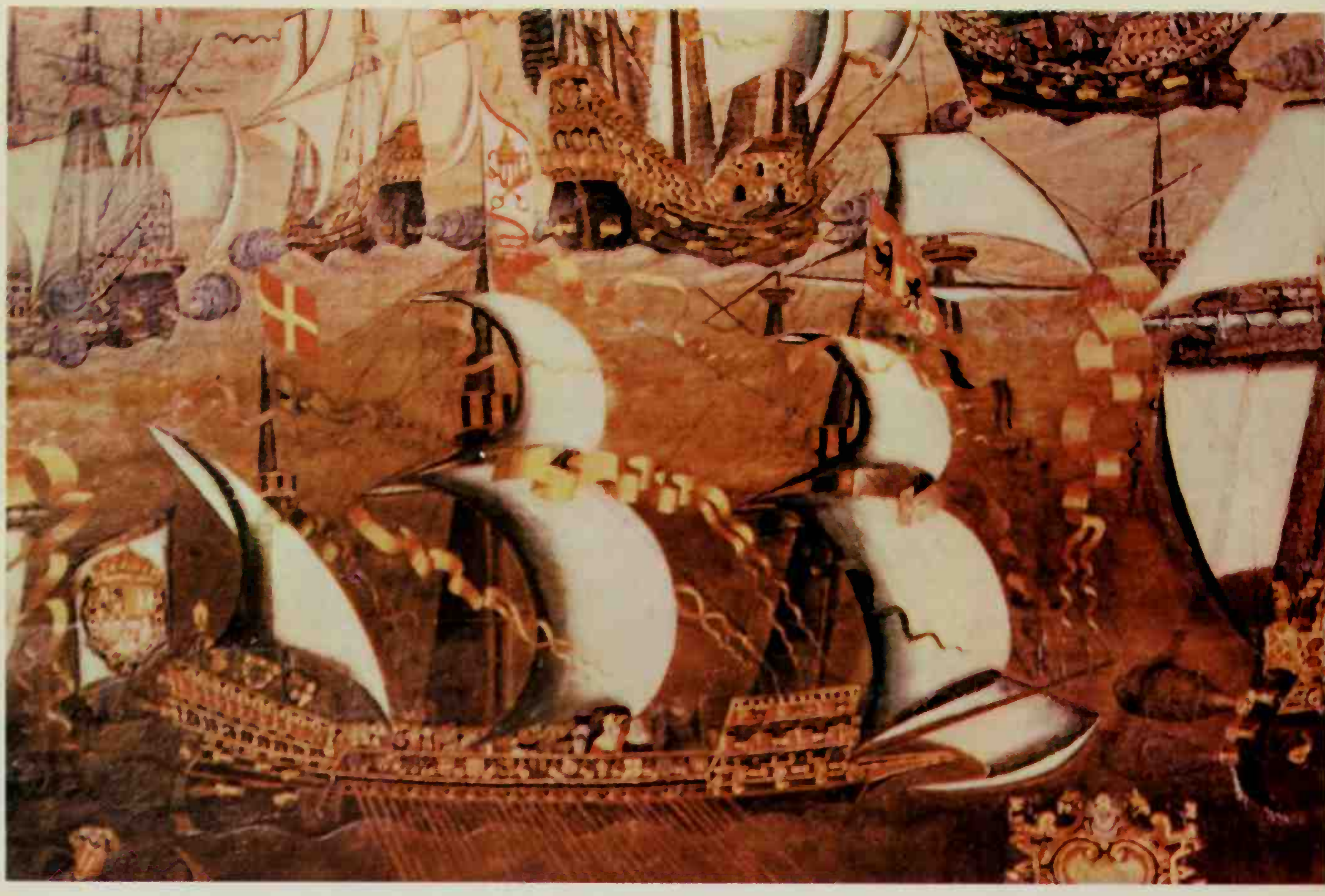
THE battle with the Armada in 1588 ushered in, with a roar of cannon, the heyday of the sailing ship, an instrument that affected the course of history profoundly. Seventeen years earlier, the Battle of Lepanto had ushered in, with curses, cries, and the crash of hulls, a new lease on life for the oared warship, an instrument that turned out to be a military debit and a moral blight.

Some galleys accompanied the Armada in 1588, and Spain for a while thereafter stubbornly kept sending them into English and Dutch waters. But their career in this area was short and unhappy: the weather was just too much for such light craft. Henry VIII had experimented with a ship he christened the *Great Galley,* a huge affair with no less than sixty oars a side; eventually he was forced to turn even this behemoth into a plain sailing vessel. In the Mediterranean, however, where the weather was far milder and calms were a continual problem, oared warships still had some reason for existence.

Yet, a half-century before Lepanto, they were finding it no easy job to stay alive even there. Venice's famed heavy merchant galleys (above, p. 74) were rotting in their slips; the sailing ship, now that it had the rig to provide speed and maneuverability and the guns and size to discourage pirates, was carrying most of the cargoes. It was almost as efficient and far less expensive; even pilgrims to the Holy Land forwent such conveniences as uncramped nights ashore to save money and go by sailing vessel. And the light war galleys were having crew trouble: oarsmen, always scarce, were harder to find than ever; in Venice, for example, citizens would accept any kind of military service other than pulling an oar, and the men available for hire were from the bottom of the human barrel.

On January 22, 1443, Charles VII of France gave Jacques Coeur, a canny French shipping magnate who had a private fighting flotilla all his own, the right to impress vagrants for his crews. The act was a veritable signpost pointing out the way to solve the problem of getting rowers; from then on the vicious practice of putting conscript labor at the oars spread like the plague. Moslem navies, particularly the Turks', favored Christian slaves. Christian nations returned the compliment by using whatever Moslems they could get their hands on, but they could never get enough. The majority of their crews came not from capture but the courts—criminals were now sentenced to the rower's bench instead of jail. Most of the volunteers that were left quit in disgust at the company they had to keep. Venice, of all the Mediterranean powers the proudest of her oared navy, held out the longest but, by 1550, even she had to give in. In the vital showdown between Christendom and the Turk at Lepanto, the fact that Allah's adherents were rowed into battle by Christians, and Christ's by infidels and criminals, apparently bothered neither Christendom nor the Turk.

But rowers were not the only problem. The sixteenth century was the era of naval can-



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142. One of the four galeasses attached to the Spanish Armada. The artist has been prodigal with his oars, showing no less than thirty-seven a side when there were actually only twenty-five (each pulled by six men). The Spaniards occasionally, as here, used a square rig instead of lateen on their galeasses. Note the impressive armament these ships carried.

non, and galleys too felt the need to carry a battery forward to fire over the bows. Yet even popguns added a dangerous amount of weight to the foredeck of an *a zenzile* ship (above, p. 71), which was little more than a glorified racing shell. Just about the time that Venice joined all the other nations in employing conscript oarsmen, a change came that solved a lot of difficulties—oarsmen, guns, the obsolescent merchant galleys—at once. It was a new system of rowing.

Compare Illustration 43, p. 36

Compare Illustration 91, p. 75

Compare Illustration 118, p. 96

The Greeks and Romans had favored the use of one man to an oar, and the Middle Ages had known no other. But, about 1550, the long, slender oar and its one oarsman made way for the massive sweep manned by several—the galley rowed *a zenzile* gave way to the galley rowed *di scaloccio,* to use the technical term for the new arrangement. It had two all-important advantages: for one, it could drive a broader and heavier hull at no less speed—and this meant that some fair-sized guns could now be mounted forward; for another, the new system was better adapted to untrained, unwilling rowers—only the num-

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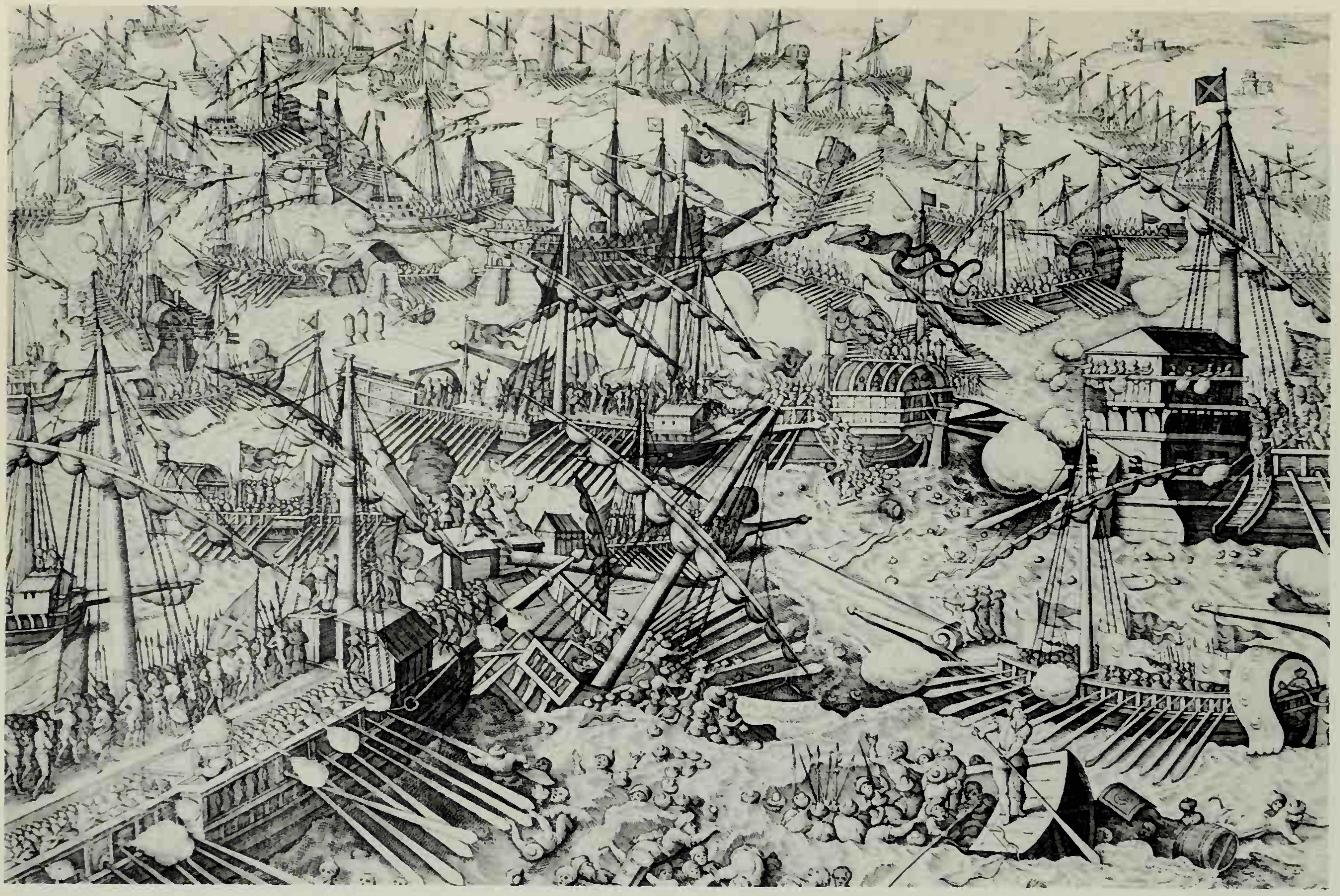
143. The *Bucentaur,* the monumental state barge of Venice's doges, in its eighteenth-century form. In weight and structure and general shape, the *Bucentaur* was a galeass; instead of fighting castles and other accoutrements of war, it carried spacious quarters and gorgeous decoration. This particular version was 114 feet long and twenty-four feet wide, and had twenty-one sweeps a side each thirty feet long and manned by four or five men.

ber one man on each oar had to be professional; the others simply supplied muscle. The change gave the galley a shot in the arm that kept it alive for another two hundred years.

The *a zenzile* war galley of, say, A.D. 1400 ran 120 feet in length and fifteen in beam, and had 150 oars twenty-nine to thirty-two feet long manned by 150 oarsmen. Two hundred years later, the average galley ran about 150 feet in length and twenty-three in beam, and had forty-eight forty-foot sweeps, each manned by three men, for a total of 144 rowers. Three hundred years later the average ran 170 in length and twenty-six in beam and had fifty-one sweeps each manned by five men.

With all its improvements, the war galley still had its limitations: it was, after all, little more than an overgrown open boat, and its guns were still too few to be very effective. Around 1550, the Venetians came up with an idea that gave them an oared warship heavy enough both to provide cover for the rowers and to mount an armament able to trade blows with the guns of a sailing man-of-war—and, at the same time, they solved



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144. The Battle of Lepanto, 1571. In the left foreground a heavy Christian galley has taken a Turk in the flank; a group of marines on the beak fire down on the doomed ship's deck. Midway along the right side of the picture is the towering sterncastle of a galeass; there were six at Lepanto, and they are shown here in a line that runs from this point to the upper left-hand corner. The six led the Christian forces into battle; the galeass had not as yet made its way into the Turkish navy.

the problem of what to do with their obsolete merchant galleys. These had plenty of room and weight but had always been too slow for use in battle. Now, however, the new *di scaloccio* system of rowing was proving capable of sending heavy hulls through the water at a good clip. What the Venetians did was to take their ponderous merchant galleys out of the mothballs, replace the *a zenzile* oars with long sweeps, build a deck over the rowers, mount no less than seventy cannon (eight to ten forward, about the same number on the poop, and the rest light pieces between the oars)—and thereby create the galeass, as this superdreadnought of galleys was called. Galeasses generally used five or six men to an oar (e.g., the four galeasses of the Spanish Armada had each three hundred rowers, twenty-five oars a side with six men on each), but in the seventeenth and eighteenth centuries a few oversize models were built in which seven, possibly eight, men pulled sweeps nearly fifty feet long.

In addition to galeasses and galleys, every oared navy had a number of swift, smaller types, all using one man to each oar, for scouting and carrying dispatches. The most common were brigantines, which varied in size from eight to sixteen benches, and frigates, which varied from six to twelve. In the seventeenth century these two names were transferred to certain fast sailers that performed similar duties in the sailing fleets.

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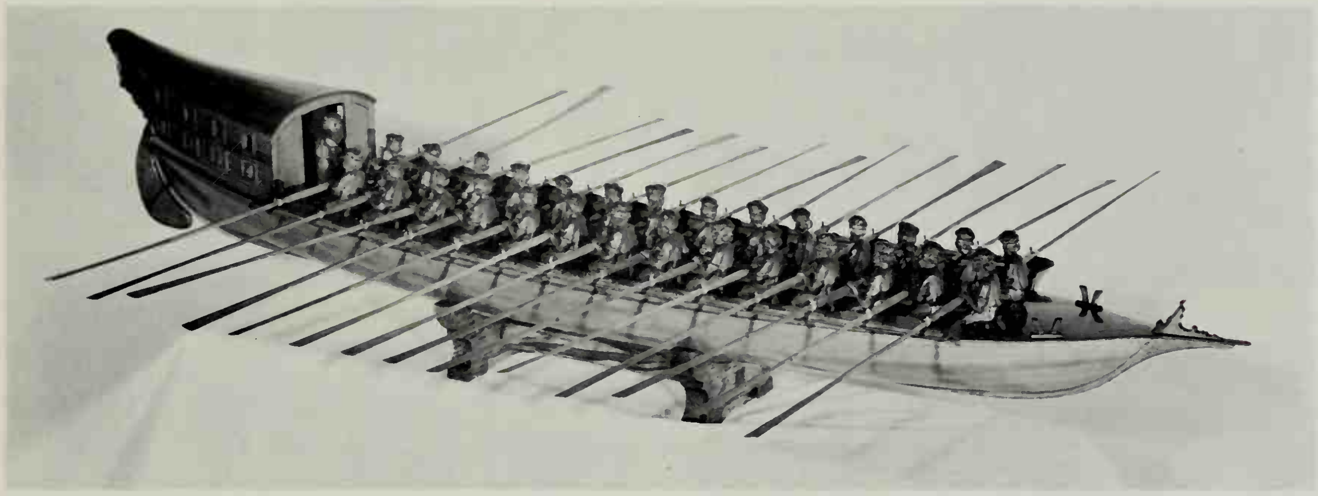

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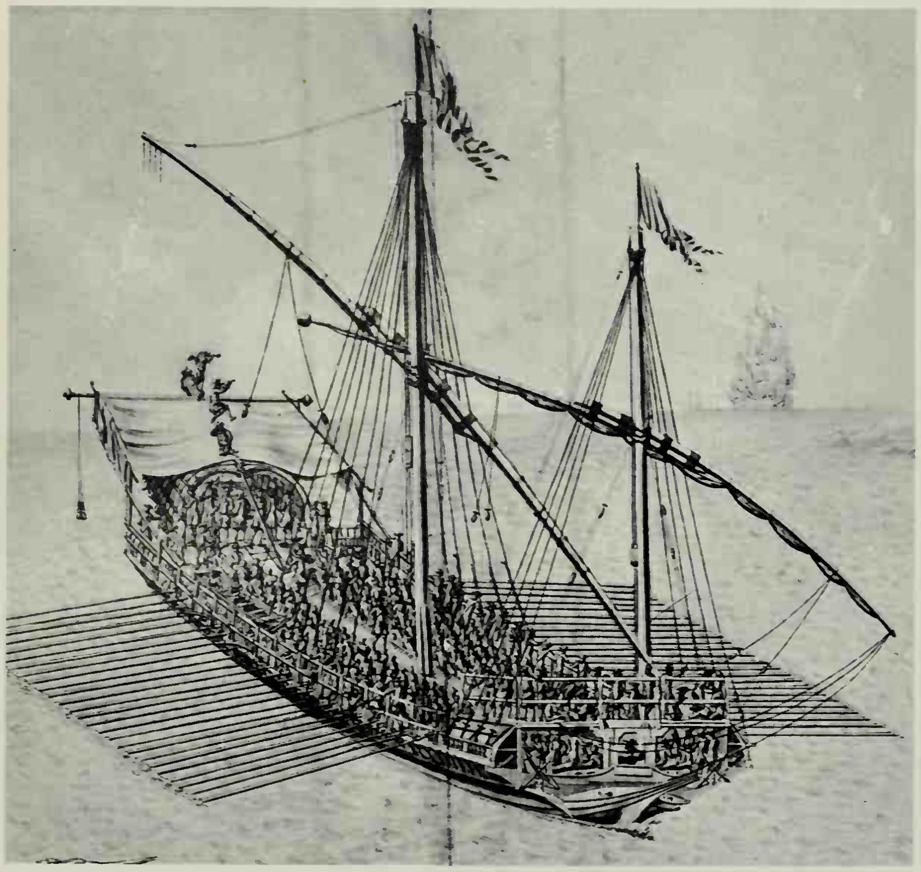
145. A galley of the early seventeenth century in the harbor of Amsterdam. The ship is a small type with only twenty-one oars a side and one sail.

146. Modern model of a sixteenth-century Venetian brigantine. Since the prime feature of the ship was speed, the hull gives almost the impression of a racing shell. There are fourteen oars a side, each pulled by one man.

We know best the galleys in use in Louis XIV's navy at the end of the seventeenth century, thanks to a detailed description left by Barras de la Penne, captain of one of them. The standard galley had fifty-one oars: twenty-six on starboard but only twenty-five on port; the ninth from the stern was omitted to leave an area seven feet by eight for the kitchen. Since there were five men to each oar, the rowing complement totaled 255. Flagships had up to thirty-two oars a side with as many as seven men on each. Like rowed ships of any age, these galleys used the wind whenever possible; only getting in and out of harbor and going into battle had to be done under oars. The rig was a two-sail lateen: there was a foremast, fifty-five feet high, in the bows, and a mainmast, seventy-five feet high, amidships; two centuries earlier, the foremast had been the taller (above, p. 73). The weather determined what sail would be raised; every vessel carried five sizes for the mainmast, and two for the fore. Under oars the ships could do five miles per hour—but only for the first hour; during the second, the men were good for only four and a half miles; and, after that, they dropped down to two or slower.



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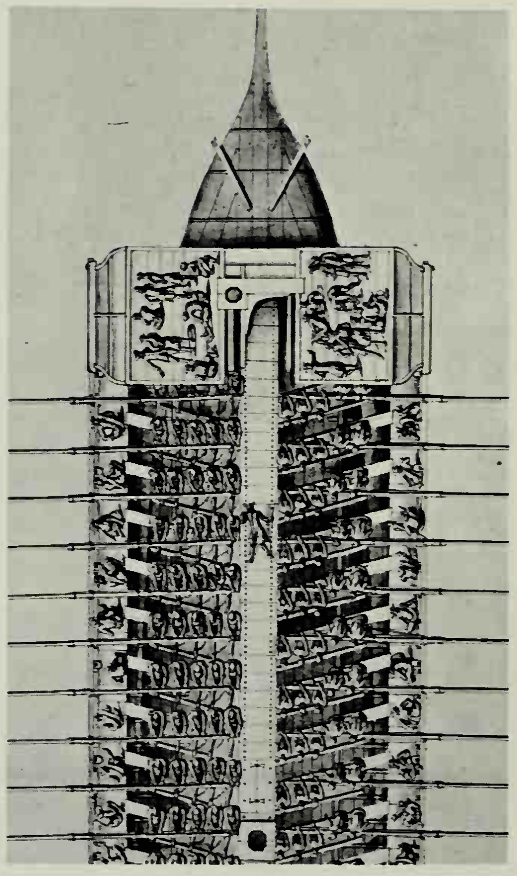

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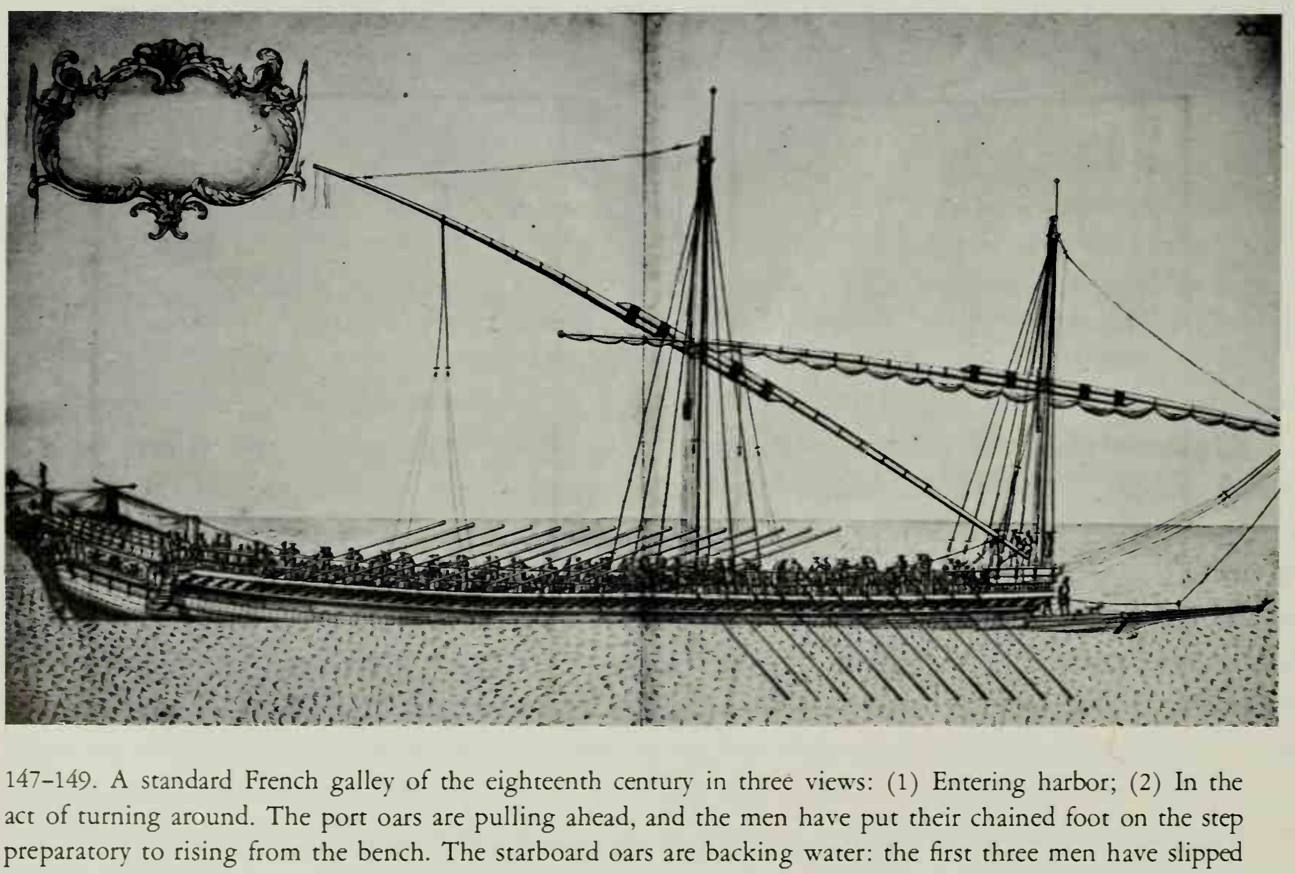


147–149. A standard French galley of the eighteenth century in three views: (1) Entering harbor; (2) In the act of turning around. The port oars are pulling ahead, and the men have put their chained foot on the step preparatory to rising from the bench. The starboard oars are backing water: the first three men have slipped around to the other side of the loom in order to get their backs into the pull (with no handholds here they have to grasp the oar as best they can), while nos. 4 and 5 push from the bench. The fighting personnel, quartered on the platform over the main battery or on the outrigger between each oar, lounge about enjoying the proceedings; (3) Proceeding under oars in the usual cruising fashion: part of the crew rows while the others rest.

In the interior, the space was sectioned off to meet the needs of a man-of-war crowded to the gunwales with over four hundred souls. In the bows was the forepeak for miscellaneous storage; from here, going sternward, there was sickbay (one of the smallest compartments, a slice of the hold less than eight feet from front to back), storage for spare lines and tackle, sail locker, canteen, powder magazine, storage for bread and biscuit (the largest compartment, a twenty-four-foot slice), storage for other foodstuffs and wine, storage for the captain's gear, wardroom, and the captain's stateroom.

Let us mount now from the interior to the deck. Forward was the covered platform where the main battery was mounted, in the center a heavy smasher that threw a thirty-six-pound ball and, on either side, an eight-pounder and a six-pounder. Cannoneers and some of the marines had their quarters here, if we can call "quarters" a mere area of the deck to flake out on at night. Along each outrigger ran a narrow corridor on which a half-dozen perriers were set, stubby smashers that threw stone balls. More marines were stationed along these corridors, one by each bench; a galley might carry as many as one hundred fighting men in all. Down the center ran a gangway where the deckhands had their station along with the infamous clique in charge of the rowers: the *comite* and assistant *comite,* who supervised them, and the two *argousins,* who wielded the whips and kept the keys to the leg irons.

The poop was officers' country. Here was a cabin which, though not much in size—fourteen feet by twelve—was the last word in luxury. The sides bore gilded carving, the arched lattice over it was covered with gorgeous stuffs, oriental carpets lay on the deck, and, in the midst, stood a throne-like armchair for the captain.

Between the sumptuousness aft, and the businesslike platform forward, there lay a hundred-foot area that, for human misery, was not to be matched till the days of Auschwitz and Buchenwald: the rowing space. The oarsmen's benches were ten feet long, six inches wide—no more than that—and four feet apart. In this rectangle, four feet by ten, five people lived; here they ate, slept (one on the bench and four on the wide plank that formed a sort of deck space between the benches), worked, and emptied their bowels and kidneys. Animals are taken out of their stalls; these men were shackled by the leg into theirs. At sea they were never unlocked. The only washing their clothes ever got was an occasional dragging alongside. At stated times they were all ordered to go to the rails—or as near as their chains would allow—and pick the vermin off themselves. The officers on their sybaritic poop kept their noses filled with the strongest possible snuff or buried in cloths bathed in musk.

In port the men were unlocked and allowed to go down to the canteen and buy wine at sky-high prices from the *comite,* or to go on the quay to barter with peddlers the scrimshaw or other things they had found time to make. In winter, when their ship was laid up, they were penned ashore.

The clothing issue for each oarsman consisted of two shirts, two suits of underwear, a wool jacket, a wool cassock, and a wool hat; this was to last them for a year and generally had to do for lots more. Under way, they shivered in the rain and broiled in the sun; there was an awning to shade them but it could only be spread when there was either no wind or a very gentle one. In port the awning was kept spread and, during periods of cold, it was closed in like a tent and a layer of wool thrown over it.

The best oarsmen were the Turks; they were able to endure weather and work and, if captured in battle and not kidnaped from some coastal village, came well trained. Captains tried to have a Turk as number one man on each oar, and as many as possible on the stroke oars (first from the stern). Next best were the volunteers; a few of these were still around. Under way they were shackled in like all the others but in port they enjoyed shore leave and other privileges. The great majority of the rowers, however, were men condemned either because they had committed some crime, or because the naval authorities had passed the word to the courts that crews were needed. In the seventeenth century, when Protestantism was fighting desperately for its life in France, her Catholic kings filled the benches with Huguenots. Negroes were tried but without much success; they died like flies from the cold.

Each oar pivoted about a thole roughly 2½ feet long and over three inches in diameter; the oar strap was a piece of one-inch line five feet long. The loom, specially left thick to counterbalance the weight outboard, was too big to grip; its end was trimmed to allow a handhold for the number one man, and a stick of wood nailed along it provided handholds for the other four. In rowing, the men rose pushing the oar before them, raised it, climbed up two steps (or one step and onto the bench in front) in order to gain height enough to plunge the blade into the water, then threw themselves back on their own bench, which was padded with wool rags under a worn leather covering to deaden the fall. The procedure produced a short stroke in which the oar handle described a semicircle; with 255 men all falling at once, the whole boat received a shock which made it progress in a series of spurts. The crew rowed as a body only when entering or leaving port, or when going into battle; at other times one-half or one-third would row for quarter-hour stints while the others rested; and of course, whenever possible, sail was raised. All commands were delivered not by voice but by shrill blasts on a whistle, from the initial command to remove clothing to the final pre-action command to place a chunk of cork, which each man carried on a string about his neck, into the mouth as a gag to prevent disturbing screams or groans.

Action in almost all cases meant an attempt to board. The roar of the main battery was to coincide with the splintering of wood as hull met hull. The master maneuver, comparable
Illustration 144, p. 120
to breaking the line in a fight between sailing ships, was taking an opponent in the flank; the marines could then race along the beak as it overhung the enemy and jump down on his deck. The do-or-die line in a boarding attempt was the kitchen area; once you drove past that, the ship was yours.

Lepanto was the Mediterranean galley's great day; from then on it was all downhill. Captains quickly discovered that they could fight only other galleys, that a sailing ship, with its lofty sides, if well-defended, was simply impossible to board. In 1587, Sir Francis Drake coolly sailed a fleet into Cádiz Harbor, into the hornets' nest, as it were; galleys buzzed about as he stayed there for thirty-six hours, including twelve when he lay becalmed, but didn't dare come within range of his guns. In 1684 a French warship singlehandedly held off no less than thirty-six Spanish galleys until a breeze sprang up and she was able to break off the fight. One of the chief reasons this outmoded type of ship lived on and on was that, in France at least, certain powerful families had made the officering of galleys a family tradition, and they were as reluctant to make way for the sailing man-of-war as cavalry officers were to make way for the tank. Eventually the galley's ineffectualness, compounded by the growing public clamor against the inhumanity it represented, took effect: by the middle of the eighteenth century the ship that had ruled the Mediterranean for over four millennia finally abdicated.

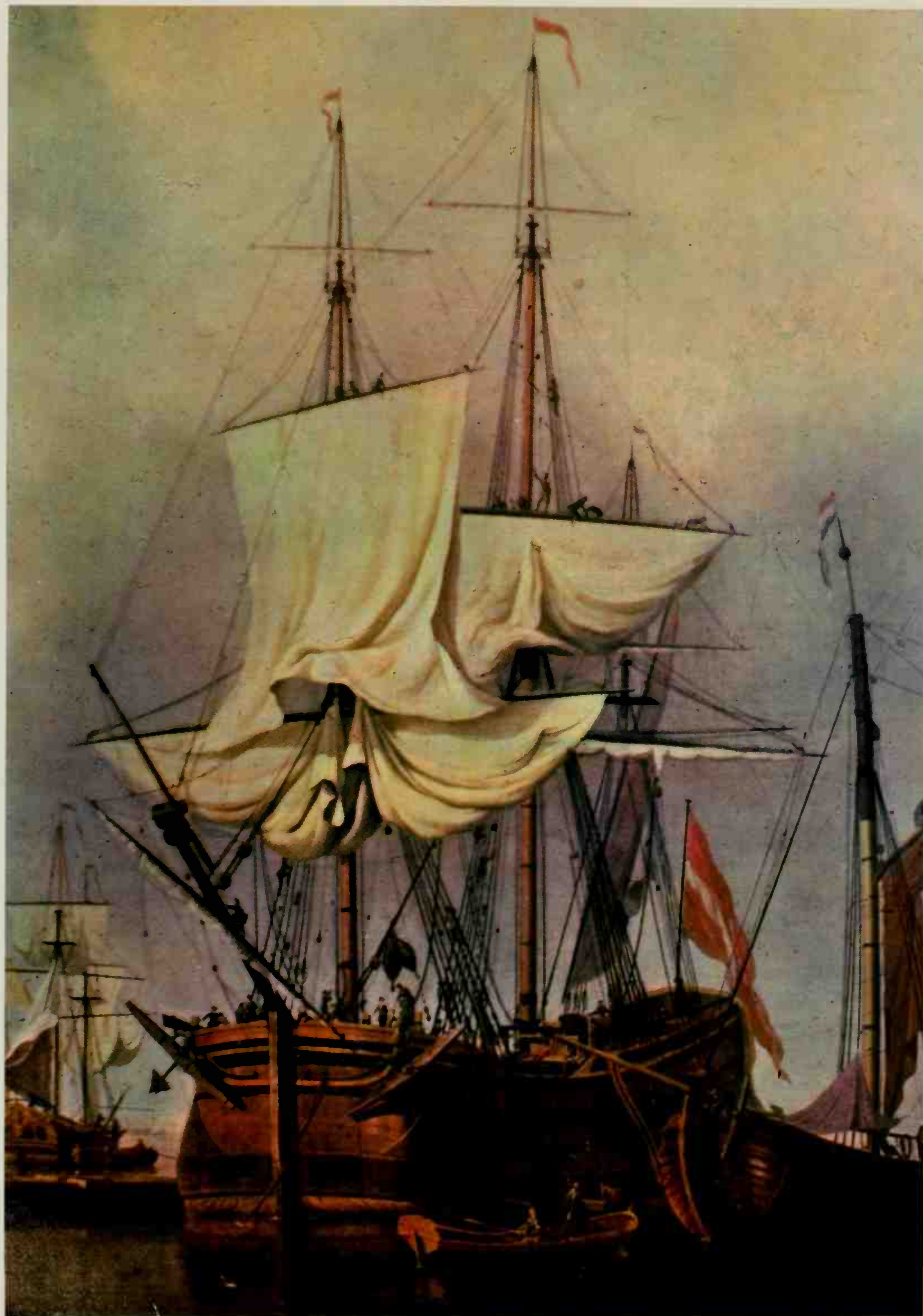
150

150. The *Styrbjörn*, a Swedish *hemmema*, one of the last versions of the oared warship in western waters. The vessel, launched in 1789, was in effect a rowed frigate. She was 146 feet long, thirty-six feet wide, and ten feet deep in the hold. The main battery, mounted on the gun deck, consisted of twenty-two thirty-six-pounders. The rectangular holes between the guns are for the oars, twenty pairs of forty-foot sweeps, each pulled by four men.

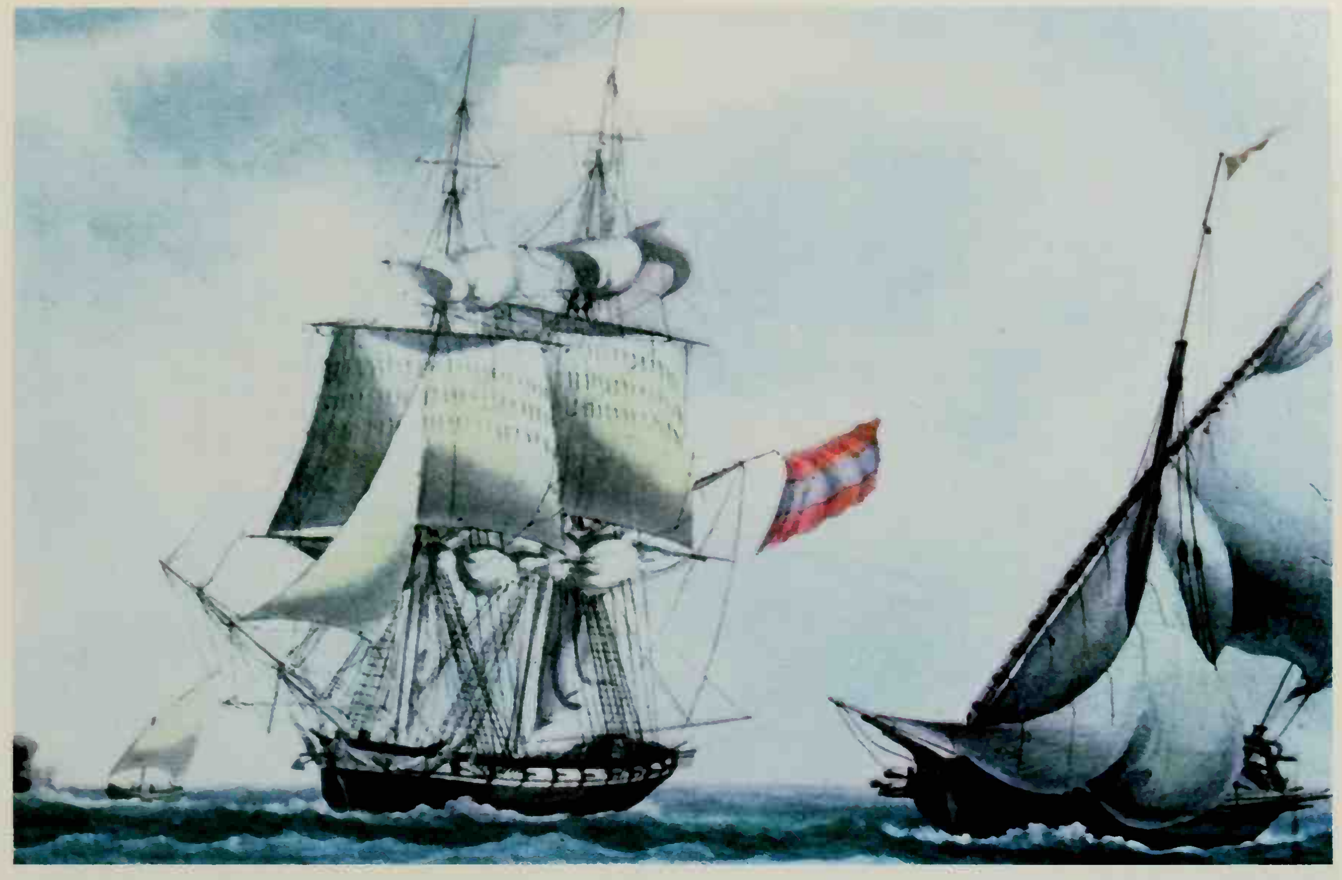
But the oared warship had a gasp or two of life left before giving up for good: there were certain places where special conditions made it a useful instrument. For example, on the cramped waters of Lake Champlain, where a man-of-war needed all the freedom of movement possible, the United States maintained what were called "galleys" from the days of the Revolution through the War of 1812. Actually they were more sailing ship than galley, fast armed vessels of shallow draft with ports for sweeps cut in the spaces between the ports for guns. The biggest, $72' \ 4'' \times 19' \ 7'' \times 6' \ 2''$ and 125 tons burden, were two-masted lateeners and had seven ports a side. The Baltic was still another spot where oared warships lingered on. In the maze of rocks and islets off the coast of Finland, fighting vessels couldn't afford to depend solely on the wind. Peter the Great, who had built galleys to use on the Black Sea against the Turks, added a flotilla on the Baltic for his fights with the Swedes. In the second half of the eighteenth century both sides had some imposing oared craft in operation. One, the Swedes' *hemmema*, was nothing less than a shallow-draft frigate with its sides pierced for sweeps in the manner of the American galleys, an oarport between each pair of gun ports.[1]

[1] Ever since the end of the seventeenth century smaller sailing men-of-war had been equipped with sweeps worked through ports cut in the spaces between the gun ports. The oars here, however, were auxiliary, intended only for emergencies; on the Lake Champlain galleys, the *hemmema*, etc., they were a prime source of power.

164



164. An eighteenth-century Danish timber bark getting under way. This boxlike affair makes no pretensions toward speed or good looks: it was designed purely and simply to carry cargo, and carry it cheaply and safely. To push it the basic six-sail rig has been beefed up to include topgallants on fore and main, a topsail above the lateen mizzen, and no doubt a number of staysails which presumably are stowed below. *See page 136.*



166

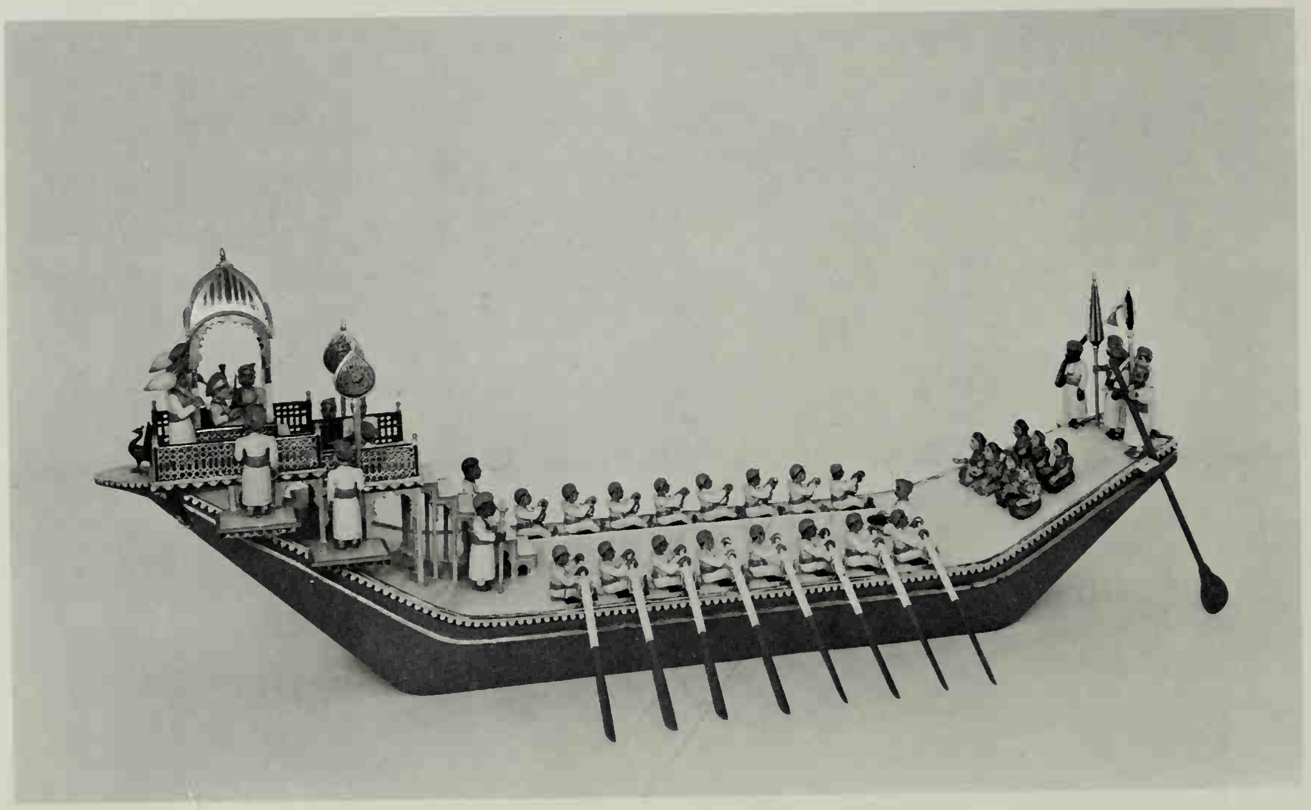
166. A French brig of about 1800. Antoine Roux of Marseilles, who executed this watercolor, was not only a renowned portraitist of ships himself but fathered a whole family of accomplished marine painters. *See page 138.*

170

170. A Genoese pink of about 1800 under her lateens. *See page 139 and illustration 169.*

151

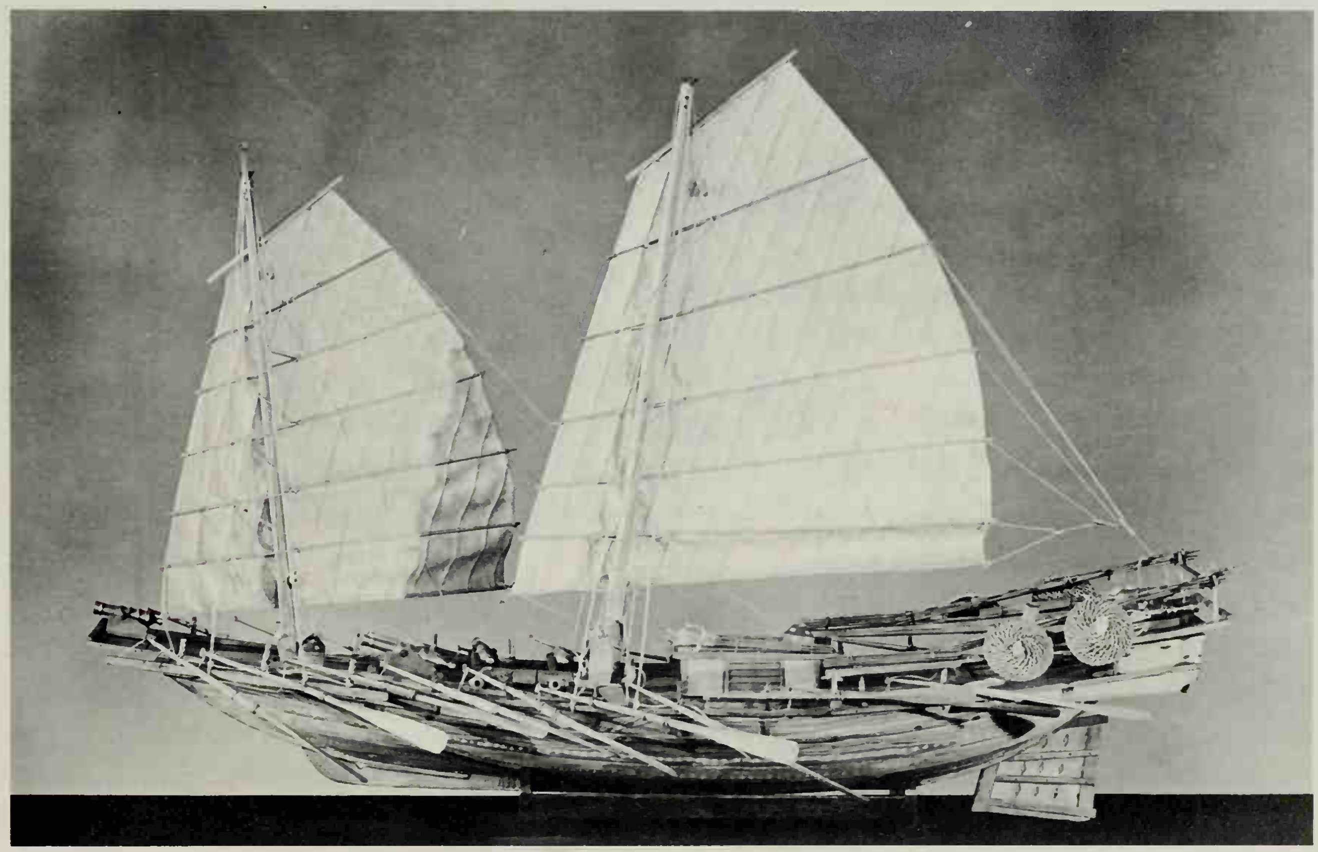
152



151. Galley of the type used by the Portuguese colonists on the Malabar Coast of India toward the end of the sixteenth century. The hull is more or less Mediterranean, the crew and the oars Indian. The lateen rig was familiar to Indian seamen.

152. Modern model of a ceremonial barge of Udaipur in northwestern India.

153



154

153. A Cambodian galley of the twelfth century A.D.

154. A Chinese war galley of the early nineteenth century. The ship is almost eighty feet over-all and thirteen feet wide, and there are ten rowers a side.

But the galley was far from a European—or American—monopoly. To be sure, elsewhere it never achieved the size and complexity of the Mediterranean versions, but some interesting and impressive craft were produced, particularly in Asia.

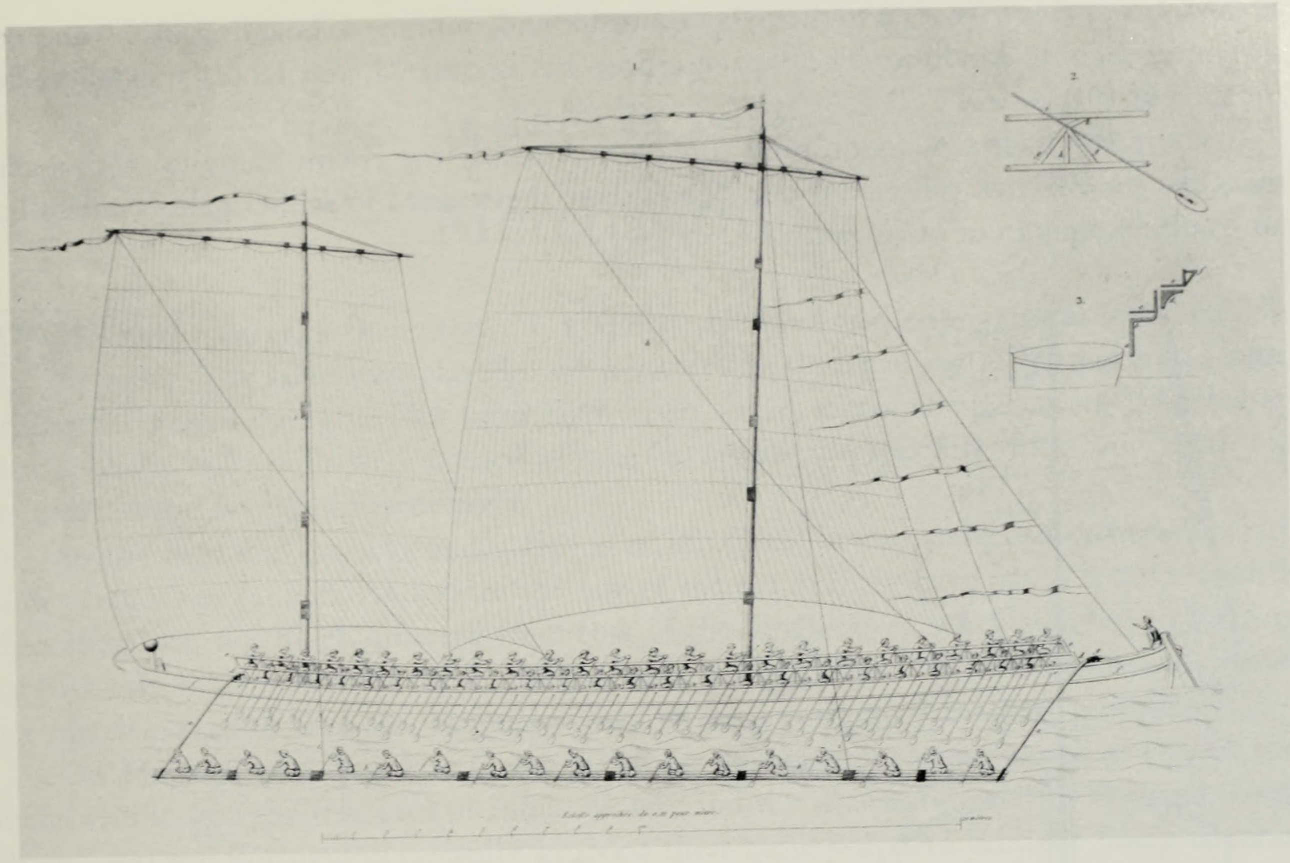
Most Asian types were single-banked, using one man to an oar. The Portuguese merchants who lived on the west coast of India, for example, developed a curious hybrid, a more or less Mediterranean hull driven by oars of the Indian type—a necessary innovation since, obviously, Indians and not Portuguese were going to ply them. The Indians themselves built both fast-stepping war galleys and ponderous ceremonial state barges mounting towering galleries. Farther east, Chinese pirates—and the Chinese navy—used light, sleek junks driven by oars as well as by the typical Chinese lugsails.

The most complicated galleys designed outside the Mediterranean, however, were the Malayan. The Malay seamen were renowned pirates who for skill, daring, thirst for blood, and just plain orneriness were the equal of any who ever raised the Jolly Roger. To operate in their local waters, oared craft were practically a necessity: ever-shifting bars ring the rivers whose mouths served as ports; the breezes are light and variable; and strong tides produce baffling currents. Most Malay galleys were single-banked, but they did have a form of bireme: one line of rowers, squatting on the deck, plied oars from the gunwale while a second line, standing over them, plied oars from an outrigger. There was even a three-banker, an overblown outrigger galley driven by three banks of rowers, twenty-five to a bank—a veritable trireme powered by almost the exact number of oarsmen the ancient trireme used. For an added bit of zip, eighteen paddlers were added on each outrigger.

The most unusual achievement, however, in the Far East in oared warships took place not in Malay but in Korea of the sixteenth century, the building of a completely unorthodox craft that embodied the principles of the famed *Merrimack* of American history—and that, like her, had one great day of glory. In 1597 Japanese armies had overrun Korea. The very next year their commander, Hideyoshi, the heart and brains of the invasion, died, and they were recalled. They boarded the three hundred transports and warships that were to carry them back, a fleet trained in the traditional galley tactics of grappling and boarding, and set sail. How to overcome this armada, manned by Japan's superb swordsmen, with the pitiful dozen or so craft he could muster was the problem that faced Korea's Admiral Yi Sun Sin. His brilliant solution was the "turtle boat"—the first armored craft in history.

The turtle boat, one hundred or so feet long and about thirty wide, was driven by ten oars a side, each pulled by two men. The feature that gave it its name and that sets it apart from any other galley ever built in the Occident or the Orient was the construction: the planking was everywhere four inches thick, and it did not stop at the gunwale but continued on to form an arched roof, like a turtle's shell, over the whole vessel; only a narrow longitudinal slit from stem to stern was left open through which a mast could be raised or lowered. The vessel was, in other words, completely cased in solid wooden armor;[2] moreover, to discourage any Japanese foolhardy enough to try boarding through the slit, the canopy bristled like a porcupine with iron spikes. As armament there were some twenty cannon and a dozen or so archers firing through ports in the side, and the figurehead of a dragon on the stem belched a sulphurous smoke that served as a screen. The Japanese galleys, tubby affairs about fifty feet long and twenty-five wide, were no greyhounds—and this was the key to the turtle boat's

[2] Some writers have said it was iron-plated, but there is no evidence for this and, indeed, iron plate was hardly necessary.



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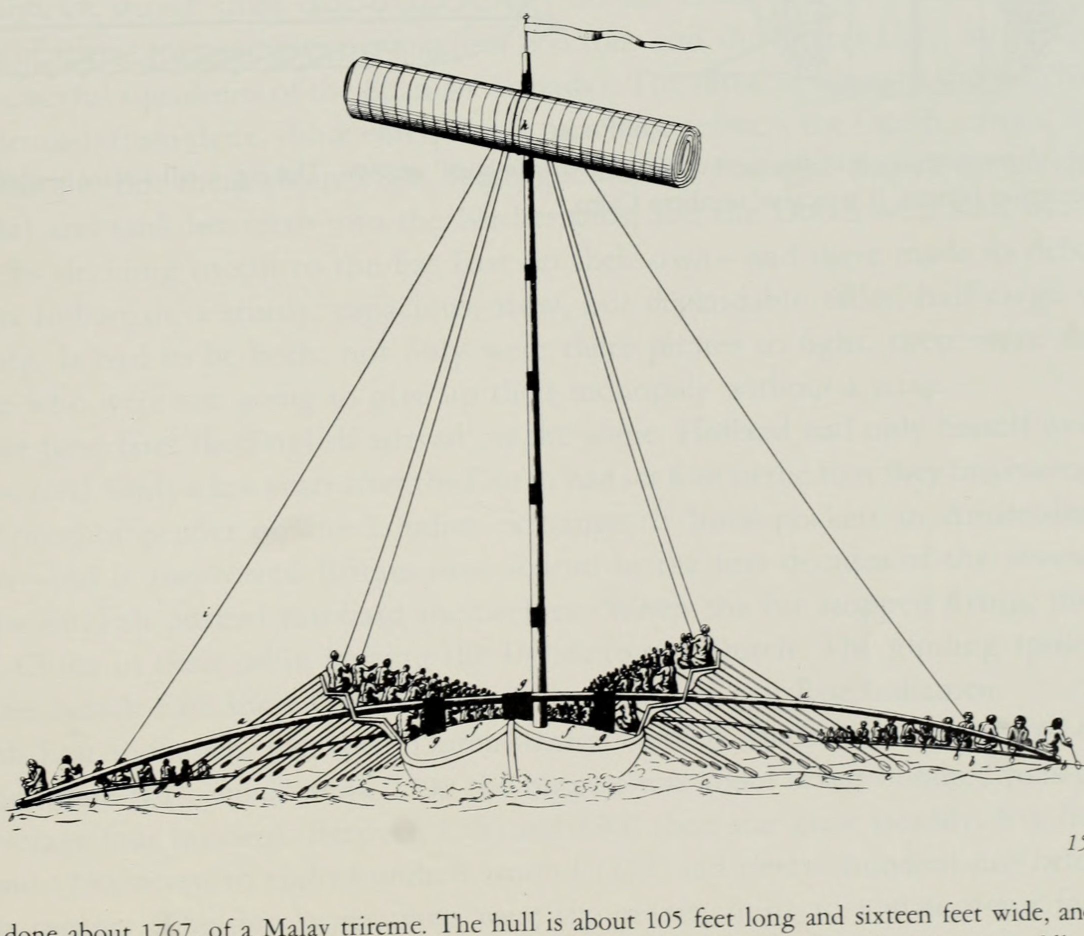


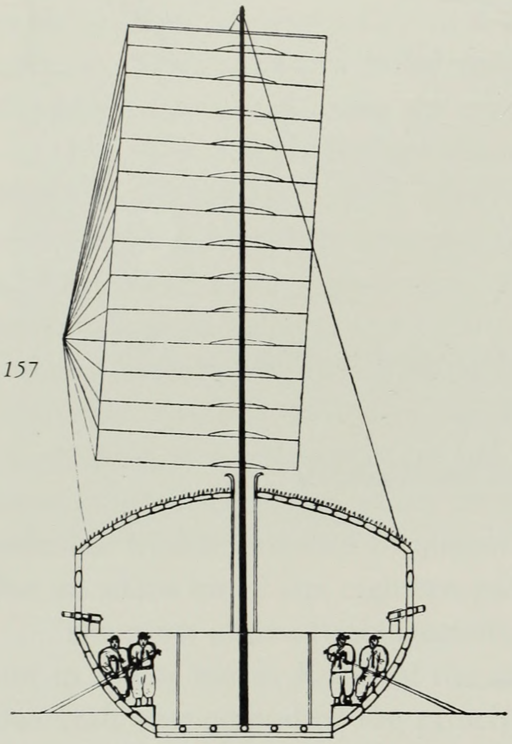
155B

155. Sketch, done about 1767, of a Malay trireme. The hull is about 105 feet long and sixteen feet wide, and the outriggers project about 26 feet. There are twenty-five rowers in each bank and eighteen paddlers on each outrigger.

success. It was able to row up to them, lay alongside and, immune to boarding, calmly proceed to pound them to kindling. The Japanese fleet was decimated, and Korea was relieved of invasion at that time.

The turtle boat saw action only this once. Possibly the enemy came up with a craft that, like the *Monitor,* canceled it out. More likely they turned to swifter galleys which had no trouble keeping out of its range.

157



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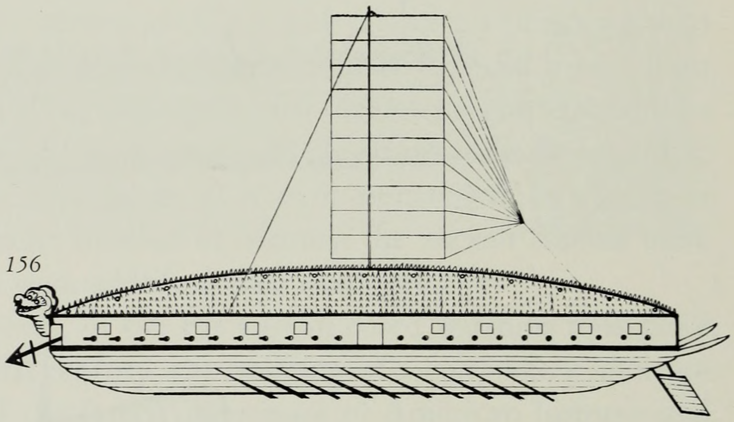


156, 157. A reconstruction of the famous Korean "turtle boat" of 1598. The rig, a tall square-headed lugsail with numerous battens, is typical of northern China.

CHAPTER NINE

Merchantmen

FOR many centuries there was no difference between the sailing man-of-war and the freighter. The same ship played both roles, at one time hauling merchandise to a port, at another guns to a fight. Not until 1600 or so, when armament had been so beefed up that specially built hulls were needed to take its weight and specially thick timbers to stop its fire, did the two go different ways.

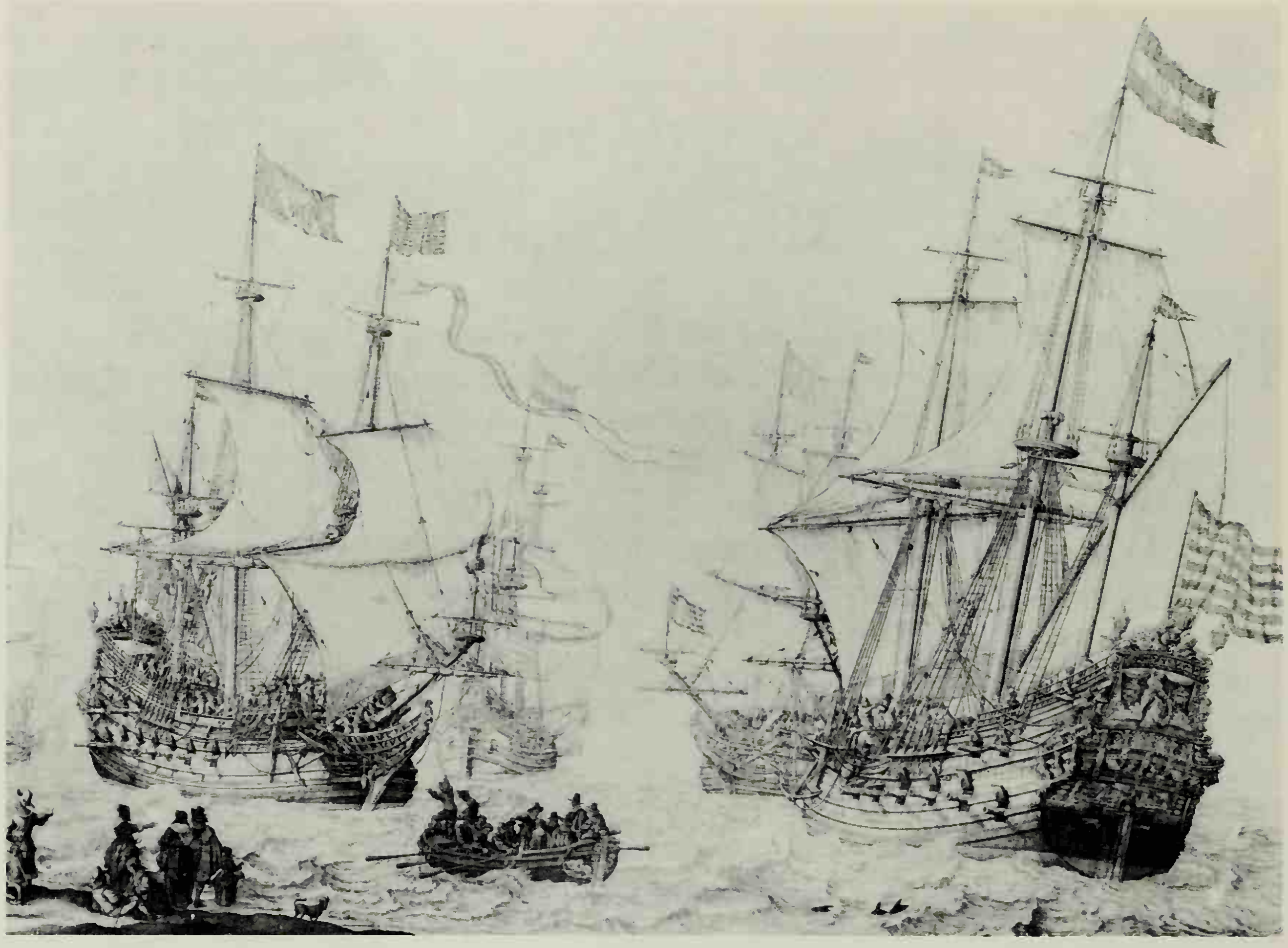
So the cogs and carracks and galleons of the fifteenth and sixteenth centuries carried either cargoes or cannon. And, since the law of the sea in those days (and for quite a while thereafter) was not much different from that of the jungle, even when assigned to carrying cargo a ship made room for some cannon. As a matter of fact, the first distinctive type of big merchantman to arise was as much a ship of war as of peace—the East Indiaman.

On May 20, 1498 Vasco da Gama sailed his squadron into the harbor of Calicut and thereby unlocked the treasures of India, Malay, and the islands beyond for Portugal. Until about 1600 the Portuguese carefully guarded their monopoly and brought home fabulous amounts of spices, silks, ivory, and the other rich pickings of the Far East in the bellies of gigantic carracks, strong ships that could readily double as men-of-war when the occasion called (ten of them, for example, the smallest 666 tons and the largest 1249, formed one of the most powerful squadrons of the Spanish Armada). The carracks brought the merchandise as far as Portugal; from there, those enterprising merchant seamen, the Dutch, carried it on to northern Europe. But then, about 1580, Spain gobbled up Portugal (hence the carracks in the Armada) and sank her teeth into the Netherlands, and the Dutch were shut out. They responded by deciding to sail to the Far East on their own—and there made its debut the Dutch East Indiaman, a sturdy, capacious, slow, but dependable sailer, half cargo vessel, half warship. It had to be both: not only were there pirates to fight, there were also the Portuguese who were not going to give up their monopoly without a scrap.

Illustration 117, p. 96

A short time later the English arrived on the scene. Holland had only herself to blame for this new rival. Only a few years after the Dutch had set foot in the East they had managed to triple the price of pepper on the London exchange. It lined pockets in Amsterdam and Rotterdam—but it also forced Britain into action: in the first decades of the seventeenth century the English pushed eastward themselves. When the fur stopped flying, they had India and China in their orbit, leaving the Indies to the Dutch. The guiding spirit in all this was the British East India Company, with its famed fleet of East Indiamen.

British East Indiamen, like their Dutch uncles, were as much warship as cargo-carrier. At first they were fairly small: until 1700 the biggest was about seven hundred tons burden and the average four hundred. Between 1700 and 1800 their size grew steadily: five hundred tons around 1730, seven to eight hundred around 1775, and twelve hundred just before the end of the century. The two larger types were the nearest thing to a man-of-war found in the merchant service. The twelve hundred-tonner, for example, whose dimensions were ap-

158 

158. Two Dutch East Indiamen of the seventeenth century. In outward appearance both ships are hardly different from contemporary men-of-war. The vessel on the right is the *Catharina,* and the saint's portrait is visible on the stern.

proximately 165′ × 42′ × 17′, to increase its carrying capacity had a flatter floor and fuller bilges than a warship and all its guns (fifty-six eighteen-pounders) were on the upper deck to release the lower for cargo but, whenever the British navy needed bottoms in a hurry, it was easily converted into a sixty-four-gun third-rate. The seven hundred-ton East Indiaman was for all practical purposes a thirty-two-gun frigate.

France was last in the field, pushed in about the middle of the seventeenth century by the indefatigable Colbert. Her ships ran just about the same size as their English counterparts, but the passenger accommodations were roomier and, as might be expected, the food was better. Near the powder-magazine a two-level sheepfold was squeezed in to make sure fresh meat was available during the six-month voyage, and on a sunny spot on deck the kitchen crew raised salad greens and fresh vegetables in flats. Fine workmanship went into the French East Indiamen. John Paul Jones' *Bonhomme Richard* started life as one, the *Duc de Duras.* When Jones refitted her she was already thirteen years old and had made the trip to China and back over half a dozen times, but her old bones managed to stay together even after the *Serapis* had shot away huge gobs of her skin of planks.

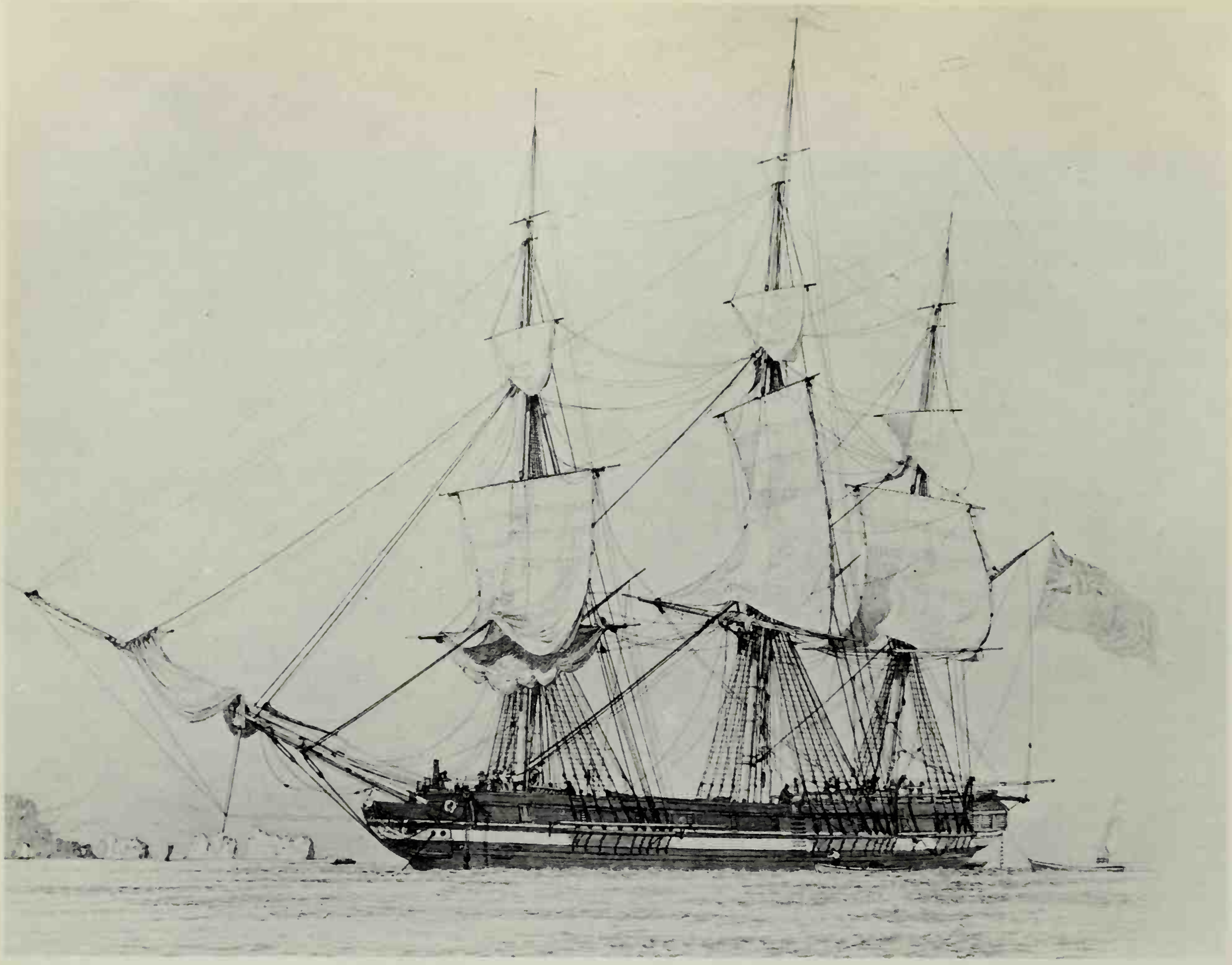
In the nineteenth century East Indiamen grew to as much as fifteen hundred tons. The open waist, which they had in common with contemporary men-of-war, was covered over to form a flush deck, and a high bulwark was erected about it, unbroken from stem to

159
159. The *Princess Royal,* a big British East Indiaman of the second half of the eighteenth century (141′8″ long over-all, 38′3″ wide, 15′ deep in the hold, 878 tons).

stern. They were three-deckers; some guns were carried on the first deck down, but the main battery (twenty-six eighteen-pounders) was on the middle deck, and the lower deck was decorated with a dummy row of ports to scare off opponents before they came close enough to get a good look and learn the truth.

The British also built special merchantmen for the West Indies trade. These were much smaller than their eastern brothers. About 1775, when an East Indiaman would average seven to eight hundred tons, the West Indiamen ran to half that or less. Even in the early nineteenth century they never had more than two decks, and the average size was five hundred tons. At all times they were much faster. The East Indiaman was literally the slow boat to China.

But Indiamen, East or West, were abnormal as merchant ships went, at least until the end of the eighteenth century. What set them apart was, even more than their armament, their size. From 1600 to 1800 the ships that tramped about the waters of Europe, or even



160

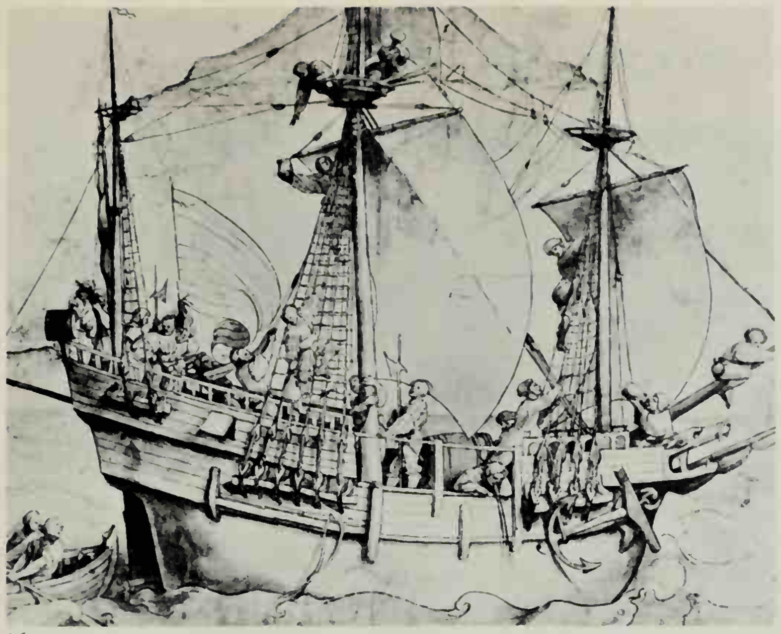
160. The *Thetis,* a West Indiaman of the early nineteenth century. The vessel, with its fine lines and lofty rig, is lighter and faster than its relatives in the East India service.

to the New World, ran from 150 to three hundred, occasionally four hundred tons burden. Colbert sweated hard over France's merchant marine, yet, by the time he died, she had only three ships over six hundred tons; there were sixty-four over three hundred tons, and the great majority ran between 150 and two hundred.

In those leisurely days how fast cargo could be hauled wasn't nearly as important as how cheaply. As a result, shipwrights were far more interested in the capacity of a carrier's maw than the fineness of her lines. The flute, built by the Dutch but used by any number of nations, was a roly-poly vessel with an enormous port aft for loading long pieces of timber and the like. The French favored a type they called the *pinasse,* somewhat more conventional than the flute but with plenty of bulge in its belly. The English went in for what they called "barks" (the Scandinavian version were called "cats"), box-like apple-bowed and apple-sterned affairs.

Illustration 164, p. 126

All these vessels, like their sleeker cousins in the navy, were "ship-rigged," that is, they had three masts with the normal complement of sails—though without the trimmings, such as royals and mizzen topsails, that navies could afford to go in for. The average tramp sailer, as a matter of fact, generally found the old basic six-sail rig enough for its purpose.



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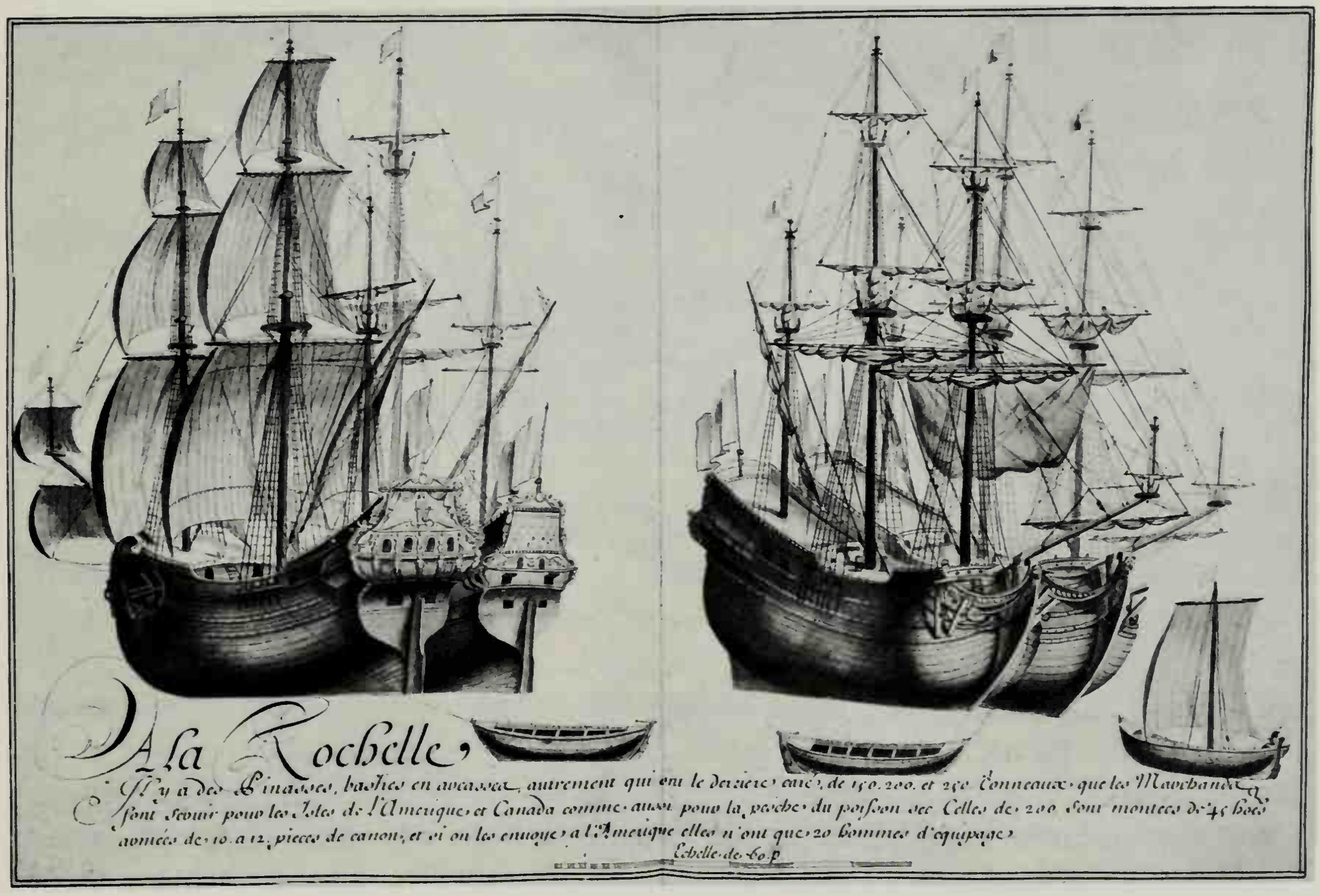


163

161. A typical small merchantman of the sixteenth century. Though the human figures are oversize—and having an oversize wild party—the ship clearly is not very big, no doubt well under one hundred feet long. The rig is the basic six-sail rig. The mizzenmast is stepped so far aft that the backstay and the sheet of the sail have to be led to a bumpkin.

162. An English flute of the seventeenth century. The bulging belly provides plenty of cargo space, and the huge open slot aft, besides giving room for the swing of the tiller, allows the loading of such items as long pieces of timber. Like all merchantmen of the period, the vessel carries a few guns.

163. French *pinasses* of the seventeenth century, drawn by J. Jouve. Jouve, a master shipwright, was commissioned by Colbert to make a survey of the shipping resources of France, and the pictures and information he provides are, consequently, of the highest order. Jouve remarks that *pinasses* such as these were used either for trading between the New World and France or for fishing. They were armed with ten to twelve guns. When fishing they carried forty-five men but when used for the run to America only twenty.

164. Color illustration, page 126.

165

165. A Prussian snow of the early nineteenth century. The fore-and-aft mainsail is mounted on a trymast stepped just behind the mainmast and reaching only as high as the main top. The vessel has the traditional lines of the merchantman built for capacity and not speed.

166. See color illustration, page 127.

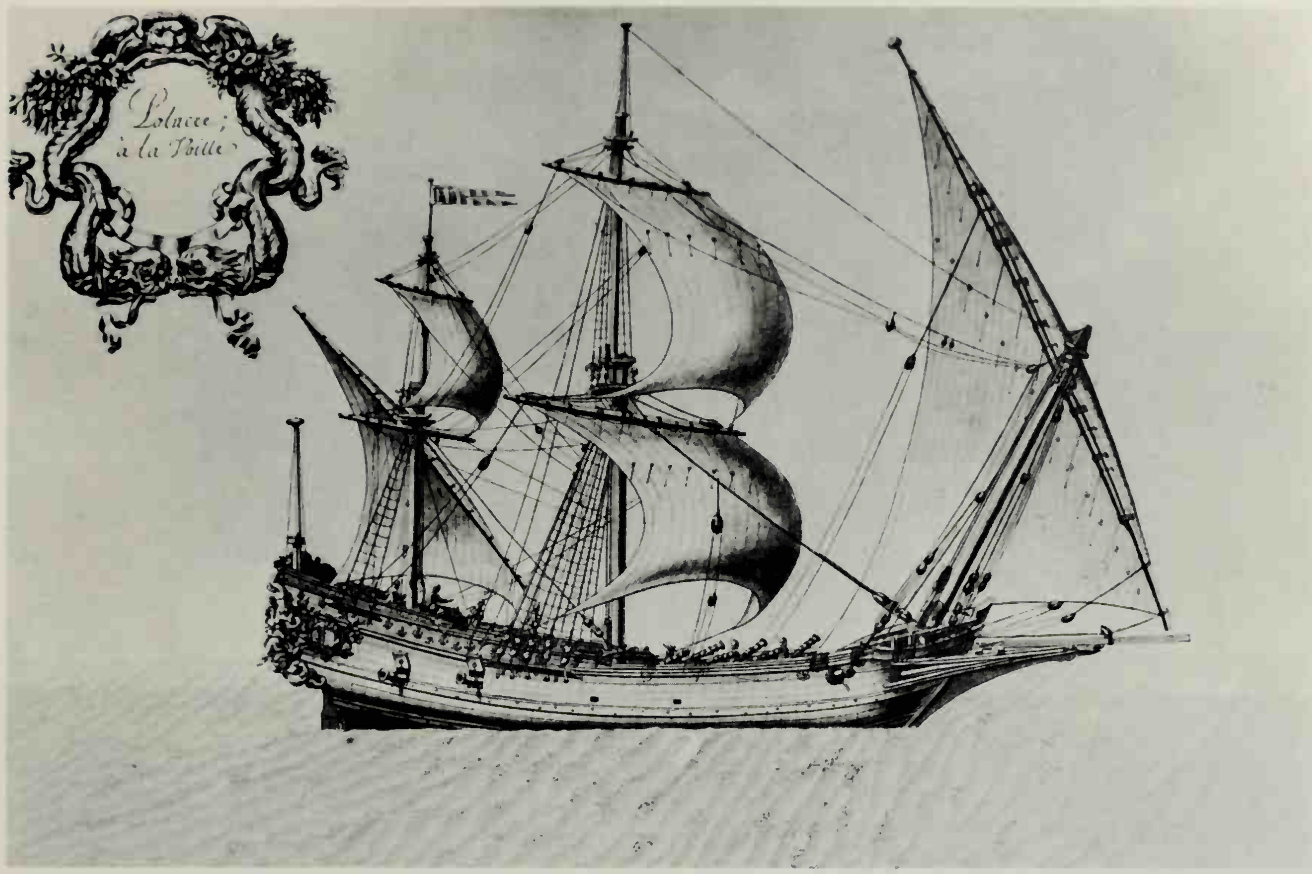
Around 1750, the ship-rig began to lose favor as the rig for moderate-size merchantmen. From the Baltic all the way across the Atlantic, three-masters gave ground to two-masters, to brigs, brigantines, and—one of America's great contributions—schooners.

Brigs and brigantines go back to what, about the beginning of the eighteenth century, was a two-master completely square-rigged on both masts. The brigantine was created by *doing away* with the square mainsail in favor of a fore-and-aft mainsail stretched along the head on a gaff and along the foot on a boom. The brig (or snow; the distinction between the two was minor and the names were often used interchangeably) was created by *adding* a fore-and-aft sail; it was mounted on a small trymast set up behind the mainmast and reaching only as high as the main top. Both brigs and brigantines carried square topsails and topgallants above the fore-and-aft mainsail. A third variation on the theme, the hermaphrodite brig, rigged the mainmast with fore-and-aft sails only; it was, in effect, very close to the schooner rig.

Illustration 166, p. 127

In the Mediterranean, though plenty of brigs and brigantines were to be found, the lateen sail was too firmly entrenched to bow out. As early as the twelfth century, vessels with as many as three lateens had sailed these waters; their tradition was carried on in the

Compare Illustration 97, p. 78



167

167. A *polacre* of the seventeenth century, as drawn by Jouve. One of the Mediterranean's combinations of lateen and square rig. The beaked prow, which must hark back to the galleys that lorded it over these waters, was typical of a number of Mediterranean sailing vessels (see Illustration 226).

tartane: the tartane ran the gamut of size from a tiny fishing boat to a three hundred-ton merchantman, and it carried one to three lateens accordingly. But the lateen couldn't resist all change, and the tartane rubbed shoulders with some interesting hybrids of lateen and square: the *polacre,* for example, which combined a lateen foremast with the standard ship-rig on main and mizzen; or the *saique,* a ketch-like craft with a lateen on the mizzen, square sails on the main, and over the bows the very image of the ancient artemon (above, p. 48); or the Mediterranean pink, which had both lateen and square aboard, the choice depending on the course and the weather. The *xebec,* a slim, swift craft far more used for war and piracy than peaceful trade, though basically lateen-rigged, used to switch to small square sails in stormy weather.

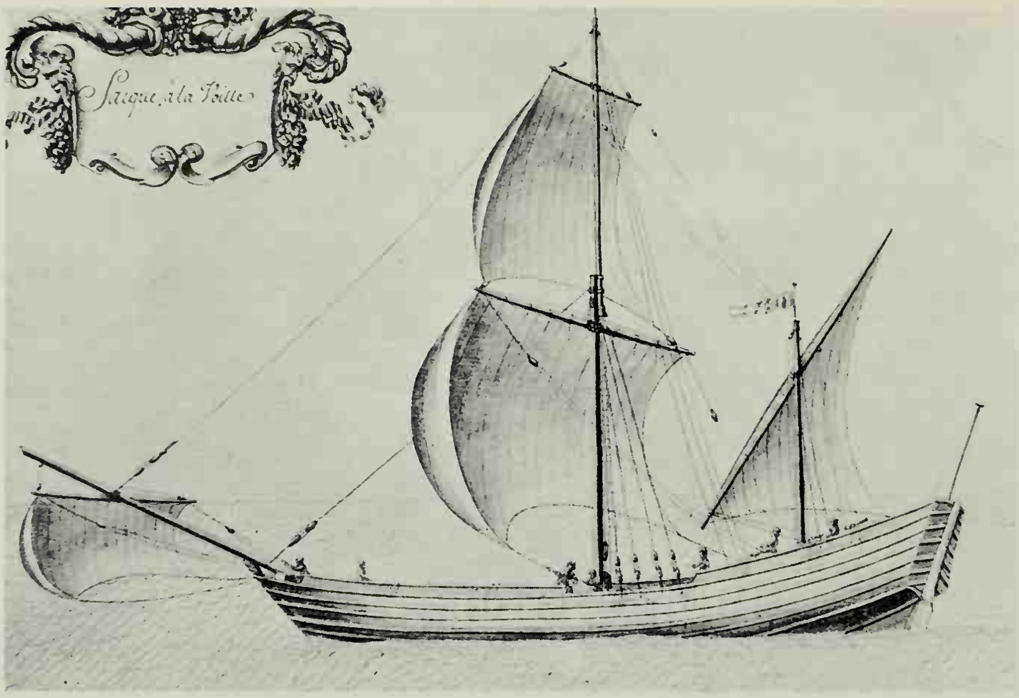
Compare Illustration 226, p. 196

Illustration 170, p. 127

Illustration 175, p. 145

In the United States the favorite two-master was the schooner. Although not definitely an American invention—it perhaps grew out of a Dutch rig of the seventeenth century—America was chiefly responsible for developing it and, by the end of the eighteenth century, it had become *the* American rig. Soon after 1800 it caught the eye of European shipwrights, who admired its clean lines and were impressed by the small crew needed to handle it. They started building versions of their own, and before long the rig was popular all over the world. Nothing could beat a square-rigger on long voyages before trade winds; it spread its wings and flew. But for coastal work, where all sorts of winds had to be dealt with, the schooner was more useful. Its basic suit of sails, jib plus fore-and-aft fore-

168



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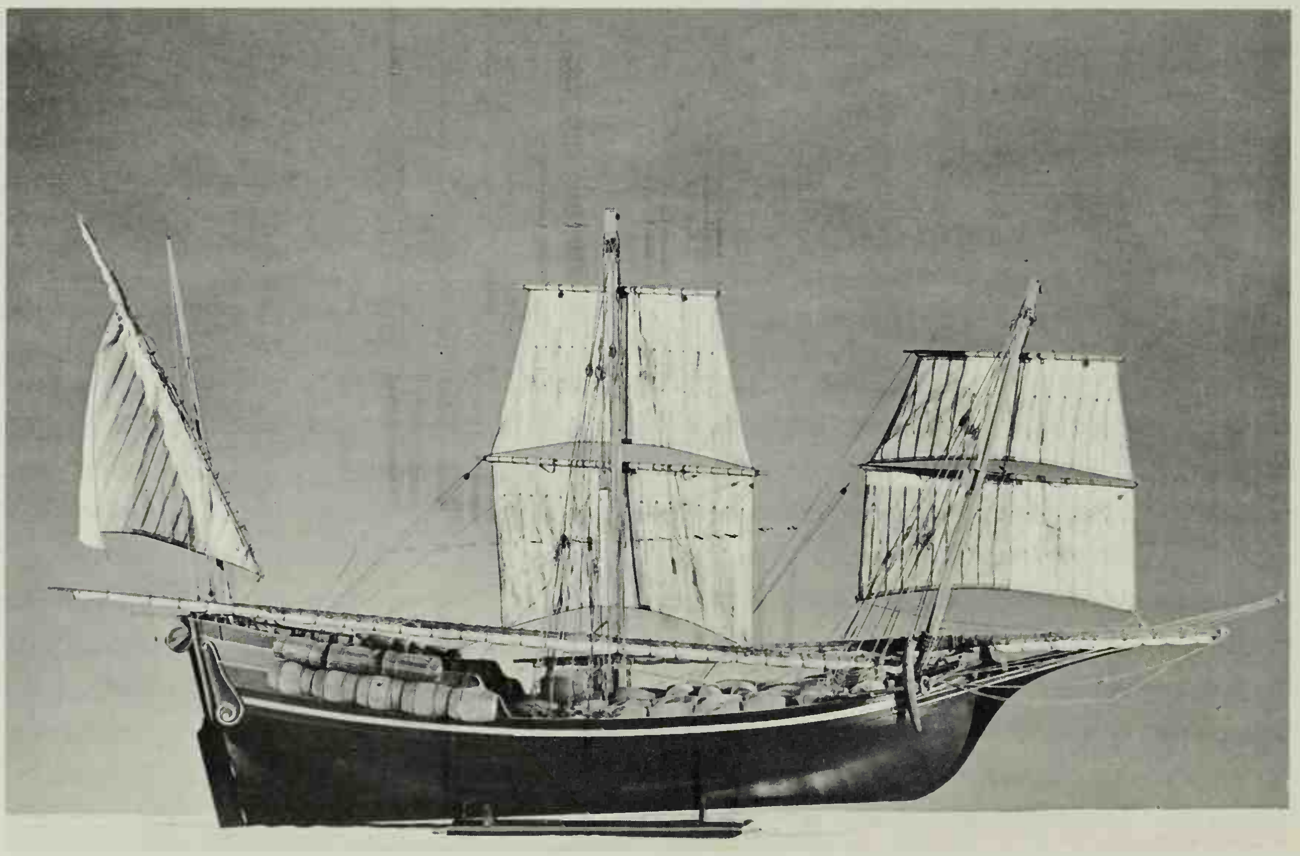
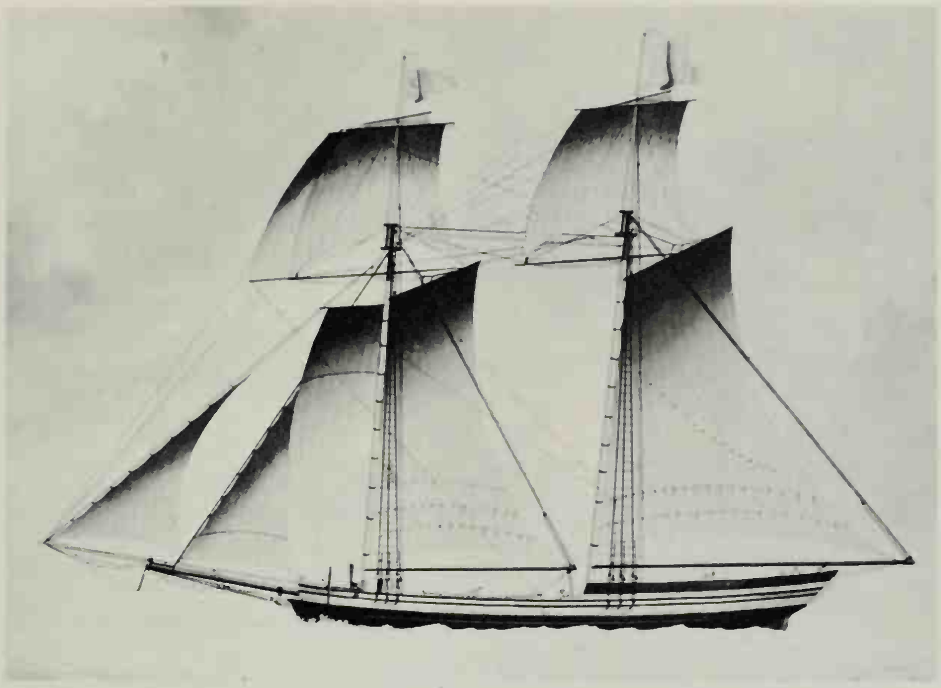


168. A seventeenth-century *saique,* another of the combinations of square rig and lateen found in the Mediterranean, as drawn by Jouve.

169. Modern model of a Genoese pink of the late nineteenth century, still another of the combinations of lateen and square rig. The spars stretching from prow to stern are lateen yards with their sails furled on them. When the weather or the course called for it, these would be used instead of the square sails on fore and main.

170. See color illustration, page 127.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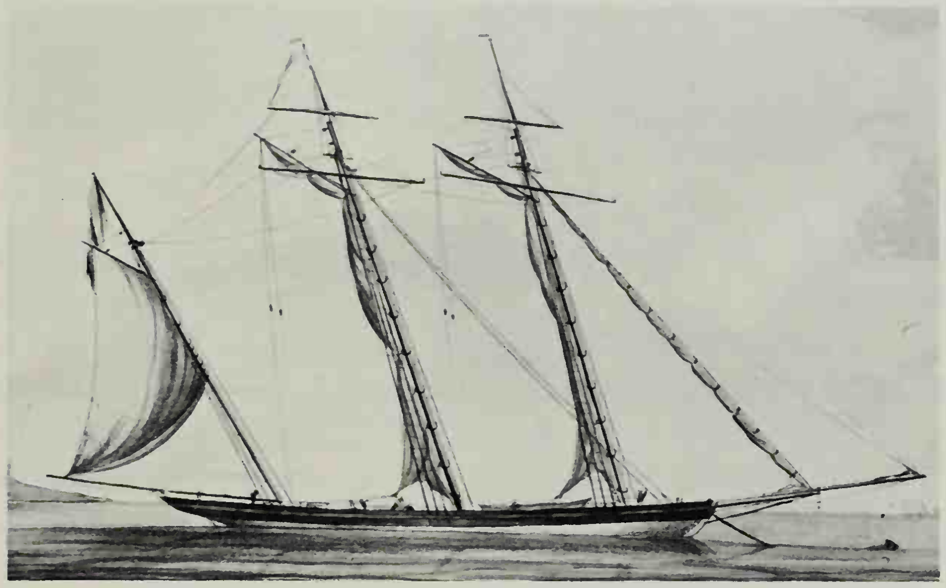

171A

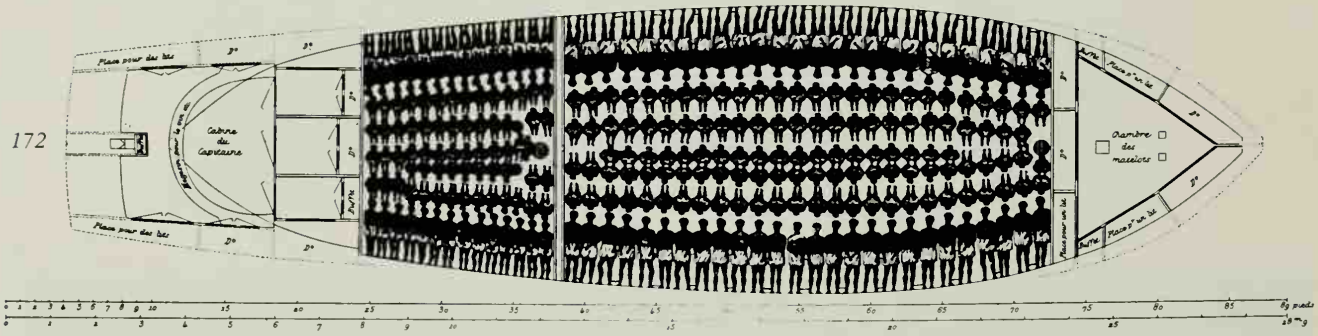
171. The *Federal George*, an American topsail schooner of about 1800.
171A. A three-masted Baltimore schooner of about 1825.

sail and mainsail, was at its best on the wind where the square-rigger was at its poorest; and the topsail schooner, rigged with square topsails above the fore and main, was available for skippers who insisted on superior performance before the wind. Most important of all for smaller merchant craft, the schooner's efficiency didn't cost very much: she could be sailed by a fraction of the crew needed for a comparable square-rigger. On top of all this, in the early eighteenth century a light-draught centerboard schooner was designed which was particularly useful in the many shallow areas along the coast where deeper vessels operated under a handicap.

But a cheap, efficient vessel wasn't enough; American ship-builders had another requirement to satisfy—the national mania for speed. As early as 1750 "sharp" schooners were coming off the ways, vessels with the slim, low, raking hulls that have become the hallmark of the fast-stepping sailer. Baltimore yards in particular specialized in such craft, and the "Baltimore clipper" became the fast schooner par excellence.

In the 1800s these clean-looking ships were much in demand, though not always for clean purposes. During the Revolution and the War of 1812 American seamen took up privateering with great glee, and schooners with the size to stay at sea and the speed to show their heels to heavy-armed pursuers were ideal for the purpose. Privateering was, strictly speaking, within the law. But the qualities that made the schooner a useful privateer made it equally useful for far less reputable pursuits—piracy and, worse, slaving.

172



172. Plan showing the cargo arrangement aboard the French slaver *La Vigilante,* a 340-ton brig, at the time of her capture on April 15, 1822. She was carrying 350 slaves.

The slave ship had come into being long before the schooner had, just about the time the New World was discovered. It was never a particular make of ship—any hull or rig would do. Sir John Hawkins in his three renowned slaving voyages between 1562 and 1568 had a motley collection of craft; it made little difference: all he needed was the space to cram in his miserable cargo and the sacks of beans carried as food. In the seventeenth and eighteenth centuries, the heyday of slaving, two hundred-ton and three hundred-ton ships, brigs, schooners, or what have you, plied between Africa and America, their holds loaded to the point of suffocation. Generally the rule of thumb was one slave per ton of a vessel's burden, but by the eighteenth century Britain had to pass a law limiting the cargo to five slaves per every three tons. In other words, a two hundred-tonner had to hold its cargo down to 333 slaves; previously there had been times when that many were sardined into ninety-tonners. By 1807 Britain and America had outlawed the filthy trade, but it wasn't until after the War of 1812 that their navies could do anything about it. From this time on, slaver captains could no longer use any old merchantman. They had to find a vessel that would outsail whatever a navy could send against them, and many found the answer in fast-stepping schooners.[1]

But the sharp schooner was used on the right side of the law too. Privateers and slavers got a dose of their own medicine: the Navy and the Revenue Marine, a forerunner of the Coast Guard, used schooners for running them down. Schooners made fine pilotboats, able to dash out of port and hurry pilots to the side of incoming packets. And newsmen

[1] Ironically, the poor slaves were even worse off after slaving was outlawed. While the trade was legitimate they used to be given regular exercise periods in the open air. Now, to avoid detection, slaver captains kept them hidden below; they never left the crowded hold during the whole voyage.

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173. The *Dreadnought,* one of the later packets (1853), and so fast that she has been called a "clipper-packet." She was 217 feet long, forty-one feet wide, twenty feet deep in the hold, and 1413 tons burden. The cross is the insignia of her line, the "Saints" line.

used the swiftest of the breed to dash out to the side of incoming European packets even before the pilots got there. Newspapers were out to scoop each other in the 1830s just as much as they are today, and one way was to send a crack sailer racing a hundred miles or so out to sea to meet a ship arriving from Europe and hustle what news it brought to the editor's desk.

From 1600 to 1800 the lordly East Indiamen had been the aristocrats of the merchant marine. Then, when the battle of Waterloo finally brought peace to the Western seas, there came into being a fleet of ships every bit as impressive—the packets that plied between Europe and America.

At the outset, from about 1818 to 1825, there was nothing special about these boats; they were just ordinary, large ship-rigged merchantmen pressed into service on the new run. The only thing that made them different was that they were packets, they ran on a schedule. They left on fixed dates published in advance, and the captains did their level best to bring them into port within a predictable period, five to six weeks, for example, from Liverpool to New York, and three to four weeks from New York to Liverpool. As the idea caught on and several shipping lines were attracted into the business, competition arose, and then the packets became very special: they provided something no merchantmen had before—comfort for the passenger. They were tough, sturdy two-deckers—it wasn't their lines that gave them their speed but the way their skippers drove them—with

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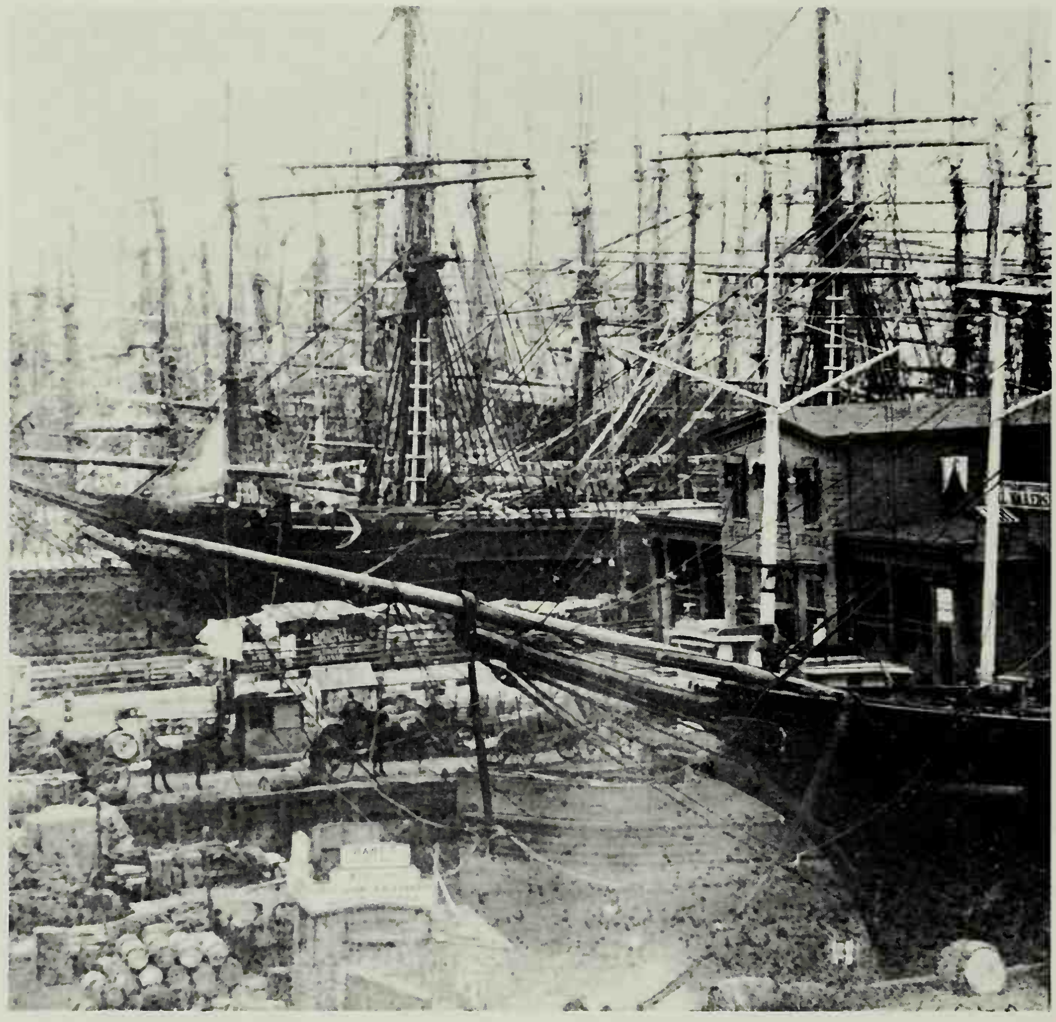

174. South Street, New York, in the 1860s. The bowsprit and prow in the foreground belong to the *Dreadnought.*

the after portion of the upper deck reserved for officers and passengers. And passenger accommodations were not merely comfortable, they were elegant. Staterooms were eight feet square, done in polished wood of matched grains and fitted with wash stands, bureaus, bookshelves, and beds closed in by damask curtains. The salons, with mahogany tables and deep sofas and silk draperies, would have done credit to a room in a pasha's palace. To accommodate all this, packets grew steadily in size, from an average of a little over one hundred feet long and twenty-eight broad and 350 tons in burden at the outset to big fellows over 166 feet long and thirty-five feet broad and better than one thousand tons in burden by the 1840s.

Unlike most merchantmen, the packets were not kept in service until they wore out. The owners sold them off after five or six years, while there was still plenty of life in them, in order to add glossier new ships to the line and thereby get an edge on the competition. And, among the most eager buyers of second-hand packets were the owners of what are probably the best-known and most romanticized merchantmen that ever sailed the waters, the nineteenth-century American whaling ships.

Whaling was no American creation. It was a full-fledged industry as early as the thirteenth century, when Basques living along the shores of the Bay of Biscay used to

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175. A *xebec* of about 1800. *See page 139.*

set a day-long watch on waterfront towers and, as soon as the lookouts sighted a whale, would spill into dories and take off for the kill. By the fourteenth century they had heavy ships of one hundred tons burden, big enough to enable them to carry the search as far as Greenland and to cut in and boil blubber at sea.

By 1600 the English and Dutch were whaling intensively. They used ordinary sturdy, bluff-bowed and big-bellied merchantmen of about two hundred tons manned by a crew of fifty-five or so and carrying five whaleboats to do the chasing. By 1700 there were something like 350 ships in the business, and they were working as far north as Davis Strait.

In the early years of the eighteenth century Americans got into the act, and whalers from New Bedford and Nantucket were soon sharing the waters north to the Arctic and south to the coasts of Brazil. When the Revolution broke out there were better than three hundred American ships in the business. They were mostly small, about one hundred tons on the average. Then came the Revolution, followed by decades of war on the sea, and the whaling fleet was wiped out.

But, around 1815, American whalers staged a comeback so strong it carried them surging on into the grand and glorious days of "Thar she blows!" In 1803 there were no more than a few dozen craft in operation; in 1839 New Bedford alone had a fleet of 221, Nantucket eighty-one, and practically every other seaport town of Massachusetts a respectable number.

In this great age of whaling, the ships would start by rounding Cape Horn, and then leisurely range the length and breadth of the Pacific. A vessel had to have tough timbers to take the pounding of icy seas and a big belly to hold plenty of provisions and plenty of the

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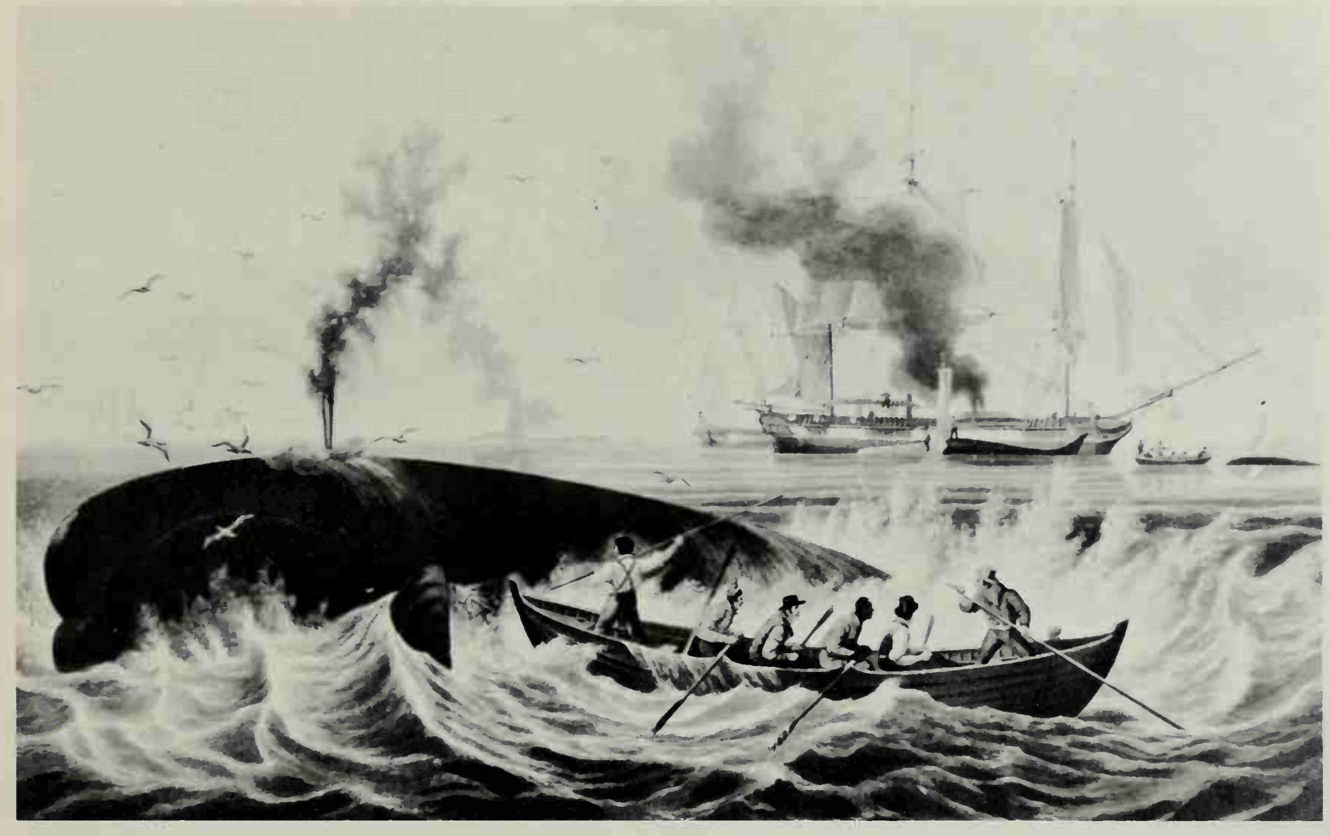
176. The *Vergulde Walvis* ("Golden Whale"), a Dutch whaler of the early seventeenth century at work in northern waters. The vessel has a sturdy, roomy hull, and her rig is the basic six-sail type plus a mizzen topsail and that hallmark of the seventeenth century, the spritsail topsail.

pay load, the barrels of oil cooked out of the carcasses after a catch. Speed was unimportant; these "blubber boilers" sailed "about as fast as you can whip a toad through tar," as Melville puts it. His hard-driving Captain Ahab was an exception; whaling cruises lasted three to four years, and most skippers were content to amble along. Any stout, roomy merchantman could serve as a whaler, and second-hand packets—the earlier three hundred- and four hundred-tonners, not the big fellows of the 1840s—made ideal ones. And, once a



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177. Whaling in the South Seas as depicted in a mid-nineteenth-century engraving. All phases are represented here: the kill, the cutting in, the boiling of blubber.

ship went into the whaling service, she stood a good chance of living to a hoary old age. The life was leisurely, and the oil that seeped in everywhere was an excellent preservative. The *Charles W. Morgan,* built in 1841, was still at work in 1920, and is alive today, enjoying honorable retirement in the whaling museum at Mystic, Connecticut.

The whale ships, in a word, were far from romantic. As a matter of fact, aside from the actual chase and kill, there wasn't the slightest bit of romance in the whole business—certainly not for the miserable seamen. Pay was microscopic and punishment sadistic. Fagin was the soul of generosity compared with the owner of a whaler, and Simon Legree an angel compared with its captain. An ordinary seaman could spend four years being worked and treated worse than a beast and discover that, what with "expenses" and "miscellaneous deductions" and the like, he owed the owner money! Since no self-respecting American seaman would put up with this, the crews were made up of wide-eyed hayseeds inveigled from the farms, unemployed immigrants, and plain waterfront riffraff. Naturally, they deserted in droves—many a Pacific island beachcomber got there by way of a whaler's forecastle—and were replaced by any manpower available. It was the facts of whaling life and not a fevered imagination that led Melville to make one of the harpooners aboard the *Pequod* a Fiji Islands cannibal.

Then, after the Civil War, kerosene and not whale oil lit the lamps of the world, and whaler-owners hurriedly found better places to invest their money. At about the same time, the steamboat rang the knell of the sailing packets and started its inexorable drive to take over the seas. But the sailing merchantman was not quite ready to fold its wings. As a matter of fact, it was poised to spread them wider than ever for one magnificent final flight.

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181. The famed English tea-clipper *Cuttysark,* built in 1869, enjoying honorable retirement at a dock on the Thames near Greenwich. A composite ship (i.e., wooden skin over iron frames), she was 280′ over-all, 36′ wide, 22½′ deep in the hold, and 963 tons. *See page 154.*

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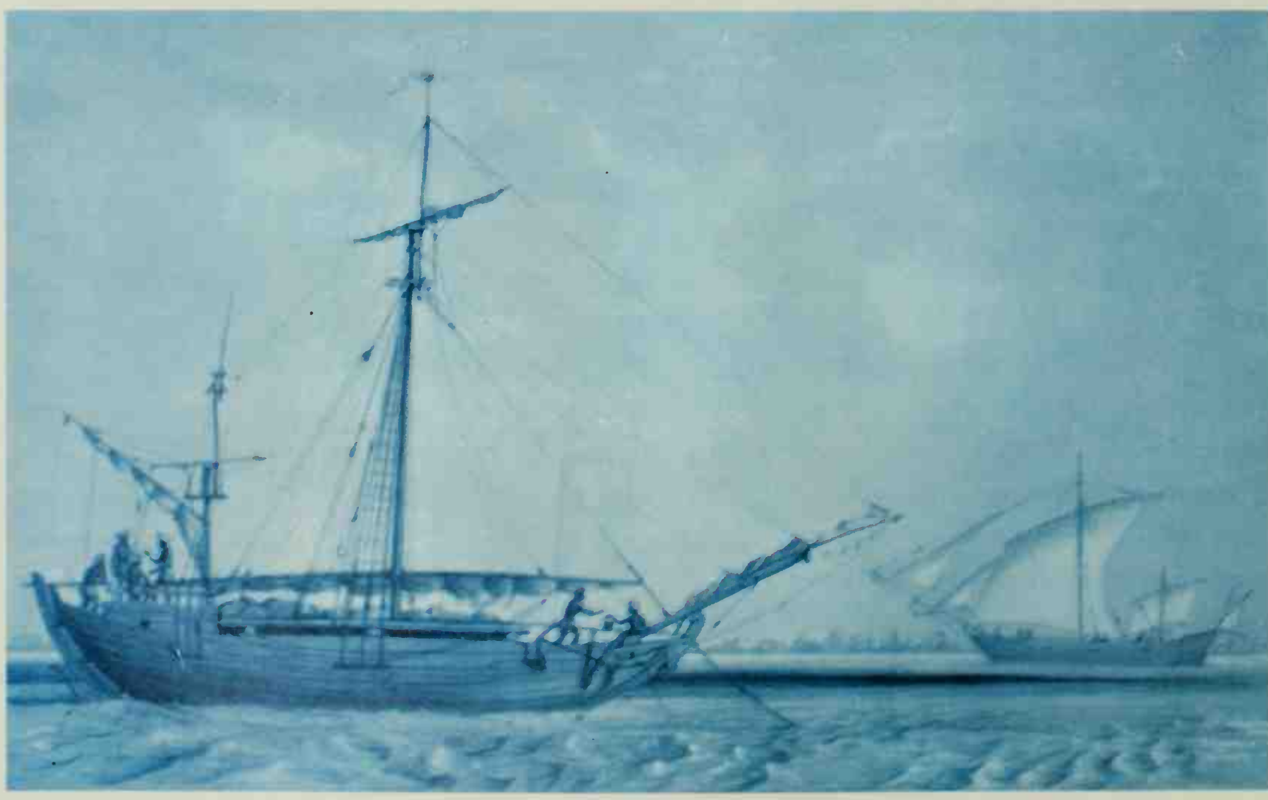
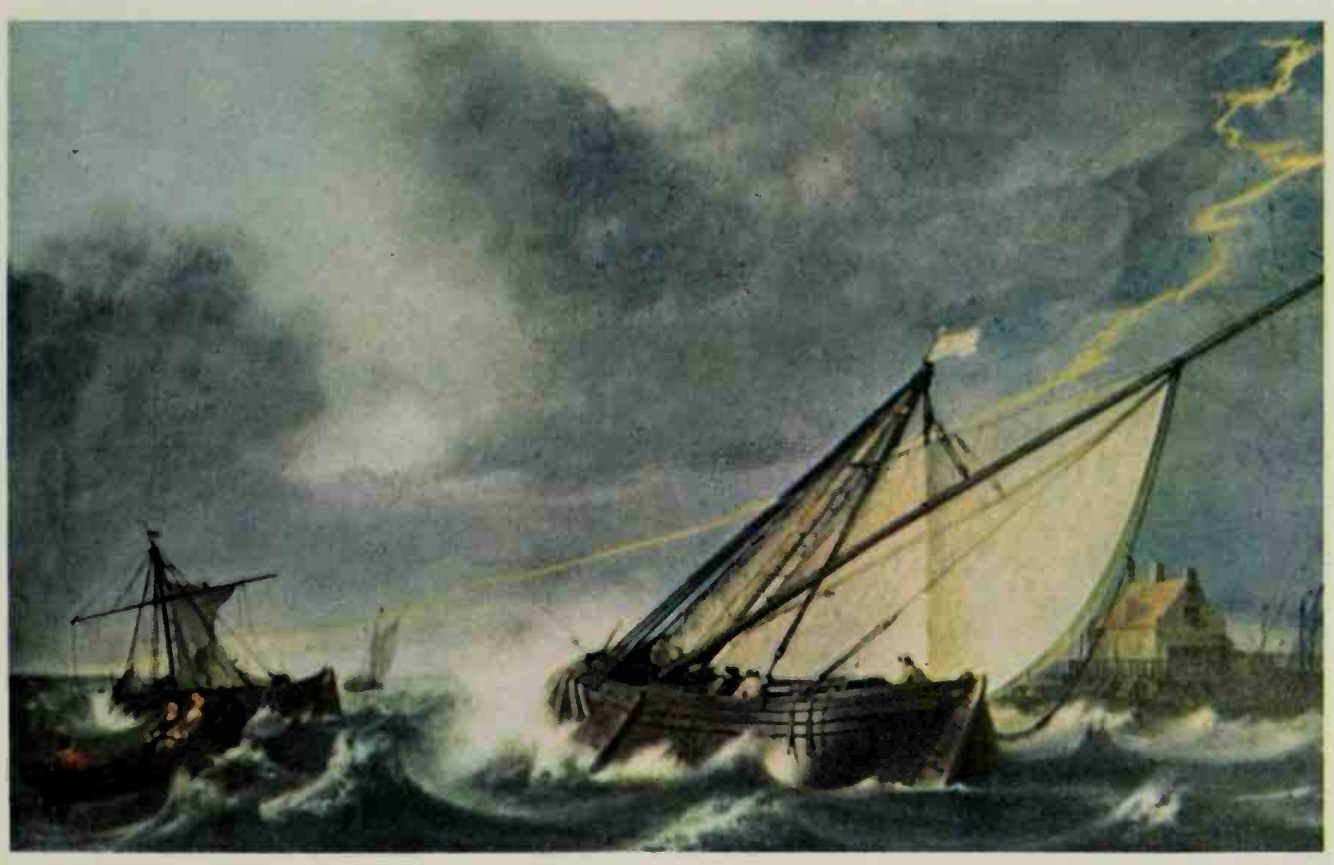


193. A dhoni of the early nineteenth century from the Coromandel Coast. *See page 171.*

185

185. An Arab passenger boat of the thirteenth century. Though the accommodations are good—each passenger seems to have his own cabin—the seaworthiness, to judge from the energetic way in which two hands are bailing out the bilge with clay jars, leaves something to be desired. The stern rudder is already in use in this area at this early date. The anchor is the grapnel type. *See page 162.*



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204. Sprit-rigged craft of the seventeenth century under shortened sail in a storm. *See page 181.*

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178. The *Sea Witch,* 907 tons, one of the early clippers (built in 1846) for the China trade.

179. The "down-easter" *Samuel Skolfield,* 1590 tons, built at Brunswick, Maine, in 1883.

CHAPTER TEN

The Swan Song of Sail

ON January 24, 1848, a workman spotted a nugget of gold in the raceway of a sawmill in the inland country north of the modest and quiet town of San Francisco. It took a while for the news to filter out but, when it did, it exploded in the East. Men dropped everything to follow the yellow siren's call. Many elected to go all the way by sea, without turning a hair at the thought that, between them and Eldorado, lay a voyage of half a year or more, which included a fight through Cape Horn's howling gales.

Though California gold didn't father the clipper ship, it certainly was responsible for the dizzy speed with which the child matured. Almost two decades before 1848, Baltimore architects, the creators of the "Baltimore clippers," had started to tinker with the lines of the three-masted merchantman, deflating her apple-cheeked bows and slimming her pot belly so that she wouldn't batter her way through the water but slip along. In the 1840s a whole group of sharp ships came off the ways to take part in the long China run and give American merchants an edge over the slow-footed British competition. The designers neatly transferred the characteristics of the fast schooner to the full-rigged ship: they created vessels which, with their impressive spread of sail and fine lines, including the famous concave bow and semi-elliptical stern, qualify to be called clippers. Then came the electrifying news from California, and the curtain was raised on that epic, romantic, fantastic age when the sea was ruled by its most beautiful queens, the full-fledged clipper ships.

Compare Illustration 171A, p. 141

Speed had always brought freighters something of a bonus, but in '49 and the four or five years thereafter it brought a jackpot. The first vessel to nose into San Francisco Harbor loaded with anything in short supply could pay off her total costs with the profit on that one run alone. Freight rates climbed astronomically. An owner no longer was interested in ships carefully designed to hold enough cargo to guarantee a proper return—let them carry half as much so long as they could carry it in a hurry.

This was the climate that produced the grand ships of the 1850s. A clipper's soaring masts, forest of spars, and acre of canvas cost a fortune, while far less could be stowed in her slender hull, whose length ran five and a half times the width or better, than in an everyday jowly, bulging merchantman built on the traditional 4 : 1 ratio or less. But what she held she was able to move from New York to San Francisco in a hundred days or so and not in half a year. To take advantage of every bit of wind the clippers set a veritable cloud of canvas. The *James Baines,* for example, crossed her mainmast with no less than six yards (main, topsail, topgallant, royal, skysail, and moonsail), and she could carry more than thirty-five sails, right on up to skysail stunsails. Under proper conditions, with hard driving, clippers could for short stretches reach eighteen to twenty knots, a speed that steamboats weren't to match for decades. And their skippers drove them like men possessed. "At 5 p.m.," reads the log of the *Lightning* under date of 21 October 1855, "sighted a

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216. "Breezing Up," Winslow Homer's well-known picture, done in 1876, of a Gloucester fishing boat. *See page 190.*

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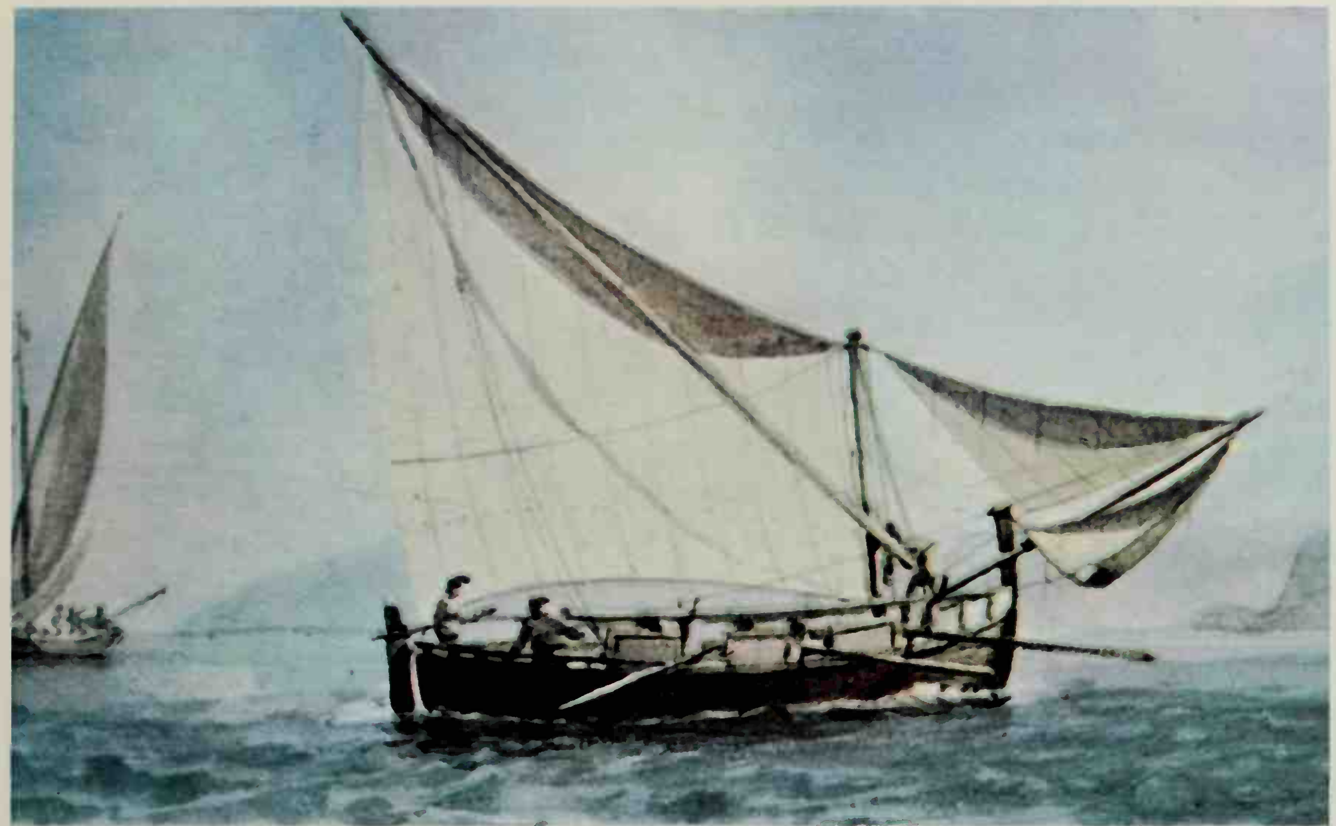
221. Boats on the beach at Sorrento in 1794. *See page 194.*



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223. A barquette of about 1800 from Marseilles. *See page 194.*

225

225. Fishing for swordfish in the Strait of Messina in the late eighteenth century. The lookout from his lofty vantage point spots the fish and the men in the small boats harpoon them. *See page 194.*

large ship . . . sailing under double-reefed topsails. . . . They must have taken us for the Flying Dutchman . . . for, notwithstanding the strong breeze, we could be observed carrying our skysails with studding sails 'low and aloft." This was traveling fast with a vengeance and, during the half decade after '49, traveling fast paid off with a vengeance.

Moreover, there was a solution to the limited capacity of a clipper's svelte hull: bigger clippers. The ship generally considered the first true clipper, *Rainbow,* built for the China trade, was launched in 1845 and rated 750 tons. The first ship designed by that brilliant naval architect, Donald McKay, whose name is to clippers what Michelangelo's is to sculpture, came off the ways in 1850 and was 1534 tons (209′ × 37′ 8″ × 21′), his *Flying Cloud* in 1851 was 1783 tons (229′ × 40′ 8″ × 21′ 6″), his *Sovereign of the Seas* in 1852 was 2421 (258′ 2″ × 44′ 7″ × 23′ 6″), and in 1853 he launched the sensational 4556-ton *Great Republic,* the largest wooden ship ever built: she was no less than 334′ 6″ long, 53′ 6″ broad, and 38′ deep; iron braces were used to enable her to achieve this length. The traditional three masts weren't enough to drive her: she was given four, rigged in a way that became very popular for giant windjammers, the barque rig, square sails on fore and main and mizzen, and fore-and-aft on the spanker-mast. Her original sail plan called for an acre and a half of canvas; even her skysail yards were all of forty feet long. Unfortunately, she caught fire on the eve of her maiden voyage, and an extensive rebuilding cut down her size and rig drastically.

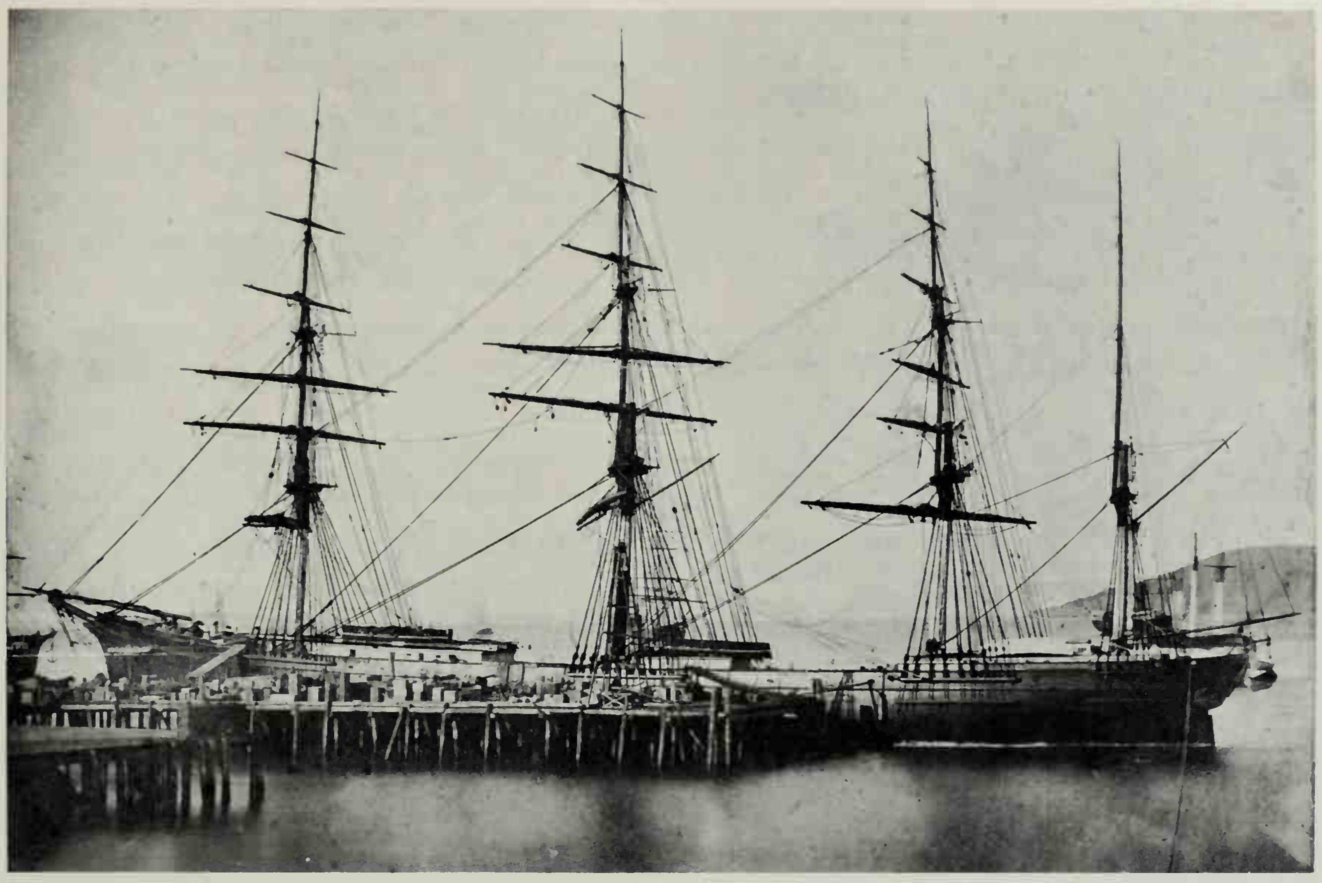
The great ships raced to California—but that was only the smaller part of their allotted rounds. From there they pressed on in ballast to China, where they had no trouble snatching cargoes away from the lumbering British East Indiamen. In 1851 came news of gold in Australia, and American clippers rushed starry-eyed grubstakers out to Melbourne. But, by 1855, things—and freight rates—came back to normal. It was a body blow for the costly, uneconomical clippers. Six years later the firing on Fort Sumter announced the Civil War, conditions on the sea changed radically, and the clippers' brief day was over. Some lived on —but no longer like queens. "With lofty rig cut down to cautious dimensions, with glistening deck and topsides scarred and neglected, [they] limped about the seas under foreign flags, like faded beauties forced upon the streets."[1]

But they had left their mark. Box-like hull lines were now for the most part a thing of the past. The new merchantmen were not exactly extreme clippers—queens are a luxury; it takes gold rushes to support them—but they had the clipper's general profile and some of her generous spread of canvas. And, if there were no queens, there were at least princesses. When the clippers first nosed into Canton and Hong Kong to load up with tea for London, British shippers received a rude shock: the first tea to arrive got the top of the market, and American ships were now carrying off the honors and the profits. Their answer was the fleet of famous English tea-clippers, smaller than their American cousins (one thousand tons was a good size), yet nearly as fast. But the English clipper's day was not very long either, for in 1869 the Suez Canal was opened, and China came into the range of steamers, now that these didn't have to reckon with the long circuit of Africa, whose primitive shores offered no place to recoal. Some of the tea-clippers moved over to the Australia wool run, but there too they were able to hold on for only a decade or so.

Illustration 181, p. 148

As a matter of fact, in these years steam was busy elbowing sail off the seas everywhere. Yet windjammers were stubborn and put up a plucky last-ditch stand. The key

[1] Samuel Eliot Morison, *The Maritime History of Massachusetts, 1783–1860* (Boston: Houghton Mifflin, 1921), p. 371.



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180. This very old photograph, taken in 1860, shows the *Great Republic* alongside a dock in San Francisco. The rig is the later, reduced version.

181. Color illustration, page 148.

182. The *Great Republic* as pictured on a Currier and Ives lithograph.

figures in their struggle for survival were the hardworking "down-easters," the cheap and handy multi-masted schooners, and the monster iron-hulled barques and barquentines.

Illustration 179, p. 150

The down-easters were superb ships—fast, handy, able to carry plenty of cargo and yet be operated economically. They were born early in the 1860s, when it was discovered that the grain produced by California's sun-drenched valleys was so hard and dry it could take the fourteen thousand-mile voyage around Cape Horn to Europe without spoiling. To carry it, Maine architects designed, and Maine shipyards built, the down-easters, which some naval historians consider the finest all-around sailing merchantmen ever created. They weren't as sharp as the great clippers nor as heavily sparred, but they were fast enough, better sailers, had far greater capacity, and needed far less crew. For the down-easter had the benefit of some belated but crucial improvements in rigging: bulky, short-lived hemp had now given way to slender, durable wire; topsails, which over the centuries had swelled till they were now bigger than the main courses, had been sliced horizontally into an upper and lower topsail of a much more easily handled size; and steam-driven winches allowed a mighty cut in the amount of muscle needed aboard. The down-easters proved so useful they were soon operating everywhere, carrying the sort of cargoes a steamship wouldn't

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183. The seven-masted, steel-hulled *Thomas W. Lawson.* She was 395′ long, 50′ wide, 35.2′ deep in the hold, and 5218 tons. Her schooner rig and various mechanical aids enabled her to do with a crew of only sixteen men.

touch because they were too cheap or too messy or came from areas where coaling stations were few and far between. A case in point, for example, is guano, a precious fertilizer in the days before the chemist came to the aid of the farmer. Guano was found off the coast of South America, particularly Peru, where certain tiny islands, by being the haunt of sea birds for centuries, had acquired literally mountains of powder-dry droppings. Down-easters hauled much of the invaluable but unsightly stuff to the four corners of the globe.

Along the coasts of North America schooners, especially the big three-masted versions, successfully fought against the competition of steam until well into the twentieth century. Many were designed with centerboards to enable them to operate in shallow waters. Furthermore, naval architects became aware that a schooner could be made longer and given more masts without a corresponding increase in the number of deckhands needed. In 1880, the four-masted version made its appearance, a year later five-masters were being turned out, and soon after that six-masters. In 1902 even a seven-master came off the ways, the *Thomas W. Lawson*. It didn't prove too successful, however; six masts seems to have been the upper limit for a schooner that was to earn its pay and not be a mere showpiece.

The *Thomas W. Lawson* is a good example of the impressive dimensions the sailing merchantman reached before it gave up the ghost. What made these possible was a new building material: iron.

As far back as 1818 (below, p. 216), iron had been used for the hull of a wind-driven merchantman and, soon after, iron spars and masts began to drive out pine, and wire rope to drive out hemp. For a short while the composite ship—wooden planking over an iron frame—enjoyed a vogue, but designers then went back to the all-iron hull: it was cheaper, more durable and—more important—could be built to any length. And, to make it worthwhile, there was one important run left from which steamers shied away: the hauling of nitrates from Chile. To go from Europe to Chile involved bashing through Cape Horn's gales; a steamer had to burn a lot of expensive coal to do it, there were mighty few places to refill the bunkers along the barren coasts of lower South America—and nitrates were a cheap cargo. The sailing ship received its last great chance when certain shrewd shipowners found the answer to the Chilean nitrate trade in giant-sized windjammers. Since a naval architect working with steel wasn't hampered the way his predecessors had been by the limitations of wood (above, p. 107), he was able to design hulls long enough to carry huge cargoes and yet narrow enough to move easily through the water. And the use of wire enabled him to work out a rig that drove these monsters along almost as fast as a clipper and yet was much more efficient and needed a much smaller crew—an important consideration in a ship that had to live off the leavings of steamers. The new ships were generally given more than three masts and were rigged as barques, that is, with fore-and-aft sails on the aftermost mast. They had no such frills as studdingsails, skysails, moonsails, and the like; only main courses, topsails, topgallants, and royals. However, since these were now hung from strong and rigid steel yards, they were able to be cut so broad that they offered to the wind all the expanse of a traditional sail plus its studdingsails. Moreover, now topgallants as well as topsails were sliced horizontally in half to make two easily handled shallow sails instead of a single clumsy deep one. It all added up to sails of smaller area and fewer of them, but increased drive and efficiency.

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184. The iron barque *Macquarie*, built at London in 1875. She was 269.8′ long, 40.1′ wide, 23.7′ deep in the hold, and her registered tonnage was 1975.

Perhaps the biggest of these steel-hulled giants—and the biggest sailing vessel, therefore, ever to sail the seas—was Germany's *Preussen,* built in 1902. She was 433 feet long and fifty-four feet wide, which gave her a cavernous maw able to hold eight thousand tons of cargo. She had five masts with six sails on each (she was ship- not barque-rigged) and, in addition, fifteen to eighteen various fore-and-aft sails—a total of sixty thousand square feet of canvas, yet, for it all, she needed a crew of only forty-seven officers and men, of whom at least four cooked and served and rarely if ever handled a line. A scant eight years after her launching, some squat tramp steamer slammed into her, and that was the end of this great lady.

After World War I, the family of large sailing ships shrank steadily. Some sturdy members, owned by shrewd operators and captained by gifted skippers, still found a way to earn their keep. But most bowed out, some by shipwreck but many by rusting away at a dock and then meeting an ignominious execution in the scrapyard. World War II decimated the already painfully thin ranks. Today there are only a handful still alive, most serving as training ships in various navies. At this writing, it looks as if their days, too, are numbered.

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185. Color illustration, page 149.

186, 187. Modern Arab *būms,* large and small.

CHAPTER ELEVEN

East of Suez

"WHEN the Etesian [northern] winds are blowing over our waters, on the shores of India the wind sets in from the ocean. This southwest wind is called 'Hippalus' from the name of the man who first discovered the passage across." So wrote the anonymous author of a set of sailing directions drawn up about A.D. 50 for skippers sailing the Red Sea and western Indian Ocean. Actually, what Hippalus, a Greek of perhaps the second century B.C., discovered and passed on to his fellow Greeks, was something that Chinese and Indian and Persian seamen had known for centuries: the monsoons, or trade winds, of the Indian Ocean.

From about October to May the northeast monsoon—monsoon comes from an Arabic word meaning simply "season"—blows, bringing clear skies and fresh, pleasant breezes. During the summer months the blustery, rainy southwest monsoon takes over. These winds, with their clockwork regularity have been, more than any other factor, responsible for the characteristics of the craft that plied the Indian Ocean. Arab and Persian skippers found the smiling northeast monsoon a favorable wind for most of their voyages both coming and going, so, with only fair-weather sailing to think about, they went in for ships that were fast and light. The Chinese found the direction of the northeast monsoon far less useful, and there were always the typhoons of the South China Sea to reckon with, so they insisted on massive vessels strong enough to stand up to any blow.

From Suez south along the African coast to Madagascar and east to the Persian Gulf and the west coast of India, almost all nationalities—Arabs, Persians, and Indians—use those graceful lateeners which we—not they—call "dhows."

The sleek, curving shape of the dhow's hull is centuries old. It harks back to a light primitive boat whose planks were not nailed rigidly to ribs but sewn one to the other with coconut fiber. The author of the sailing directions mentioned above had seen such craft in the first century A.D., and they were by no means a novelty then. In the thirteenth century Marco Polo saw them—and wasn't exactly impressed. According to him, they "[are] wretched affairs and many of them get lost; for they have no iron fastenings and are only stiched together with twine made from the husk of the Indian nut. . . . It keeps well and is not corroded by sea water but it will not stand well in a storm."[1] Polo was unfair: this system of fastening may not have been strong enough to weather a good blow, but it did lend to the hull a certain amount of give that enabled it, for example, to stand up to the battering of surf, which can be rough on a rigid-frame boat. Moreover, we must never forget that these craft were built to sail only during the mild northeast monsoon. During the stormy

[1] H. Yule, *The Book of Ser Marco Polo* (London: 1871), Vol. 1, p. 102.

southwest monsoon they hibernated on the beaches; their twentieth-century offspring do no differently.

The dhow's rig is the "Arab lateen," a lateen that varies from the triangular sail found in the Mediterranean: it is quadrilateral; it looks like a Mediterranean lateen with the fore corner clipped off to leave a short luff. The dhow's hull is a finely shaped one marked by a long overhanging bow and a raking stern. Today there are both double-ended dhows and transom-sterned dhows, but the former is almost certainly the original form.

Illustration 185, p. 149

Where the dhow got its distinctive hull and sail from is anybody's guess. There are few old pictures extant of craft from the area and these, aside from establishing that the stern rudder was used as early as the thirteenth century, reveal very little else. Since Mediterranean sailors were using the lateen back in Greco-Roman times (p. 56), there's no reason why their Persian neighbors, who were handling most of the western Indian Ocean traffic at the time, shouldn't have known of it as well.

The largest double-ended type afloat today is the Arab *būm,* which carries the bulk of the sailing-ship cargo between the Persian Gulf and the coast of Africa; it perhaps is not too different from the ships that followed the same route two millennia earlier. Big *būms* can run to one hundred feet in length, twenty-three in beam, and two hundred tons in burden; they are decked throughout, have a short poop, and boast a cabin—the only one aboard—made by closing in the space between poop and deck. Another important double-ended type which doubtless reflects the dhow's age-old form is the *zārūq.* These are undecked and rarely run over one hundred tons; usually they're much less. *Zaruqs* are extremely fast and for long were the favored craft of Arab slavers.

There is no mystery about the origin of the flat-sterned dhow. When it comes to ship design and rig, Kipling was wrong: the twain often met, and the flat-sterned dhow is as clear an example as anyone could ask for, a marriage of traditional Eastern with sixteenth- to eighteenth-century Western. In 1498 Vasco da Gama brought European ships to the dhow's home waters (it was shortly after this that the European shipwright's iron nails gave the *coup de grâce* to coconut fiber for fastening hulls, at least on larger boats). By 1675 or so, the British East India Company had a shipyard going at Bombay for building full-size Indiamen; after all, there was no better ship timber to be found anywhere than Indian teak. The shipwrights were Persians, who at first worked under the eye of English experts but later under native foremen. Local ship-owners conceived a yearning for the flat sterns, encrusted with gorgeous carving (p. 100), that they saw on the ships coming off the ways; Bombay-trained workers were available to indulge their whim; and the upshot was

Illustration 188, p. 166

the birth of the *baghalah* and the *kotia,* to give the almost identical Arab and Indian versions their respective names. From front and sides these are dhows, from behind eighteenth-century Indiamen. They are the queens of the dhows, lordly craft that run all of 140 feet in length, thirty feet in beam, and four hundred tons in burden. (These days, unfortunately, their number grows smaller each year because they are so expensive to build; as they go out of service, ship-owners replace them with the cheaper *būms.*) In the more cramped waters of the Red Sea there is a smaller version in use, the *sanbūq,* which runs to two hundred tons burden at the most. The *sanbūq*'s transom is painted, not carved, and the decorative patterns used are amazingly like those on Elizabethan galleons. Very likely the *sanbūq* preceded the *baghalah* by a century or so, coming into existence under the influence of the first European ships to be seen in any numbers in the Indian Ocean.

Whether *būm* or *baghalah* or *kotia* or *sanbūq*, the standard rig for a deep-water dhow is a vast mainsail amidships and a smaller mizzen stepped just before the poop. Both masts rake forward, the better to let their yards swing around when the ship has to change tack. The main yard, a gargantuan spar made up of several pieces fished together, is as long as the vessel itself; and the mainmast, since it is given precious little standing rigging to keep it up, is a massive timber, a veritable tree. In running before the wind, the mainsail alone is used, and its great surface, billowing out, can send a dhow along at a smart pace. On a quartering wind the mizzen can be raised. When going to windward, at least four sails can be set: main, mizzen, a lateen jigger, and a jib, a relatively recent importation from European rigs; some bigger ships carry topsails as well. Dhow skippers, particularly the Arabs, like to keep sail-handling to a minimum and have rather a predilection for traveling under mainsail alone; on the smaller *sanbūqs* and *zārūqs* the mizzenmast is often without yard or sail and gray from disuse. The canvas, cheap to begin with, is usually weathered to an advanced state of feebleness. The Arabs prefer it this way since it provides a safety valve in case of a sudden blow: better a ripped mainsail than an overturned boat.

Illustrations 186–89, pp. 160, 166–67

There are no mechanical aids aboard dhows, and everything must be done by human might and main; to raise sail on a big vessel can take as much as an hour. Lateens have no reefpoints, so, if sail is to be shortened, the yard must be dropped, have a smaller sail bent to it, and then be heaved up again—all this by hand and with wind and sea making a hard job even harder. In changing tack, unlike the Mediterranean method (below, p. 194), dhow skippers bring yard and sail from one side of the mast to the other. They rarely put their vessels through the wind; except in emergencies they wear ship: the sheet is let go—really let go; it streams out gaily over the water; the ship is brought around till its stern faces the wind; the wind, coming now from dead astern, makes the yard stand upright; and, as the head swings over, yard and sail swivel to the other side of the mast. Then someone has to snare the sheet which, in any kind of breeze, is whipping about as if intent on avoiding recapture. Despite the complicatedness of the maneuver, dhows go through it with amazing speed and ease; the stern literally spins around.

The dhow's big lateen has its disadvantages—it is clumsy to handle and, in a calm, the enormous yard bangs about terrifyingly—but it is an ideal sail for the northeast monsoon's fresh breezes. It can carry a vessel nicely to windward or pull it beautifully before a following wind. During the last century, Britain had on anti-slavery duty in the area men-of-war that were propelled by steam as well as wind, and there were times they had to do better than eleven knots to overtake a fast-flying *zārūq*.

Though dhows are lovely to look at, they are not exactly lovely to live in, particularly the Arab members of the family. Built of tough, long-lasting teak, they are generally older than their owners, at times than their owners' fathers, and during this long span enjoy only the most elementary housekeeping. A Sindbad couldn't do justice to the number, size, and variety of the insect life aboard an Arab dhow. An American oil engineer who bought a thirty-footer to use as a yacht reported that it took three distinct and strong doses of DDT to get rid of his unwanted squatters. Furthermore, since Arabs don't use paint but smear the wood with fish-oil to preserve it, their craft are, to put it mildly, gamy, and the freshly anointed can be an awesome olfactory experience.

There is a wonderful nonchalance, a devil-may-care atmosphere aboard an Arab dhow. Alan Villiers, the well-known seaman and writer whom nothing fazes, did a good deal of

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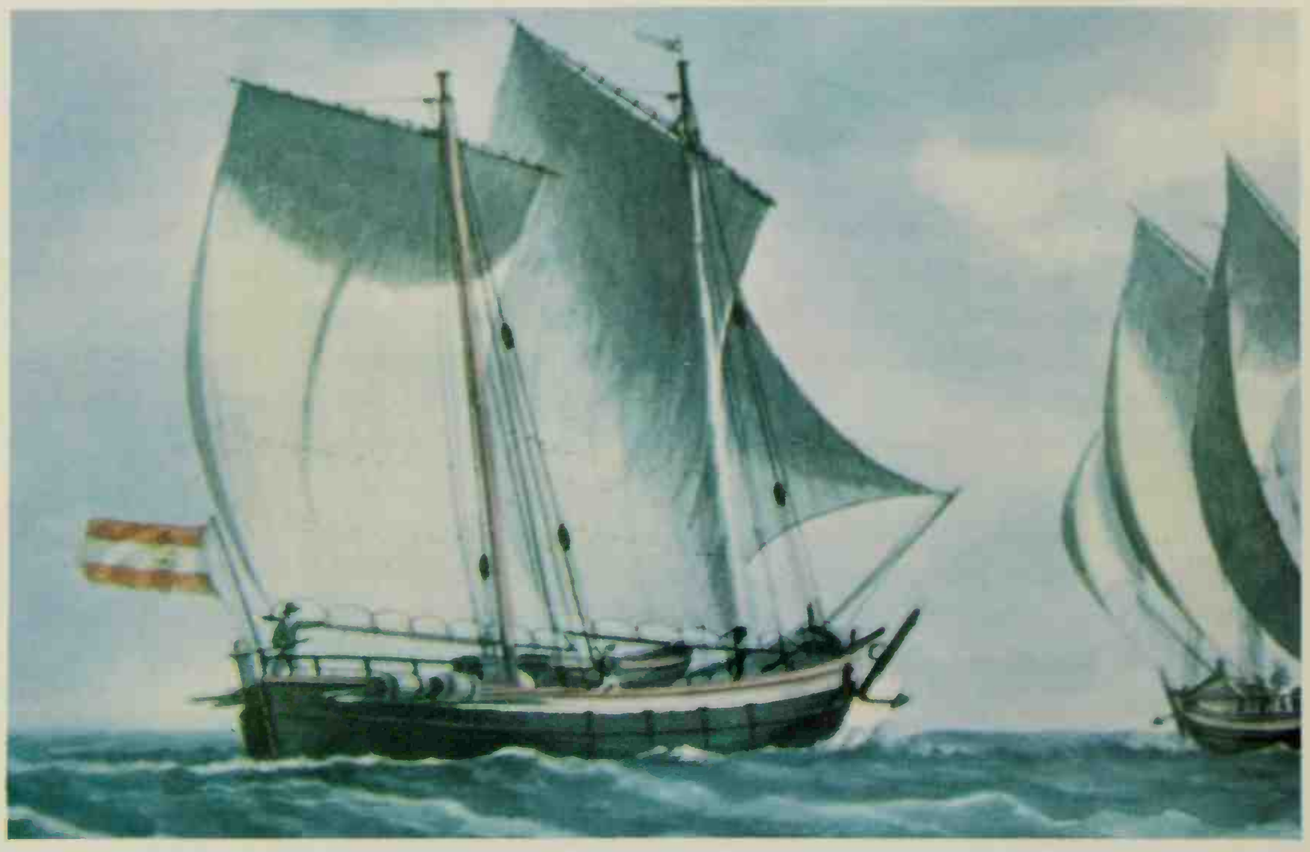


227. A *trabaccolo* of about 1800. This was the traditional type, with two lugs, the aftermost of which was slightly smaller. *See page 197 and illustration 228.*

229

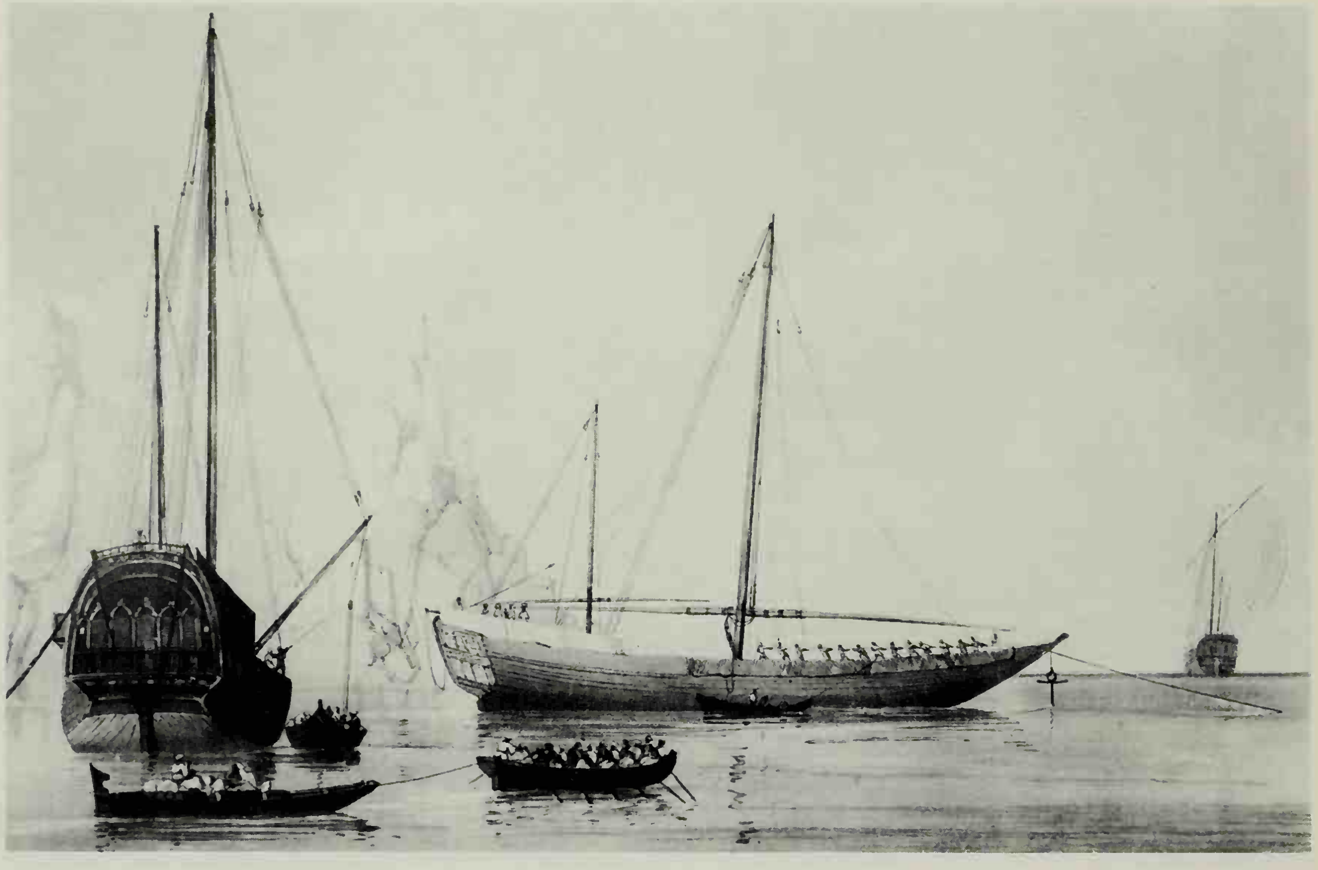
229. The *bragozzo,* the slender, flat-bottomed craft used on the lagoons about Venice. The flamboyance of the Venetians isn't limited to their art and architecture; it can be seen, too, in the color of their sails. In addition to its ample mainsail, the *bragozzo* carries a quite small lug foresail. *See page 197.*

230

230. Gondolas of the eighteenth century. *See page 197.*

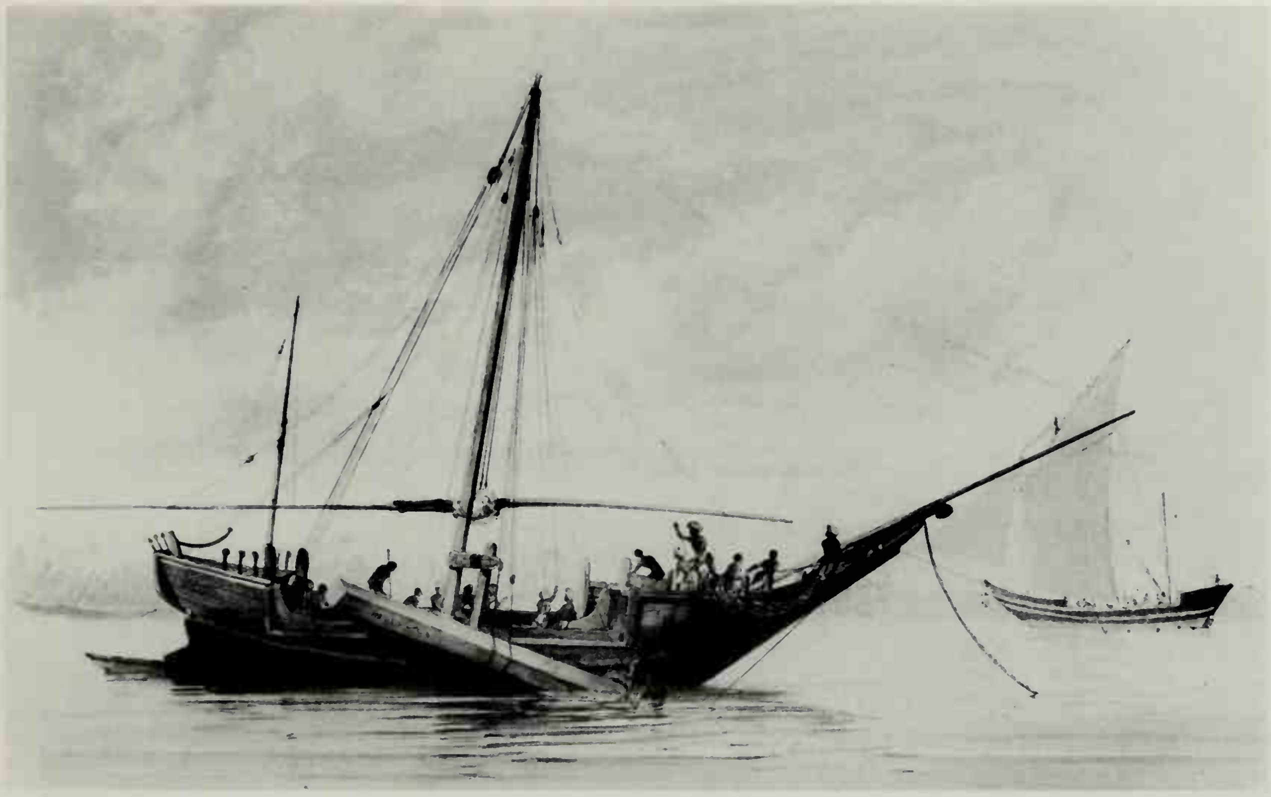
231

231. A modern large Greek caïque. The shape of the hull is typical: sharp stern with outboard rudder, low waist raised by canvas strakes, raking prow. The sails are balance lugs, but nowadays are not often raised; skippers prefer to use their diesel motors. *See page 198.*

188


188. Sketch, made in the early nineteenth century, of a *baghalah*. The flat, highly decorated stern and windowed quarters derive from European craft. Few of these expensive ships are being built these days, and those in service are fast being replaced by *būms*.

sailing on them, and he provides some descriptions which make strong men shudder. One passage he took was on a *zārūq* headed up the Red Sea. The ship, he writes, "was about as lavishly equipped as a South Sea canoe and as well-founded as an Irish fisherman. Without any kind of windlass (and no anchor save two rusty grapnels), with no boat other than a small dugout canoe which could support five expert balancers in a mill-pond, with no instruments of any kind save one ancient and very inefficient compass, without even a lead-line to sound (sometimes the Nakhoda [captain] used part of a fishing line weighted with a stone), without shelter for anyone nor a deck above the cargo nor over anyone's head, without charts, without a log, without even a pump, with nothing to cook in save a fire-box and a native oven and precious little to put in either, with no one on board who could read, leaky, overloaded, heavily-canvassed—still that little ship wandered pleasantly enough along, delivering her cargoes in good condition at the tiny outposts of one of the worst seas in the world. . . . There was not even a flag on board and no clock; no one had heard of barometers. There was nowhere to sleep save on the cargo. . . . There was not a spare rope-yarn on board, and the sea stores for eleven souls for a week were kept in one small box, from which of course they mighty soon disappeared. . . . No watches were kept, and there was no semblance of sea 'style'—no wheel turns, no set meal hours, no turns at anything. All hands were there all the time and all hands turned out for everything except bailing. As for steering, the mate or one of the sailors took the tiller when he felt like it and there he stayed until it occurred to someone else to relieve him. 'Tricks' of five and six hours



189

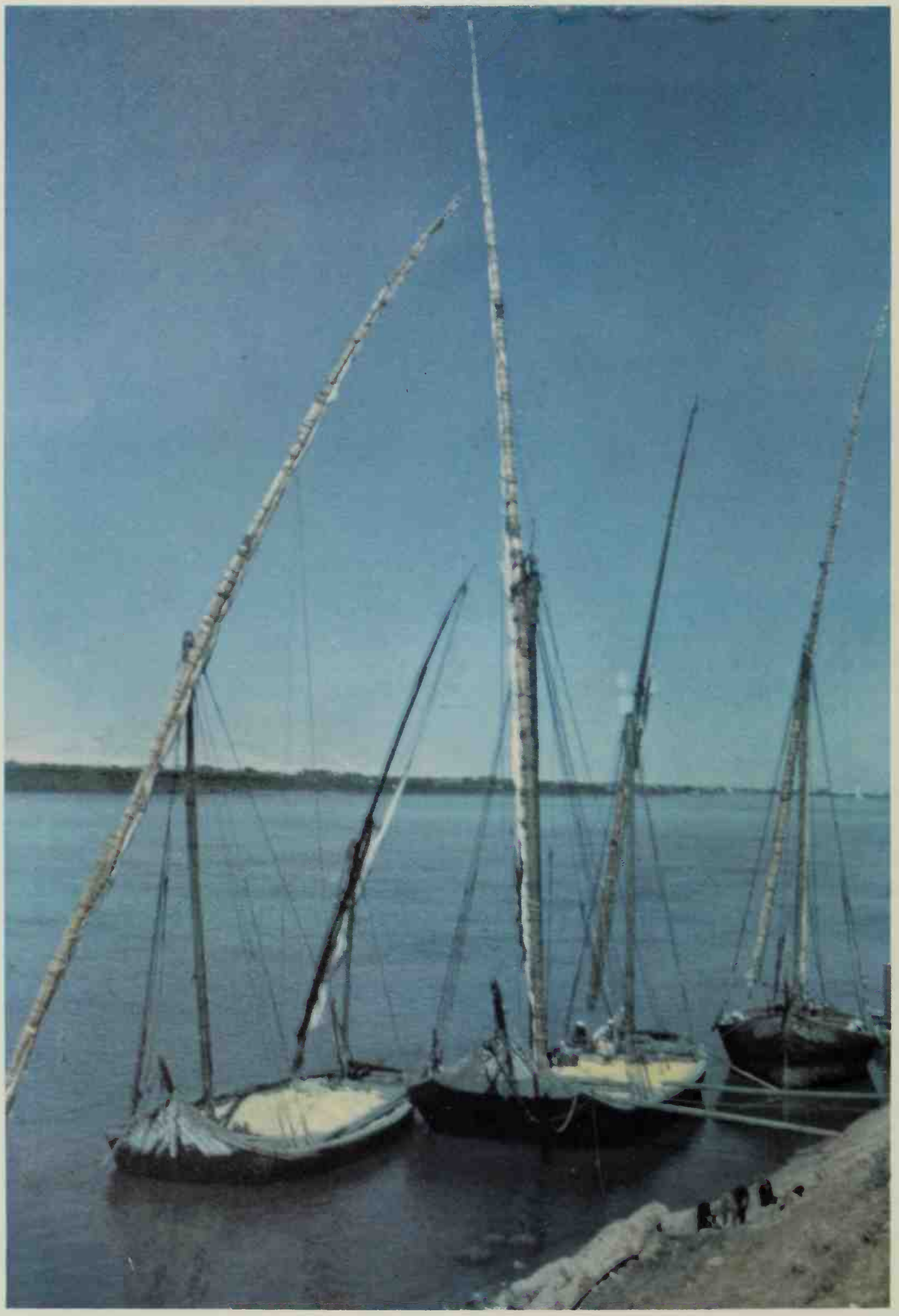
189. Sketch, made in the early nineteenth century, of an Indian merchantman of the type used for transporting teak along the Malabar Coast. The vessel is a member of the dhow family, as the rig and the lines of the hull unmistakably show.

and even all day were not at all uncommon. . . . The sanitary arrangements consisted of an old box lashed on the quarter, a small box in which one was supposed to squat and operate through a hole in the bottom. Toilet paper was a small tin in which one hauled up tinfuls of the sea. . . .

"There is not a decent piece of line aboard, nor a piece of good canvas. The main halliards are plaited straw; all else is cheapest coir. There is not a belaying pin nor a pair of bitts, nor any proper place to belay a line: and this indeed is a cause of considerable inefficiency and some delay in manoeuvres such as wearing ship. Round turns and hitches anywhere are the order of the day, and the shroud tackles are set up to bulwarks as best they may be. There are Irish pennants everywhere: the rudder seems to balance precariously on a pintle: the canoe also leaks. The anchor cable is a piece of coir line. The anchor is let go by . . . picking it up and heaving it over the side. The crew climbs aloft by walking with their toes up the main halliards: the mainmast works heavily as she rolls. She steers—or is steered—very badly: they think little of being several points off course. There is no place to put sidelights, which are supposed to be on board. (There is a certificate for them.) Freeboard is practically non-existent and the sea is kept out with a piece of straw. . . . She is infested with spiders, ants, mosquitoes, and all manner of giant beetles. Yet the crew sing at their work, and the Nakhoda knows the peace of God."[2]

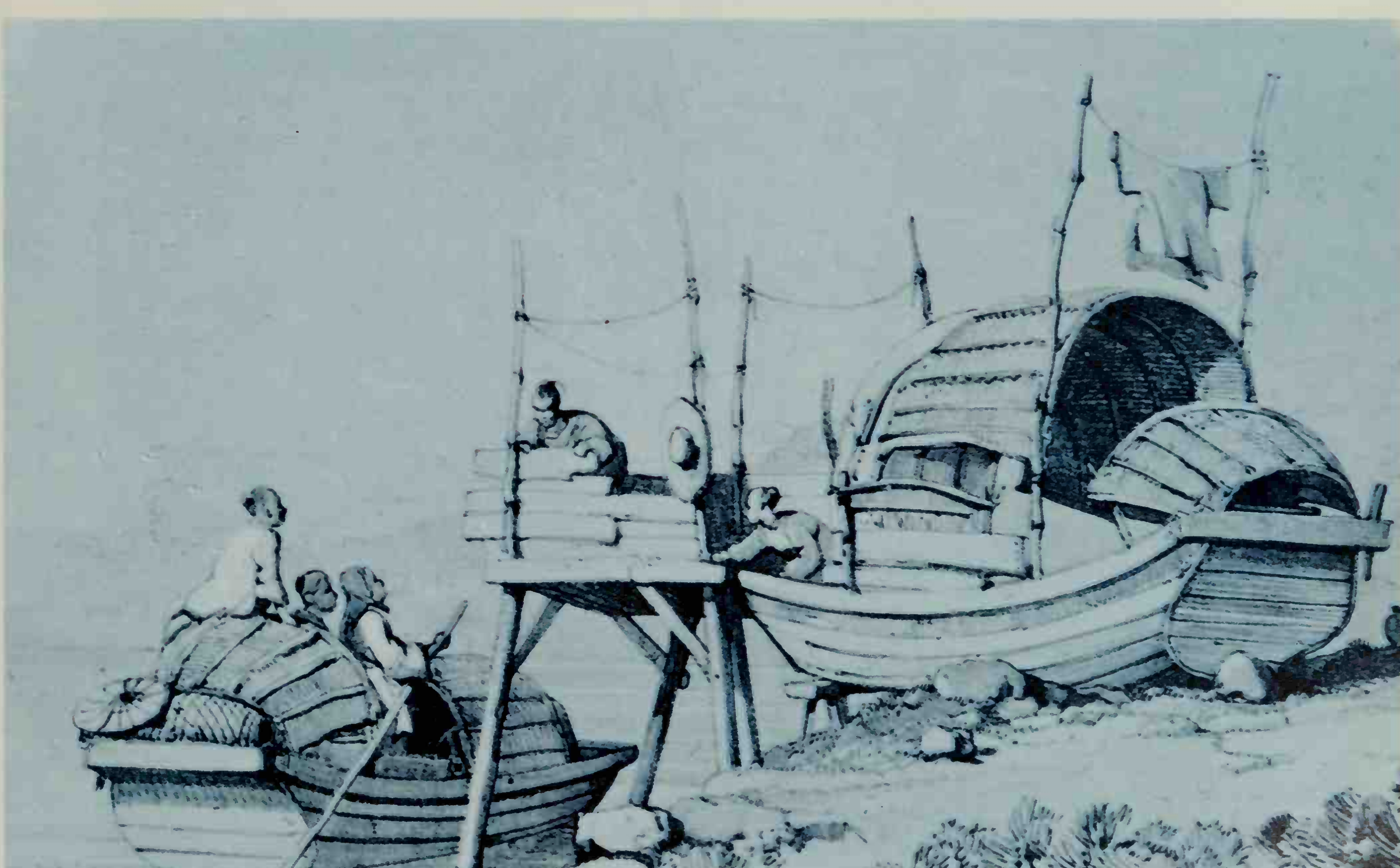
[2] *The Mariner's Mirror,* Vol. 47 (1961), pp. 246, 249–50.

234



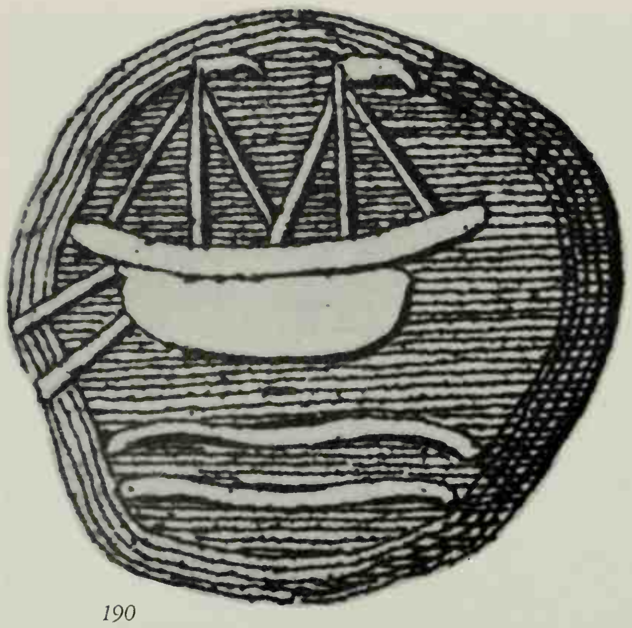
234, 234A. A group of *ghayassahs,* the workhorses of the lower Nile. They are flat-bottomed. The low sterns and the high bows, decked up to the stem at a steep angle, are typical. On an eighty-foot *ghayassah,* the main yard can run fully eighty-four feet long and the mizzen fifty feet. *See page 198.*

234A



242

242. Sketch, made in the early nineteenth century, of small boats serving as residences in the vicinity of Macao.
See page 204.



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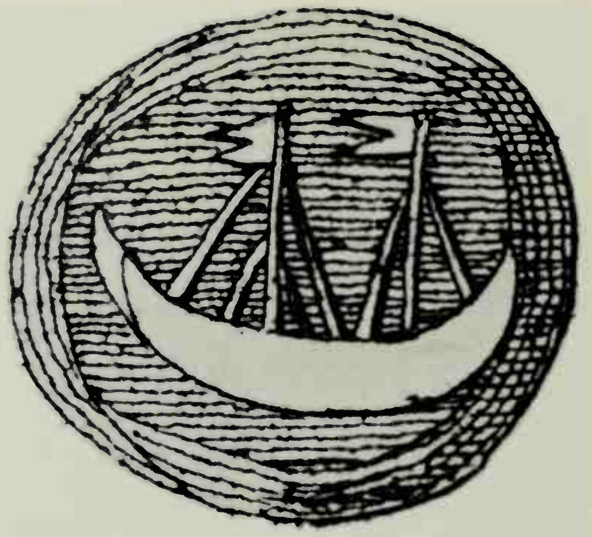

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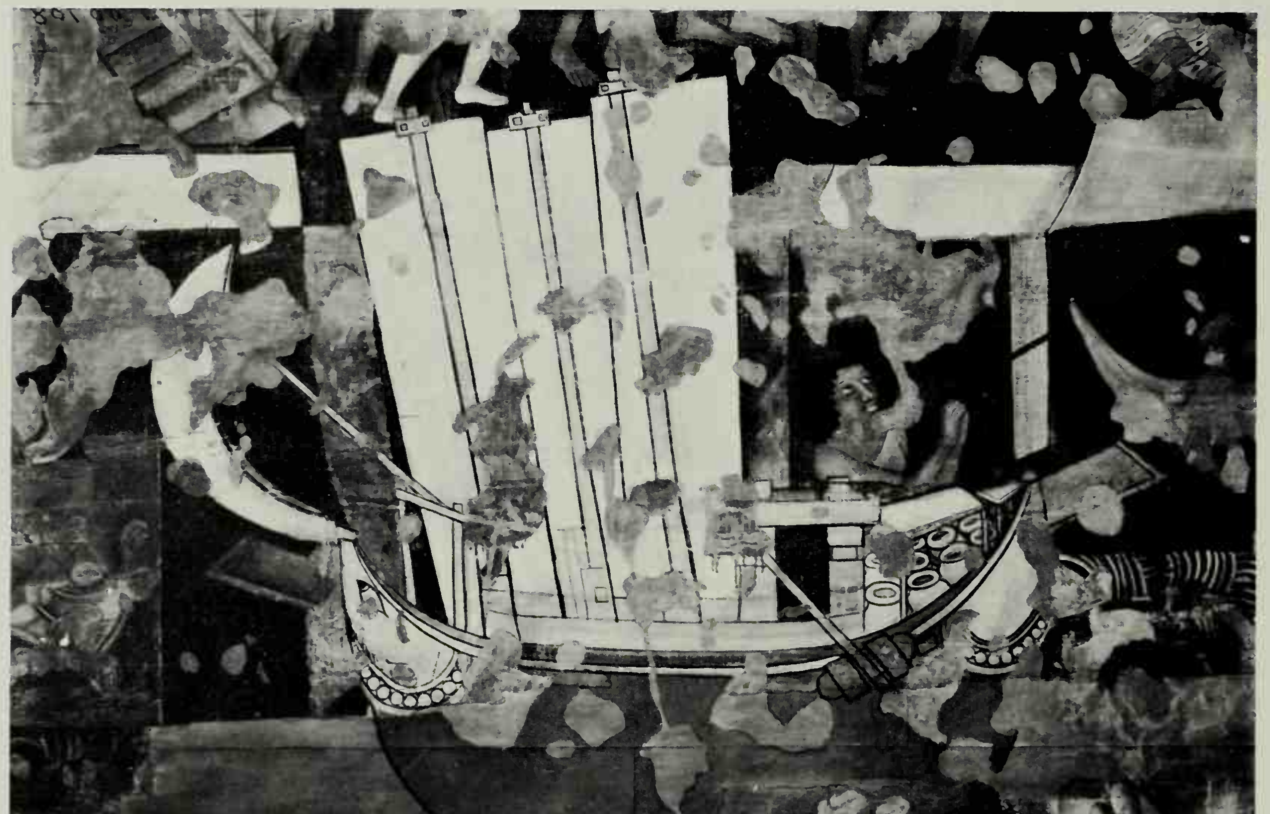


190, 191. The earliest preserved representations of Indian ships: pictures on coins of the second century A.D.

192. An Indian vessel of about A.D. 600.

193. Color illustration, page 148.

Into such vessels as this the owners cram freight, human or otherwise, like sardines in a can. Villiers reports that a *būm* he happened to take passage on came to one port and there "embarked 200 passengers, a feat I would have believed impossible if I had not seen it done. . . . The captain, disconsolate over the poor state of trade in general, said she could have taken another hundred. If she had, she would not have taken me."[3] There have been many angry words spoken and written about the way Arab slavers packed in their pitiable cargoes, and deservedly—but the slaves were being treated no worse than paying passengers would have been. Paradoxically enough, the slaves' voyage became a real hardship only when serious efforts were being made to stamp the trade out: then, to avoid capture, slavers had to strike out over the open sea and consequently couldn't follow their usual practice of coasting and stopping frequently to replenish food and water. If they had the bad luck to be becalmed, the scant rations they had aboard quickly ran out and life became a torture—but for crew as well as cargo.

On the west coast of India the dhow and its kin are the favored craft and presumably have been so for centuries. But, farther eastward, distinctively Indian types sailed the seas.

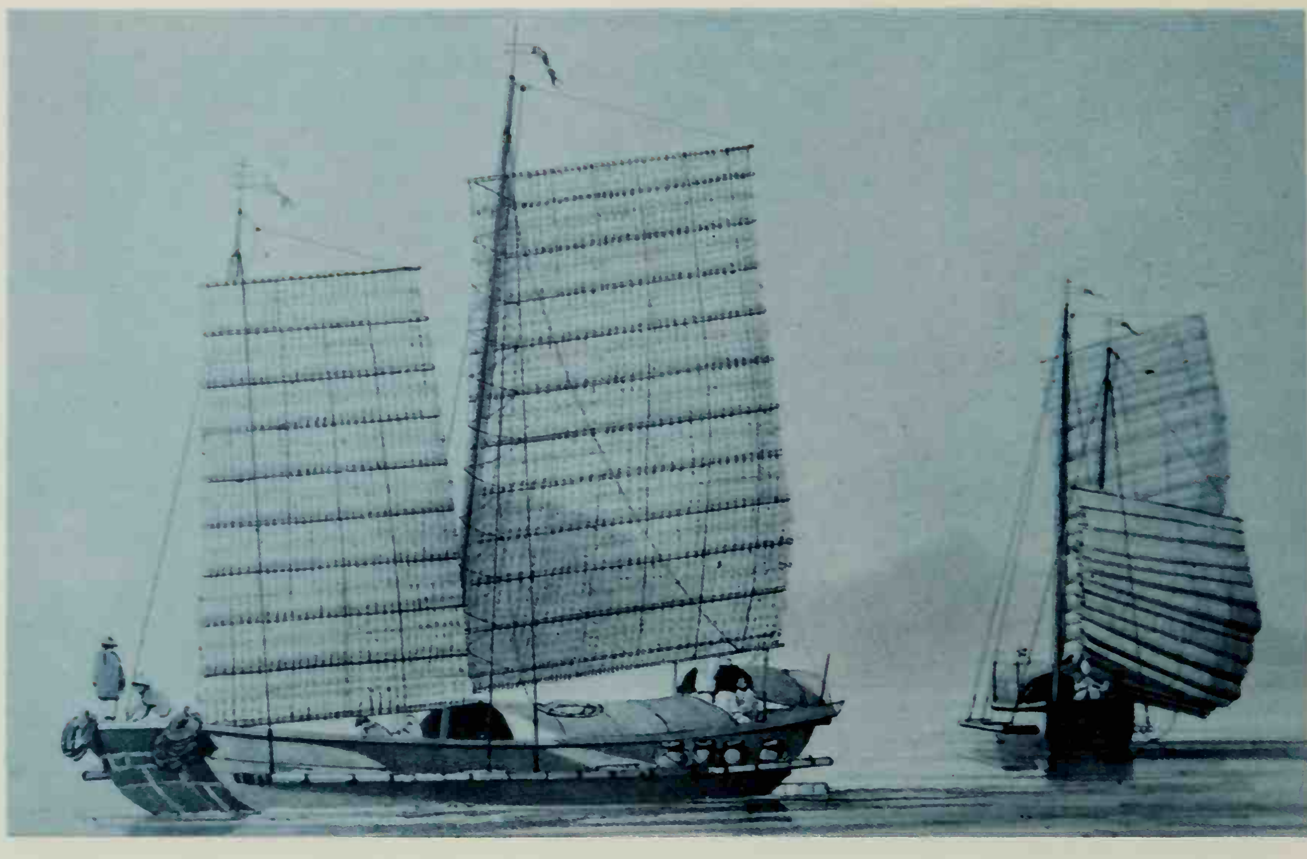
The earliest pictures we have of Indian vessels are on coins that come from the southeast coast and belong to the second century A.D. The ships they show have well-rounded double-ended hulls with galleries at prow and stern, carry two masts presumably fitted with square sails, and are steered, as their Mediterranean contemporaries were, by oars on the quarters. From the second century we jump to about the seventh, to a painting of a ship done sometime between A.D. 525 and 650 on a wall of one of India's famous Ajanta caves. The passage of four or five hundred years apparently brought little change to the hull but a lot to the rig: instead of two square sails there are three tall lugsails that smack strongly of Chinese influence plus a small sail over the bows which is the image of the artemon of Greek and Roman times. There is nothing in all this to be surprised at: both Greek and Roman ships and Chinese junks must have been familiar sights in Indian harbors long before the seventh century. *Compare Illustration 65, p. 52*

These early Indian craft had a long life for, right up to the early years of this century, one of their direct descendants, the *dhoni,* was still to be seen in the waters between Ceylon and the tip of India. The *dhoni* had the traditional graceful double-ended hull, one, moreover, put together in the age-old fashion with sewn planks. It was rigged with lugsails as in the murals—but with lugsails much nearer in shape to the square sails pictured on the coins. *Illustration 193, p. 148*

One member of the *dhoni* family, the *yathra dhoni,* had a most unusual feature. Though a fair-sized vessel, running as much as fifty tons in burden, it was equipped with something we normally connect with canoes and other tiny craft—an outrigger. As it happens, we have the proof that the *yathra dhoni* is the last of a long line, that seagoing ships fitted with outriggers go back at least ten centuries. At Boro Budur in Java there is a shrine which Buddhist monks erected sometime in the eighth or ninth century A.D. It is decorated with a series of carved stone panels illustrating a famous large-scale expedition an Indian prince once led to the island. Several scenes show the ships he used, sturdy seagoing craft equipped, all of them, with outriggers. *Illustration 194, p. 174*

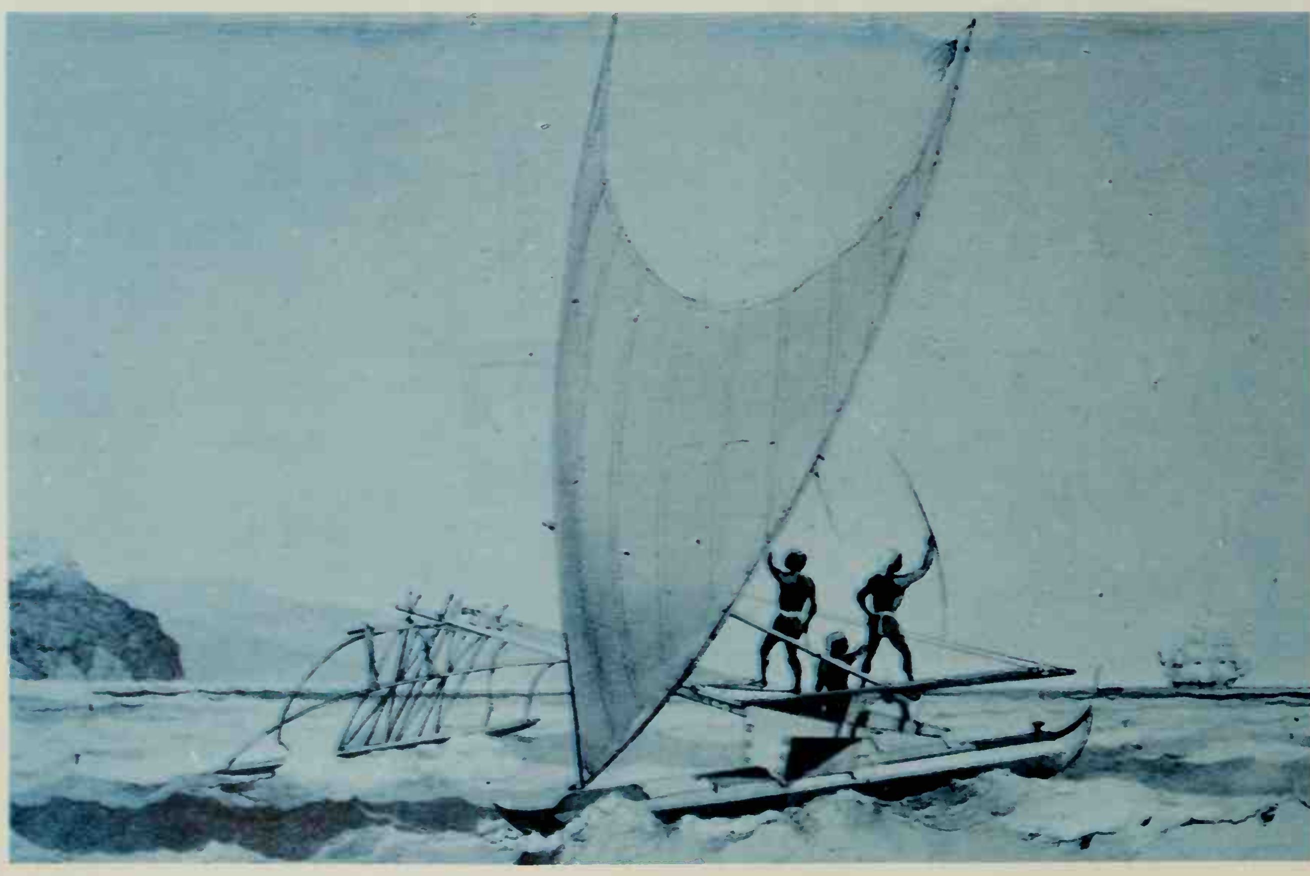
[3] *Monsoon Seas* (New York: McGraw-Hill Book Company, 1952), pp. 81–84.

244

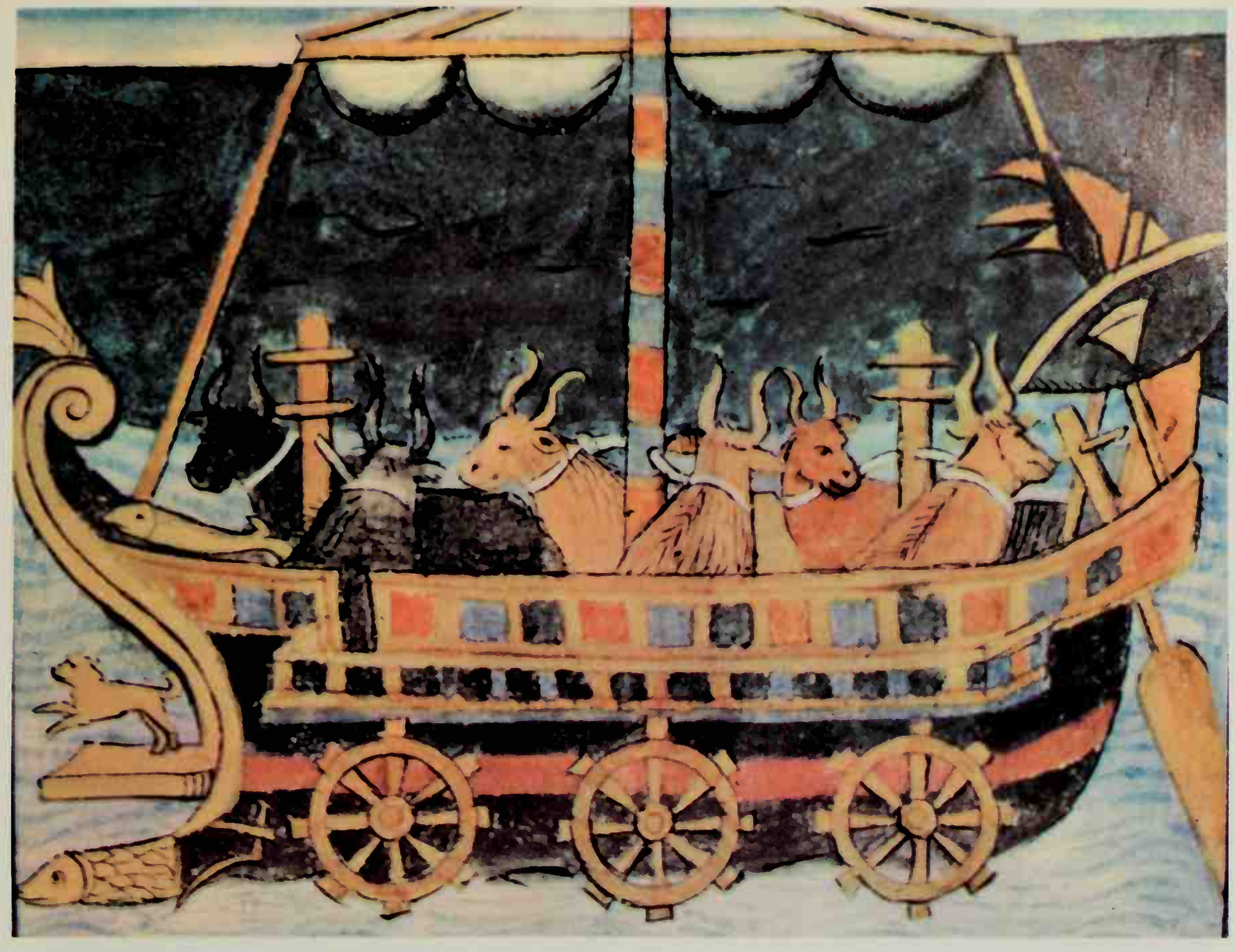


244. The harbor boats used in Manila Bay in the early nineteenth century. The rig is the Chinese balance lug of the type found in the north (see illustration 199). *See pages 179 and 205.*

251



251. Sketch, done in the early nineteenth century, of a type of canoe used in the waters about Vanikoro, in the southern Pacific. The sail is the "crab-claw" type. *See page 208.*



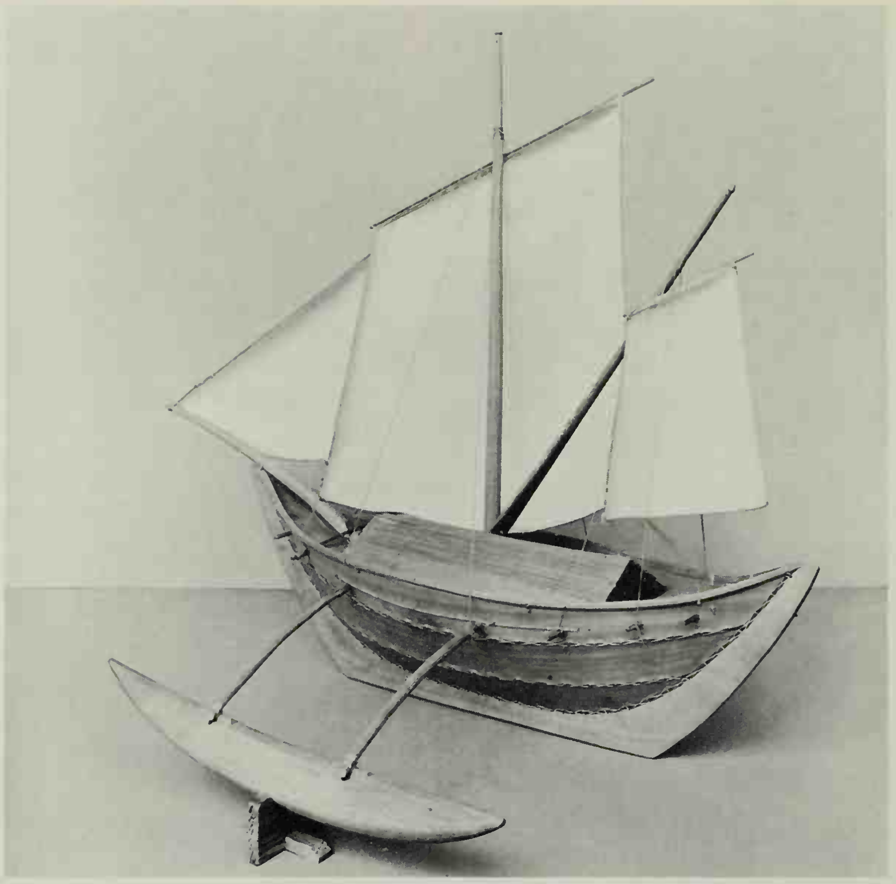
255

255. Men had thought of paddle wheels long ago; the problem was how to make them turn. This fifteenth-century painter has oxen do the job by going endlessly around and around, turning poles geared to the axles of the paddle wheels. *See page 211.*

258

258. An early version of a steam-driven tug. In this celebrated painting "The Fighting Téméraire," done in 1838, England's great artist J. W. Turner portrays starkly the death of the old and the birth of the new: a steam tug, belching ominous fire and smoke, tows to the graveyard one of the grand old ships of the line that fought at Trafalgar. *See page 212.*

194



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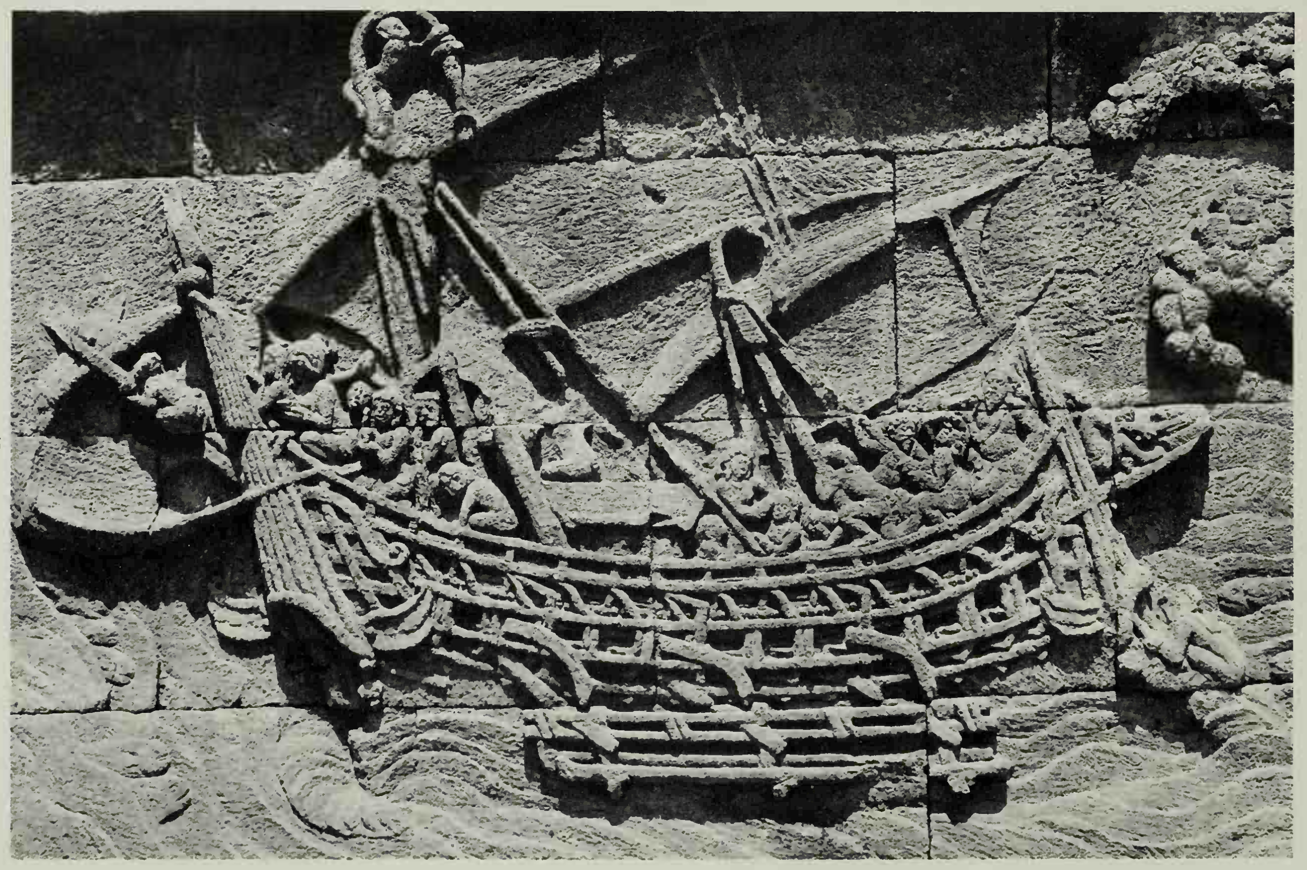
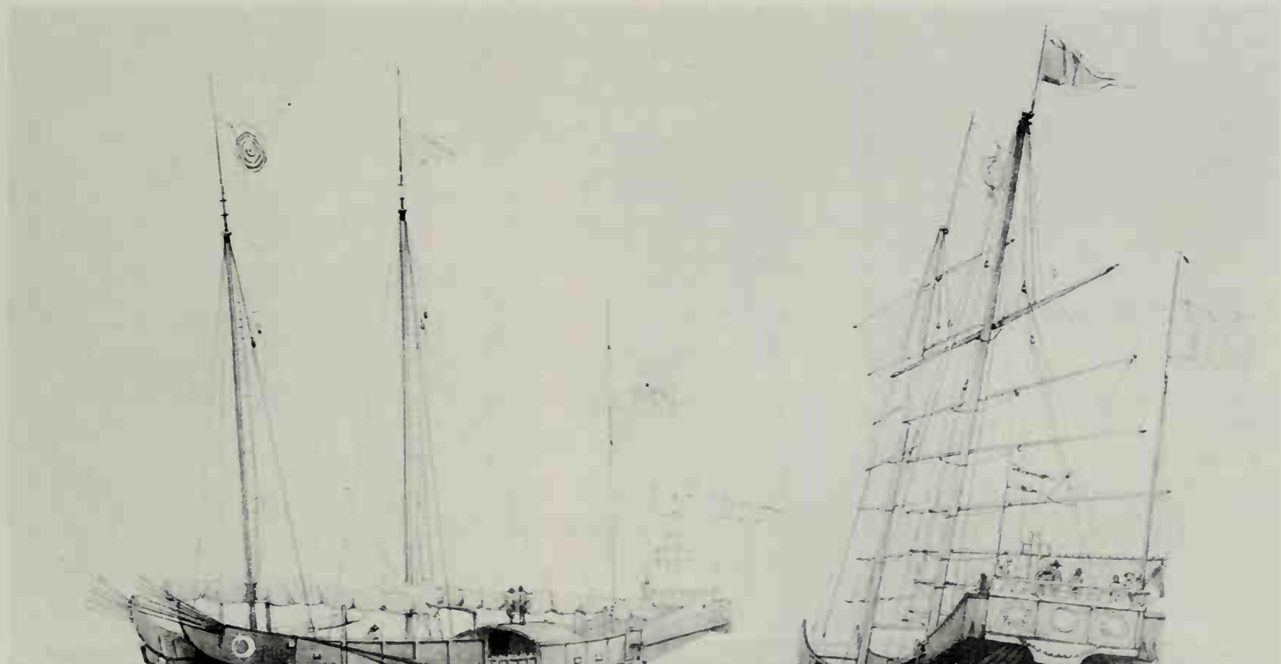


194. A *yathra dhoni,* a type of coaster used by the Ceylonese. These graceful double-enders are probably the largest craft afloat today equipped with outriggers.

195. A large seagoing Indian vessel of the eighth or ninth century A.D. Ships such as these were the ancestors of, e.g., the *yathra dhoni* shown in illustration 194. The rectangular lugsail with spars along head and foot is still standard in Indonesian waters.

196



197

196. Contemporary model of a nineteenth-century sailing vessel of southern Celebes. The rig, a rectangular lugsail on a tripod mast, is the same as that of the eighth- or ninth-century ship in illustration 195.

197. Sketch, done in the early nineteenth century, of Chinese war junks (note the guns in the waist of the vessel on the right). The battens of the Chinese balance lug run the entire width of the sail, and the main sheet controls not just the clew but the whole length of the leech through a web of lines running to the outboard end of each batten.

But the sculptures of Boro Budur are even more interesting for the light they shed on developments to the east of India.

In the waters about Indonesia there is a rig, the Indonesian lugsail, which is as typical there as the lateen is in the western Indian Ocean. It looks for all the world like an ancient Egyptian square sail set as a balance lug, i.e., aligned fore-and-aft, tilted, and hung with one-third of its surface forward of the mast: it is broader than high, very wide, and carries a spar along the foot as well as the head. Even the mast resembles a type used in ancient Egypt: early Egyptian ships hung the sail on a bipod mast; the Indonesian lugsail hangs from a tripod mast. While hardly as old as its Egyptian parallel, the Indonesian rig is by no means young—you can see the very same rig on the Boro Budur sculptures.

Compare Illustrations 247, p. 203; 249, p. 205

Compare Illustration 17, p. 20

Nor is rig the only feature of ancient Indonesian craft that has lived on almost unchanged. The vessels used as coasters in the Macassar Strait and the waters about Borneo and Celebes to this very day steer with quarter rudders exactly the way the Boro Budur boats did. This hoary feature is to be found even on ships that, after long exposure to European-style rigging, have finally given up the traditional lugsails for gaff-headed sails—which, as likely as not, will be hung on tripod masts!

North of Indonesia, along the eastern shores of Asia, that maverick among sailing craft, the Chinese junk, has reigned supreme.

With its curious bow, proliferation of rigging, fanlike sails, and other features equally bizarre, a junk seems like something from another world—but so too does a pagoda to eyes that have seen only Western skyscrapers. The junk is a fine craft, handy, efficient, and ideally adapted to the waters it must sail and the winds it must use.

In many respects, Chinese ship-builders and riggers were ages ahead of the West. They fitted fore-and-aft sails to their seagoing vessels as early as the third century B.C., beating the rest of the world by a millennium and a half. They had the stern rudder as early as the fourth century B.C., beating the rest of the world by more than a millennium and a half. They had leeboards and centerboards long before the Dutch. For centuries they built their hulls with interior bulkheads forming watertight compartments, a development naval architects elsewhere caught up with only in the last hundred years. For long voyages they provided comfortable private staterooms (Marco Polo tells of a big junk with fifty to sixty, where the merchants "were greatly at their ease") at a time when passenger accommodations in the West were, to put it mildly, grim. On the other hand, while the West slowly but steadily experimented and improved, the Chinese, having once created a craft that met their needs, let it go at that: junks of today are probably not much different from their remote ancestors.

Compare Illustrations 154, p. 129; 244, p. 172

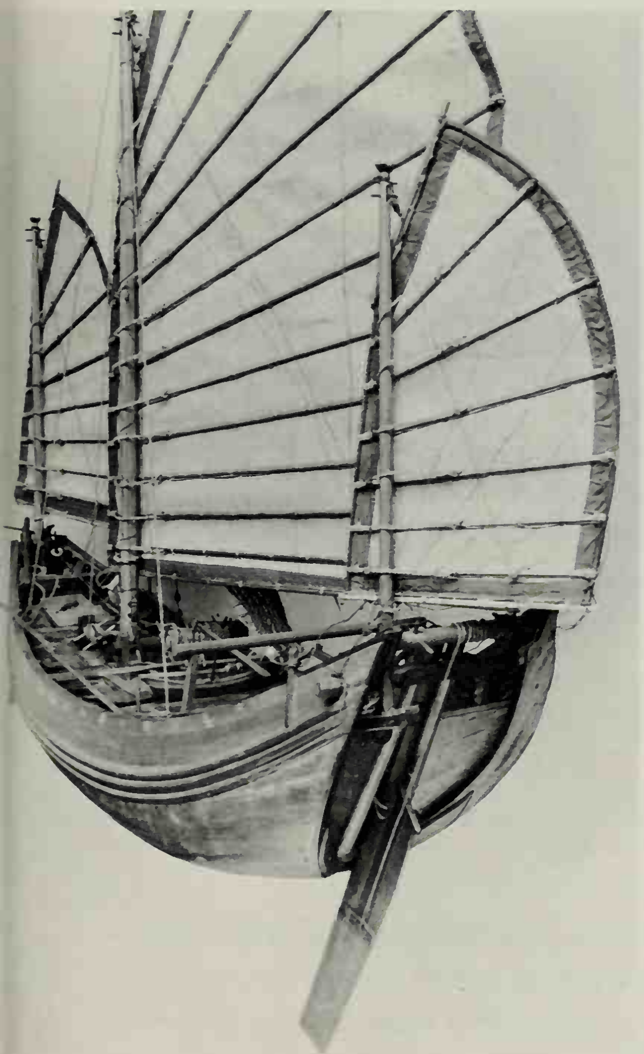
The glory of the Chinese junk is its sails, so ingenious and efficient that China's neighbors adopted them, and they have moved everything from Malay coasters to Bangkok barges as well as junks. The Chinese sail is a form of balance lug, but a balance lug with two features found nowhere else. First, it is stiffened by battens that run all the way across; second, the sheet is led to the outer end of each batten. As a result, such sails can be set as flat as the scientifically designed canvas of a modern racing yacht, and the junk can move fast and efficiently on the wind.

But the battens serve still another all-important purpose. The Chinese lug doesn't use reefpoints or bonnets or any other of the devices to shorten sail that grew up in the West;

[4] *Mast and Sail in Europe and Asia,* second edition (London: William Blackwood & Sons, 1929), p. 442 (written in 1906).

Chinese sailors never have to wrestle with sodden or frozen ropes and canvas. Shortening sail on a junk is simplicity itself: you let go the halyard, and the sail area between the lowest two battens folds up like an accordion; to shorten sail further, keep lowering and letting more battens pile up one upon the other. To raise sail again, just tighten up on the halyard. H. Warington Smyth, who once sailed a thirty-six-foot launch fitted with Chinese lugsails for twelve hundred miles, six hundred of them in the teeth of the southwesterly monsoon, gives a graphic picture of the handiness of the rig. "Black squalls," he wrote, "would threaten and batter us, or would pass away to leeward some miles ahead or astern, always, however, increasing the wind and the sea. When one of these was approaching, all that had to be done was to take a turn of the tiller rope, go forward to the main halyard, and lower away until so many battens were lying snugly in the topping lifts; then similarly with the foresail. Both the sheets would need tightening in a bit, and the thing was done."[4]

198

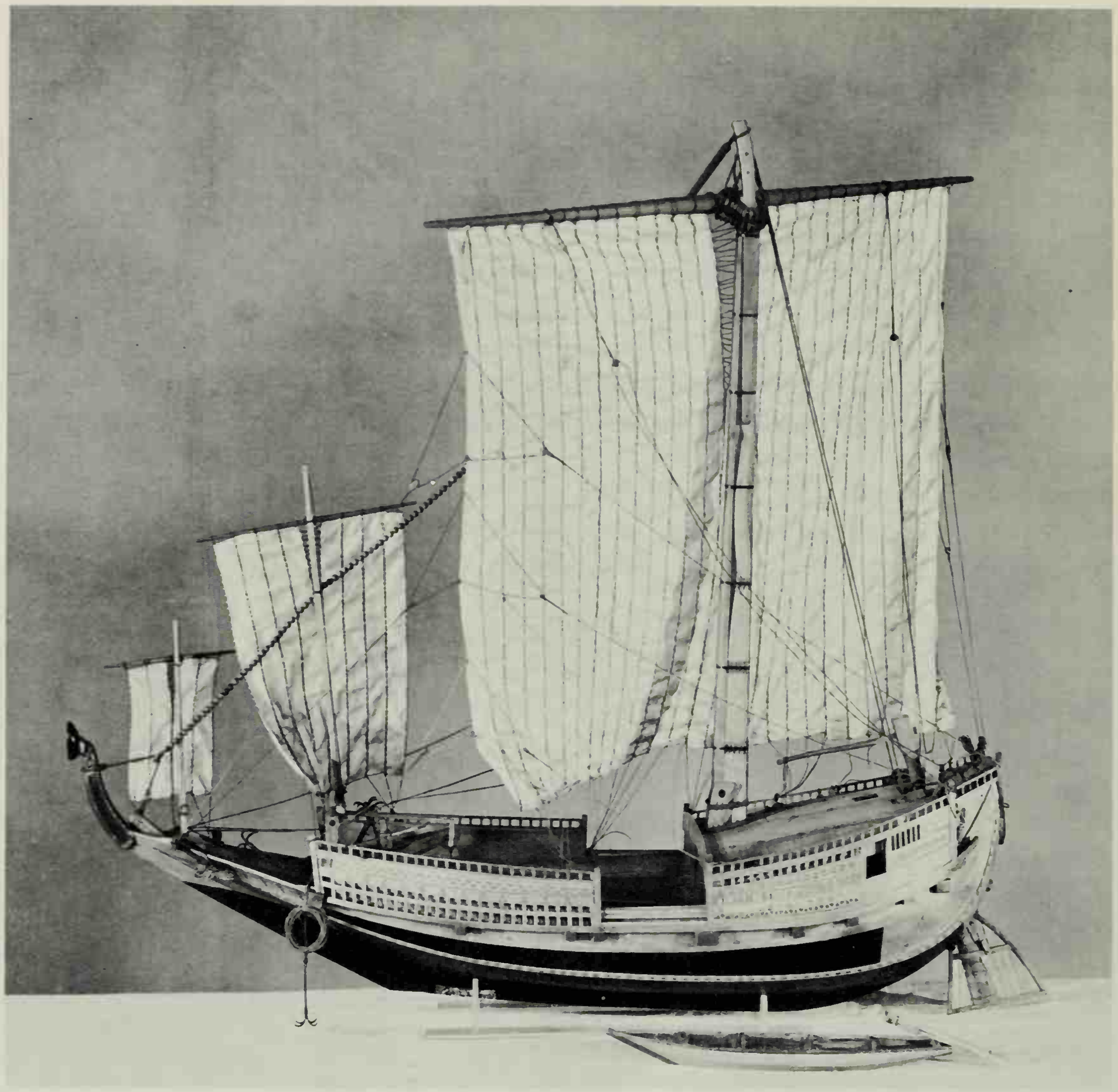


199

198. Modern model of a southern Chinese junk of the type used about Swatow. The sails, made of matting, have a handsome rounded shoulder. The rudder is carried in a slot at the stern, has a windlass for raising and lowering it and, when fully lowered, as here, reaches to a considerable depth.

199. Modern model of a northern Chinese junk, a five-master of the type made in the area of Shantung. Northern junks have a blunt bow, and their sails are square-headed and are taller and have more battens than those of the south.

200



200. Modern model of a large (106′ × 34′ × 10′) Japanese coaster of the early nineteenth century. The tall square sail somewhat resembles those of ancient Egypt (compare illustration 17) and, like them, was probably effective only with a following wind.

Most large junks are three-masted: there is a raking foremast far up in the bows which fulfills the function of a jib; the mainmast, a monster of a pole in a junk of real size, stands a bit forward of amidships; and a mizzen is set on the poop. Sometimes there are two mizzens, one on each quarter; thus one or the other can be raised without blanketing the main. Some northern junks have two masts forward of the mainmast, making a total of five. Originally the sails were all of brown fiber matting, but in the present century canvas has come into use to a certain extent. Like the Arab's feeble, weatherworn canvas, matting has the advantage of providing an automatic safety valve: in a sudden blow it tears instead of pressing the vessel down.

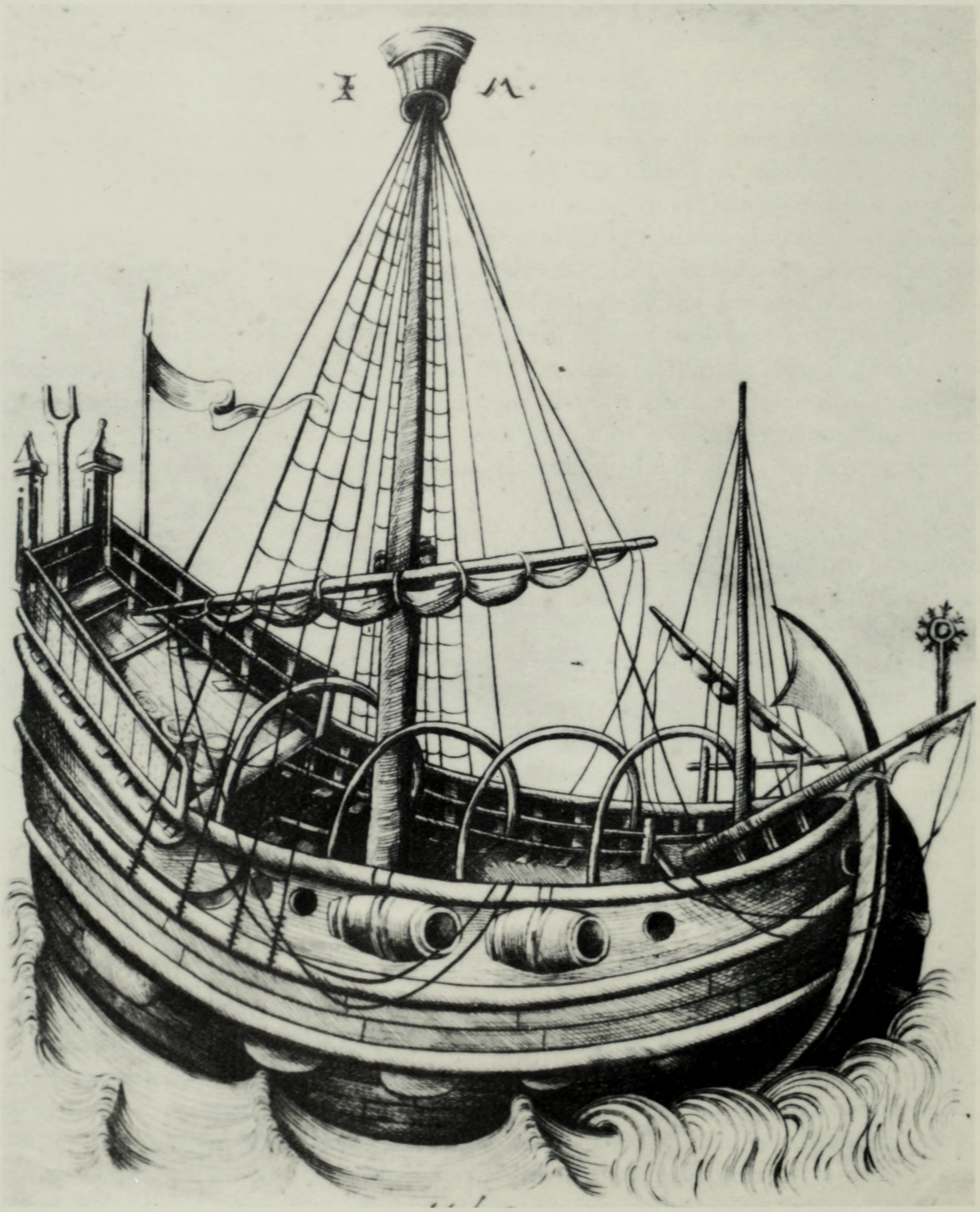
The junk's hull has as many surprises to offer as its rig. The underwater body, well-shaped for the most part, often has a flat area—a great help to a ship aground on the shallows that plague the waters junks must sail in. There is no keel, but this is in part compensated for by the distinctive steering apparatus, one which serves as centerboard as well as rudder. The rudder is mounted in a trunk in the poop or on a slide on the transom and, by means of a windlass, can be dropped to extend well below the hull. Fully lowered, it helps counteract leeway when the vessel is working to windward and, when she is going through shoal waters, it can be conveniently drawn up out of the way.

Though junks come in all sizes, shapes, and varieties, two general families can be distinguished, those from the South China Sea area and those from more northerly waters. The northern members of the family go in for tall, square-headed lugsails with a lot of light battens (sails such as these were very likely the inspiration for the elongated lugs of the Indian ship pictured in the Ajanta cave). The hull has wall-like sides and a blunt bow. The northern junk's lines may not be the world's prettiest, it may be rather slow, it may bang its bow about in a head sea—but the hands working forward don't have to worry about being buried in green water. The southern sister is much smarter-looking. She has a normal form of prow, though in a side view this feature is often hidden behind the wings the Chinese ship-designer sets up on both sides of the stem; the body has fine lines; and the sails are well peaked, carry only four or five battens, and have a handsome rounded shoulder on the leech.

Compare Illustration 244, p. 172

The Japanese, too, for centuries used a form of junk, but one that held none of the surprises of its Chinese relatives. The Japanese junk was a massive, enormously strong vessel with a raking stem, high freeboard amidships, and a lofty poop mounting a rudder of the Chinese type. The rig to move all this was a tall, narrow square sail, helped out, on the largest craft, by one or two handkerchief-sized foresails to make the steering easier. These ships obviously could stand up to any blow, but equally obviously were as unweatherly and slow as any apple-bowed, pot-bellied European merchantman of the pre-clipper era. So they were used almost wholly as coasters; long-distance hauling was left to the Chinese, who had the ships for it.

201



201. A Dutch *buss* of the fifteenth century. Stalwart square-rigged craft such as this were used to fish for herring in the North Sea. This version is a two-master; busses of a century later added a square mizzen on the poop.

CHAPTER TWELVE

On Bay and River

THE *ghayassah* of the Nile carries an elongated lateen, tall enough to reach above the banks and catch the free-flowing breezes there. Boats of Malay are built with particularly fast lines, for the local winds are feeble and variable, and with shallow draft, for bars block the river mouths that serve as ports. Dutch *tjalks* carry an abnormally short gaff; there is thus no danger that, as they glide through the canals, the outboard end may brain an unwary cow or smash a waterside window. So it goes everywhere: in each body of water, sometimes in different areas within the same body, special factors determine the lines and rigs of the boats that use it.

In these days, however, the process is finally coming to a halt. This is the age of the engine, and that noisy and evil-smelling but efficient creation of our times, the motorboat, is impervious to conditions that dictated imperiously to its predecessors. The craft to be described below were, by and large, in use up to the early part of this century; the motorboat has since riddled their ranks, and those left are limited, for the most part, to backward or archconservative areas.

NORTHERN EUROPE

Northern boatmen had started out with the square sail, and for centuries were content to go on using it; it was a good all-around sail for the boisterous breezes and seas they had to contend with. A square sail isn't at its best on the wind, of course, and maneuvering through a harbor mouth or jockeying in narrow waters must at times have given trouble, but apparently never enough to stir the stubborn seaman into making drastic changes. He knew about the lateen—lateeners from the Mediterranean were to be seen in many a northern harbor—but he wisely kept away from that basically fair-weather rig.

Then, about A.D. 1400, after centuries of standing pat, creative activity got under way, most of it in the Netherlands where the easiest—sometimes the only—way to get from place to place was by water. Holland, as elsewhere, had been making do with square sails; her vast fleet of those ancient herring boats called *busses* were all so rigged. But then, soon after 1400 or so, Dutch boatmen had learned about the sprit rig. A century later they had the gaff rig. And, within another century, they had the leg-of-mutton sail, which looks like, if it did not father, the marconi rig that reigns supreme in today's yacht harbors. *Illustration 204, p. 149*

Where did these sails come from? The Mediterranean had known the sprit in ancient times; did it live on and in the fifteenth century eventually make its way to Holland? In the Far East, sails not unlike the leg-of-mutton had been in use for ages (below, p. 208), and Hollanders were in these waters in numbers by the end of the sixteenth century; did some enterprising traveler bring the sail back with him? No one can answer these questions for sure.

202

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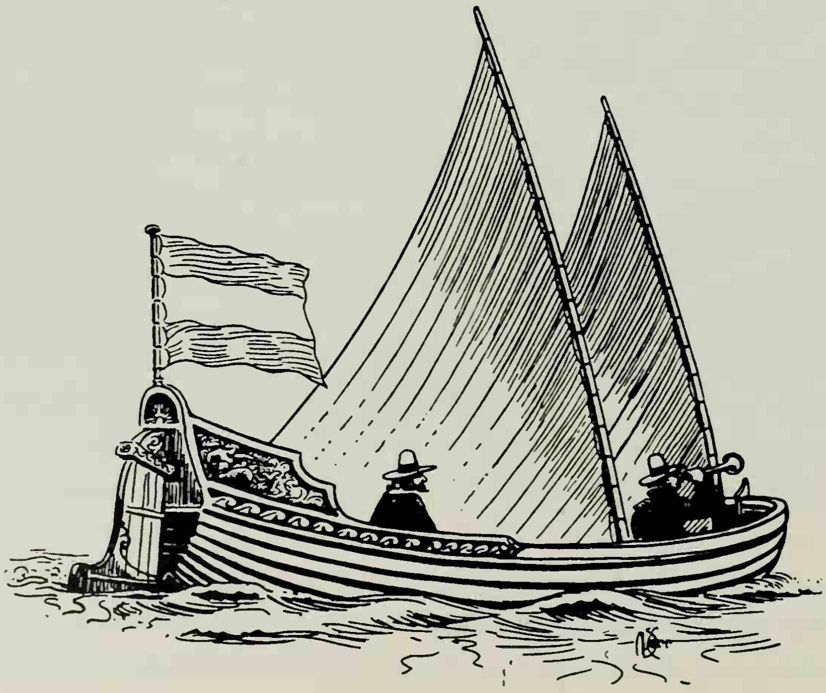


203

202. A Dutch sprit-rigged craft of about 1416, the earliest known example of the rig in the north.

203. Dutch sprit- and gaff-rigged craft of the seventeenth century. In front, an example of the sprit-rig and, behind, of the long-gaffed rig that probably developed from the sprit. In both, the sail has a high peak and is shortened by being brailed to the mast, as in the boat on the right. The long-gaffed vessel, being of fair size, carries a square topsail over the main. Both draw so little water that they can nose far into the shallows. Their broad beams and leeboards at the same time make them amply seaworthy.

204. Color illustration, page 149.

205. An early example (1629) of a Dutch leg-of-mutton sail.

With the gaff-sail we are on somewhat firmer ground. Like the triangular jib, it came into being relatively late, and all the credit for inventing it, so far as we can tell, goes to the Dutch. They devised two types, one with a long gaff and one with a short, and each apparently had a different origin. The long gaff seems to have come from the sprit; it was, in effect, simply a half sprit running from throat to peak instead of from tack to peak. The short gaff, a great convenience for boats working in crowded waterways, seems to have come from the leg-of-mutton. The first leg-of-muttons, laced tightly to a raking mast, were set up to stay put; some ingenious boatman cut the apex off and tied the short head he had created to a mere stick of a gaff which, like the headboard of a modern marconi, provided weight and stiffness, and thereby converted the sail into one that could be easily raised and lowered. *Compare Illustration 297, p. 251*

The Dutch were just as ingenious in designing hulls as sails. The water in and about Holland is shallow; any boats used there had to have very little draft. To compensate, to make them shallow but weatherly, shipwrights gave them those two characteristics we commonly associate with Dutch craft, very broad beam and leeboards. Even larger types, built to sail over open water, such as the Dutch ketch called a galliot, had the same two features.

206

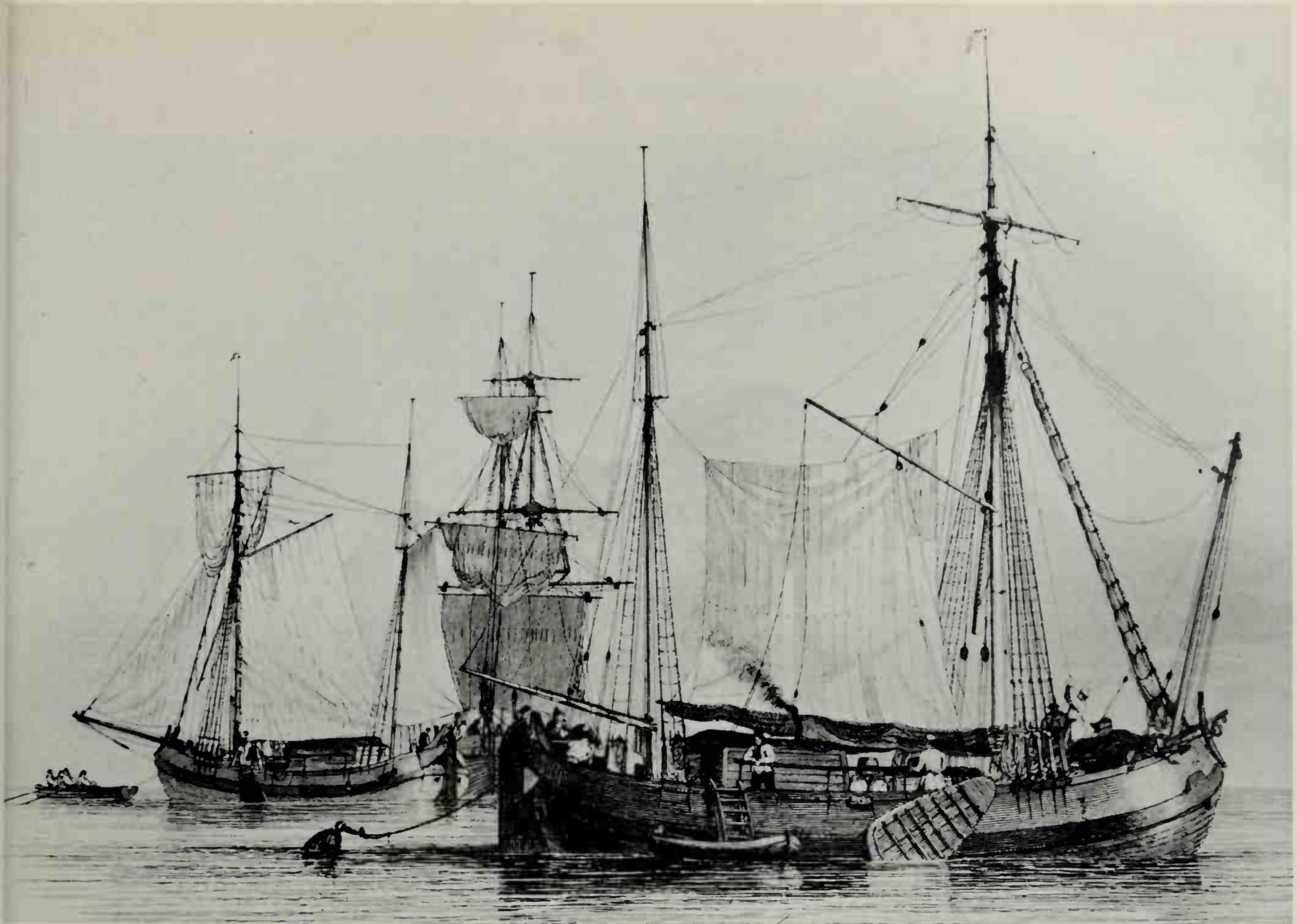
DUTCH CRAFT WITH SHORT GAFFS

207

All these varied improvements did not blush unseen on Holland's canals and bays. Each was swiftly adopted in other quarters, notably Scandinavia, England, and America.

Leeboards and light draft were hardly of interest to the boatmen of Scandinavia, who had neither narrow canals nor shallow bays to worry about. Their main problem was strong winds and dangerous seas, and their solution was sturdy clinker-built double-ended vessels with comfortable beam and draft. They rigged them for the most part with a version of the sprit, which they no doubt borrowed from the Dutch. The southern part of Norway, however, was an exception. The herring and cod fishermen working the coasts here stubbornly stuck to a boat whose lines and rig went back to ancient Viking craft, a narrow and undecked double-ender propelled by a tall square sail when the wind blew from astern and by a dozen or so well-muscled oarsmen when it didn't. Such boats were fast but also terribly wet and terribly delicate to handle. However, with a skilled and strong man at the helm they could, like their forebears, go anywhere and take any blow.

English and Scotch boatmen had a multitude of challenges to meet. They fished the same waters the Scandinavians did so they, too, were looking for safety and dependability. But, while their Scandinavian colleagues had snug fjords to put into, the English in numbers of



208

206. A yacht of the middle of the seventeenth century.

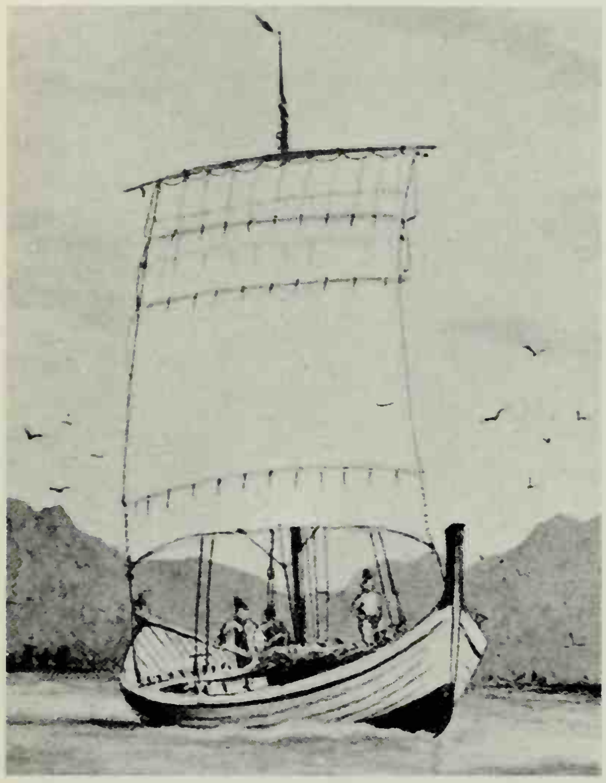
207. Model of a *tjalk* of 1890. The short gaff is frequently curved.

208. A Dutch galliot of the early nineteenth century. Ships of this type carried cargoes from Holland over open water to England and other points in Europe. The one shown here has basically the rig of a modern ketch, to which she has added a square topsail and topgallant. The vessel in the foreground is drying its topsail, and has the jib-boom hauled up. Even these large seagoing vessels, like most other Dutch craft, were built with enormous beam and equipped with leeboards.

places had nothing better than a beach. Moreover Britain, like Holland, had a network of inland waterways, and these had demands of their own to make on the boatwrights.

Where harbors were available, Scotch and English fishermen developed a series of fine, seaworthy boats of all sizes, from modest one-masters to impressive three-masters. In rigging, the designers were partial to the efficient, handy, and dependable dipping lug. The rig's one great disadvantage, that tacking is a slow business since sail and yard must be lowered and reraised on the leeward side of the mast, meant little to the fishermen; they were in no hurry.

Launching from a beach, on the other hand, demands a very special kind of craft. Perhaps the best known of the type is the famous "coble" of the northeast coast of England. The cobles show clearly their Viking ancestry: they are long and lean, are driven by oars as well as sail, and are clinker-built for strength. But the coble has a few wrinkles all its own: there is a deep forefoot to enable the boat to dig in as it leaves the beach and hits the surf; the stern is flat and, like the Chinese junk and for the same reasons, carries a rudder that



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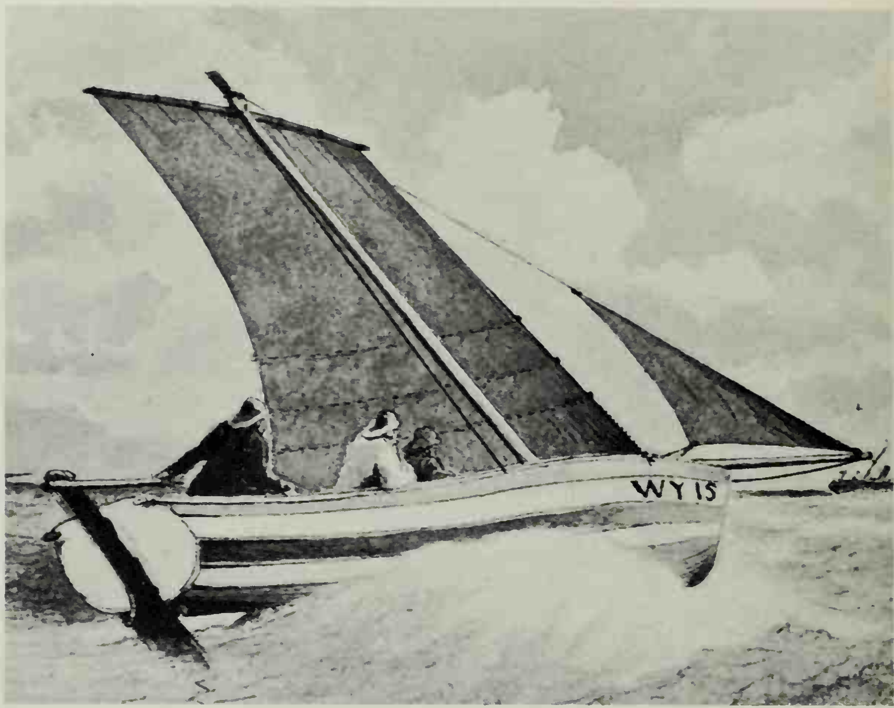

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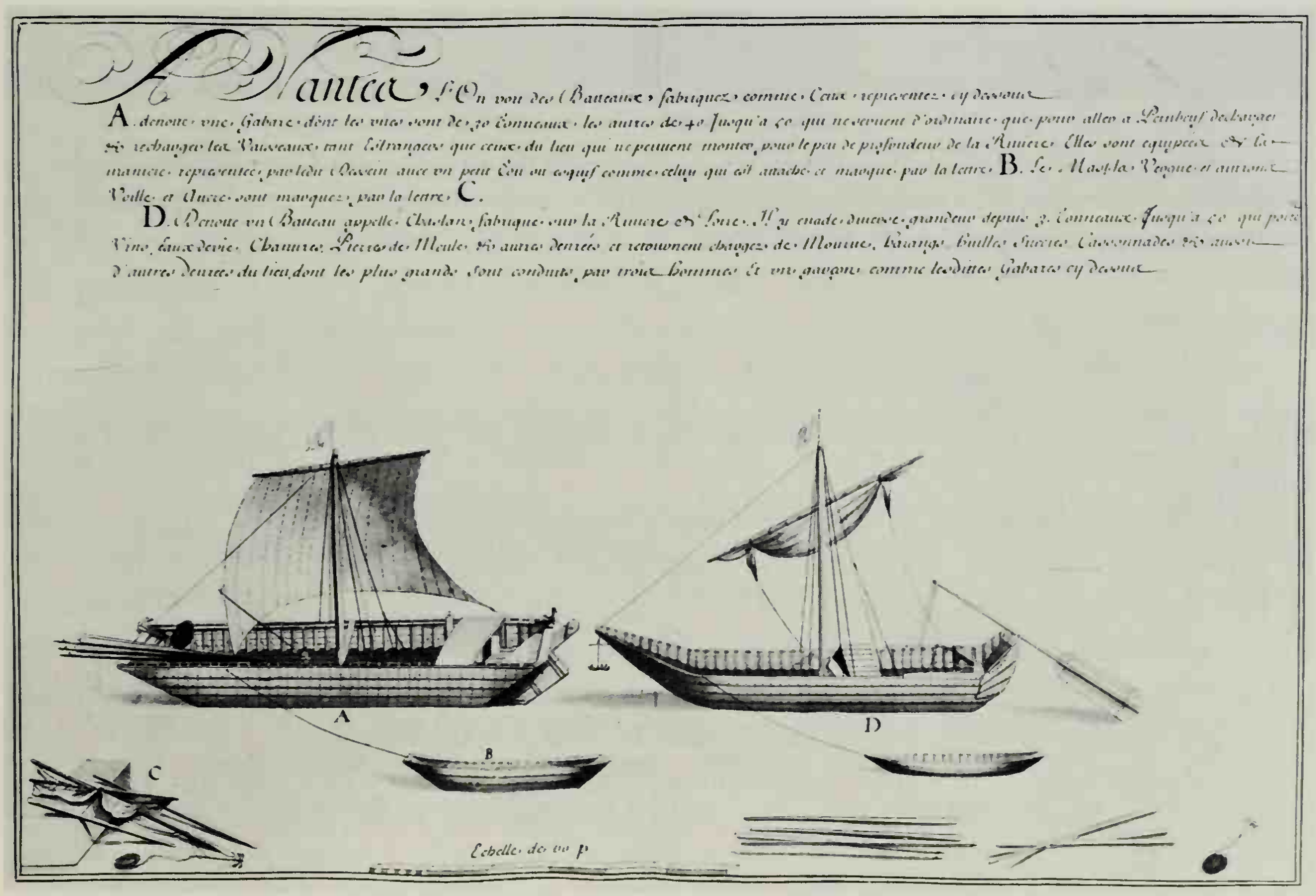
209. A sketch, done at the end of the nineteenth century, of a fishing boat of southern Norway, a direct descendant from the Viking galley.

210. Sketch, done in the late nineteenth century, of a Yorkshire coble.

211. A Hastings lugger taking off from the beach.

212

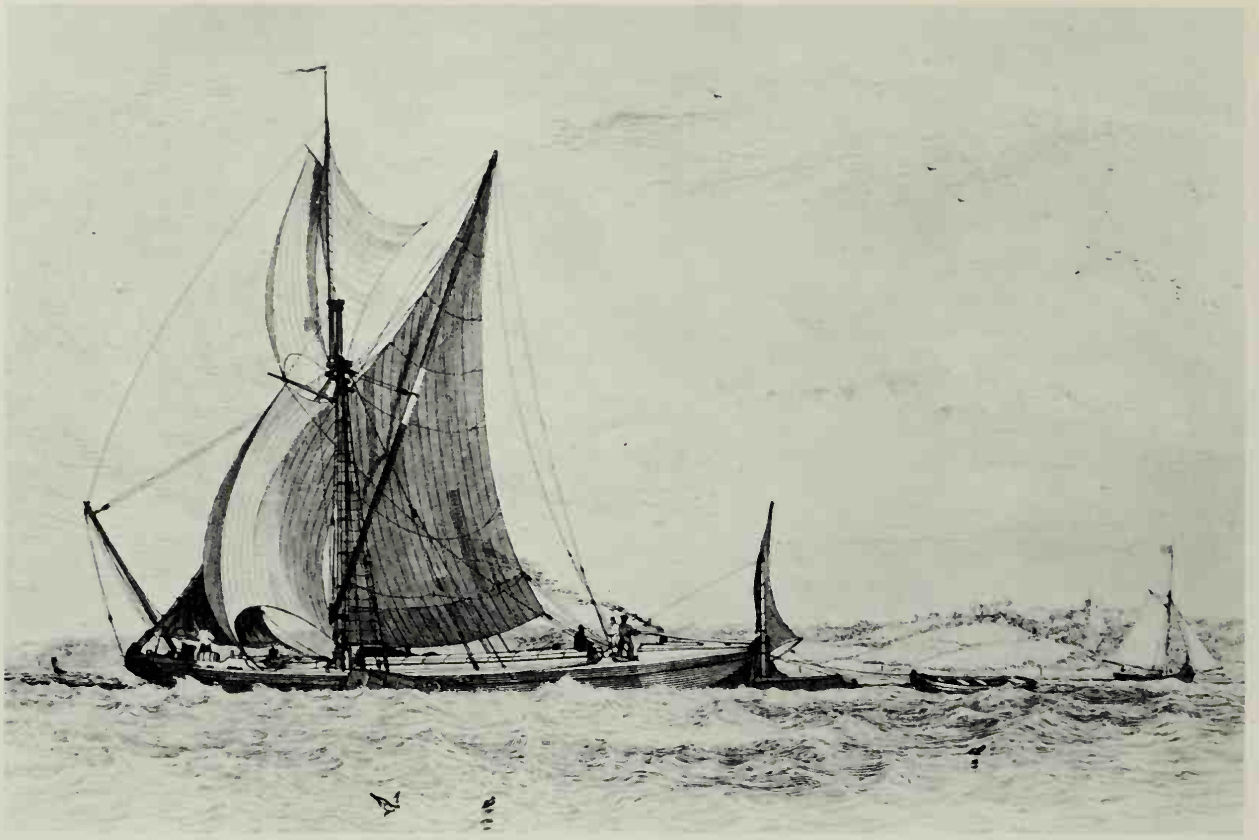


213

212. A Humber keel, photographed in 1905.

213. Boats used on the Loire in the vicinity of Nantes during the seventeenth century. The type on the left was generally of good size, varying from thirty to fifty tons burden; that on the right ran the gamut from tiny craft of three tons to fifty-tonners. The big stern steering oar is found on river craft of all ages, from ancient Egypt to modern India.

214



214. Sketch, done in the early nineteenth century, of a Thames barge. The wind is coming from dead astern, and the vessel is flying along under mizzen, spritsail, a square sail, two topsails (one square, one jib-headed), and forestaysail. At this time these boats commonly stepped the mizzen in the rudderhead.

215. Modern model of a *bisquine,* a three-masted French lugger used during the nineteenth century for fishing off the coast of Normandy. The rather ungraceful equilateral jib was favored all along the coast from northern France to the Mediterranean and in the Mediterranean. Except for the jib, the sails are all standing lugs. All three masts carry topsails, and main and fore carry upper topsails.

reaches well below the hull; and the Vikings' square sail has given way to the handier dipping lug.

The biggest, probably, of England's beach boats were the three-masted luggers favored by the boatmen of Deal, Hastings, and other points on the south coast. The principal job of the Deal luggers was to bring aid to ships seeking shelter in the area. This was no work for a cockleshell: these luggers were powerful craft all of forty feet in length and thirteen in beam; they sat in readiness on the beach, stern seawards and, when the call came, were run down and thrust into the surf—and then hauled up again on their return.

England's rivers can't match Holland's canals for diversity of craft, but they have managed to produce some interesting types all the same. The northeastern streams sired the series of flat-bottomed sailing barges called "keels" to haul coal and other bulky goods. The most impressive were the ones on the Humber, big fellows often sixty feet long and fifteen broad and able to carry seventy to eighty tons of cargo though drawing only five or six feet of water fully loaded. They were propelled by a huge, tall square sail that reveals at a glance its Viking origin; above they carried a square topsail. Square sails apparently appealed to river boatmen; boats on the Loire in France, for example, were also so rigged.

215

One of the most distinctive of all sailing barges was the type used on the lower reaches of the Thames. These were commodious craft, obviously of Dutch descent, which could run to one hundred feet in length; the rig was made up of an enormous spritsail plus topsails, jib, staysails, and a sprit mizzen that was originally stepped in the rudderhead. "Drawing about 14 feet with their leeboards down when loaded, and able to float in two feet of water when light, these vessels are without exception the handiest cargo carriers in the world. They are fast to windward, quick in stays, and handy in every point of sailing in any wind. With a crew consisting only of a man and a boy, you may meet them with all their rigging lowered on deck, at Hampton Court, or making their way, with sweeps out, through the London bridges; with mast on end and the vane fluttering 70 feet above your head, among the fields of Kent, or working under topsail up a placid creek not wider than your drawing room; with close-cropped canvas slashing around Dungeness in half a gale of wind or rolling up mid-Channel merrily."[1]

Across the Channel, the lug rig outstripped all others by a wide margin. The boatmen of France's northern shores worked out their own pet version, a standing lug—the type, hung with one-third of its surface forward of the mast, that conveniently stays on the same side of the mast no matter what tack the craft is on—with tall, distinctively square-headed sails. Most of their luggers have been three-masters, with a foremast well up in the bows, mainmast amidships, and mizzen aft. All three at times carry lug topsails, and fore and main can have even lug upper topsails.

[1] H. Warington Smyth, *Mast and Sail in Europe and Asia,* second edition (London: William Blackwood & Sons, 1929), pp. 170–71 (written in 1906).

AMERICA

The boatmen and fishermen of colonial America began, naturally enough, with imports from Europe, chiefly common English and Dutch craft (the latter probably by way of England for the most part). Gradually they altered the hulls to meet the new conditions (one of the commonest changes was to replace the leeboards of the European versions with centerboards, widely used in America from the early nineteenth century on), and fixed upon certain rigs, which they then proceeded to adapt as they saw fit. For some reason the lug, that favorite sail of western Europe, never caught on, and neither did the Mediterranean's beloved lateen (below, p. 194). Probably the most widely used rig on small boats was one that has by now practically disappeared from American waters—the sprit; it isn't particularly handsome, and when, toward the end of the last century, interest in yachting began to add a bit more tone to sailboats in general, it more or less bowed out in favor of the gaff. But until then it was the preferred sail for smaller working boats: the sprit is not only simple and efficient, but its mast is able to stand without elaborate staying, and this meant a lot to hard-fisted oystermen and fishermen glad to save a few pennies wherever they could. Since a spritsail is easily stepped and unstepped, it was particularly useful on craft designed to be either rowed or sailed. The whaleboats of America's whalers, after carrying on their celebrated chases under oars, came back under spritsails. Spritsails drove the rugged fishing dories that worked off New England's coasts, the skiffs that scurried about New York Harbor, the slightly built scows that nosed about New Jersey's marshes.

Illustration 216. p. 152

Two areas, Chesapeake Bay and Long Island Sound, went in for the triangular leg-of-mutton. This sail had come into use in Holland some time around 1600 (above, p. 181), and may have made its way to the New World via England and Bermuda, since it was widely used by yachtsmen of the island from the late seventeenth century on. A special version of the leg-of-mutton was worked out for the sharpies, that unique class of boats created by the oystermen who tonged the banks off New Haven in the eastern end of Long Island Sound. The sharpie, whose hull resembled a narrow flat-bottomed skiff slit along the center to take a long centerboard, was fitted with two masts, the foremast somewhat taller than the aftermast, and on each hung a leg-of-mutton so cut that the tack was a good deal lower than the clew. Each sail was spread by a short sprit which ran more or less horizontally from the clew to the mast. The masts—and this was probably the sharpie's most curious feature—were not fixed in their steps; they pivoted. In order to trim the sail as flat as possible, the sprit was set so hard it wouldn't turn—so the mast did the turning instead.

In Chesapeake Bay the leg-of-mutton was used on the renowned bugeyes and the other fast, slender craft that the bay boatmen developed out of the dugout canoes they found in use among the local Indians. At first little more was done than to convert these dugouts into sailing canoes by adding a rig similar to the sharpie's, a leg-of-mutton with a horizontal sprit. When bigger boats came to be needed and big logs grew scarcer, boatwrights learned to put together three logs to make a hull: one would be hewed and adzed to form the keel and garboards as it were, and the other two to form the bilges and topsides; this construction had the advantage, among others, of leaving only two seams to be caulked, one on each flank where the side logs were doweled into the center one. The bugeye, which is probably the best known of the Chesapeake dugout's sophisticated daughters, seems

216A

SPRIT-RIGGED CRAFT OF AMERICA

216. Color illustration, page 152.

216A. The "sharpie" sprit. The scene is Nevada's Truckee River—a queer place for a New Haven sharpie to be. In 1867 the War Department sent a surveying party out West and *Nettie* was shipped out for use on the rivers. This rare old photograph was taken by the party's photographer, T. H. O'Sullivan, a gifted associate of the renowned Mathew Brady.

to have come into being just after the Civil War. Originally it was made of three logs but, as it grew in size, the two on the sides were replaced by frames and planking. And, in place of its original rig, it was given the one that was to become its hallmark: two strongly raking masts, the foremast generally slightly the taller and both usually set up without shrouds, carrying a jib and two leg-of-mutton sails, each made fast along the bottom to a boom. Like the sharpie, the bugeye and its relatives were originally intended for tonging oysters in the shallow waters of the bay, and their simple, handy rig and fast hull with its scant draft made them ideal for the purpose.

American sloops, like their ancestors across the ocean, were originally mostly gaff-rigged. But American ingenuity was responsible for some innovations that have become standard today. In 1892 a handy little sloop was designed without a bowsprit to "knock about" within Massachusetts Bay. Nowadays bowsprit-less craft—knockabout yawls, schooners, and so on, as well as sloops—can be seen in any yacht harbor. American designers quite likely developed at the beginning of this century the rig that is now standard

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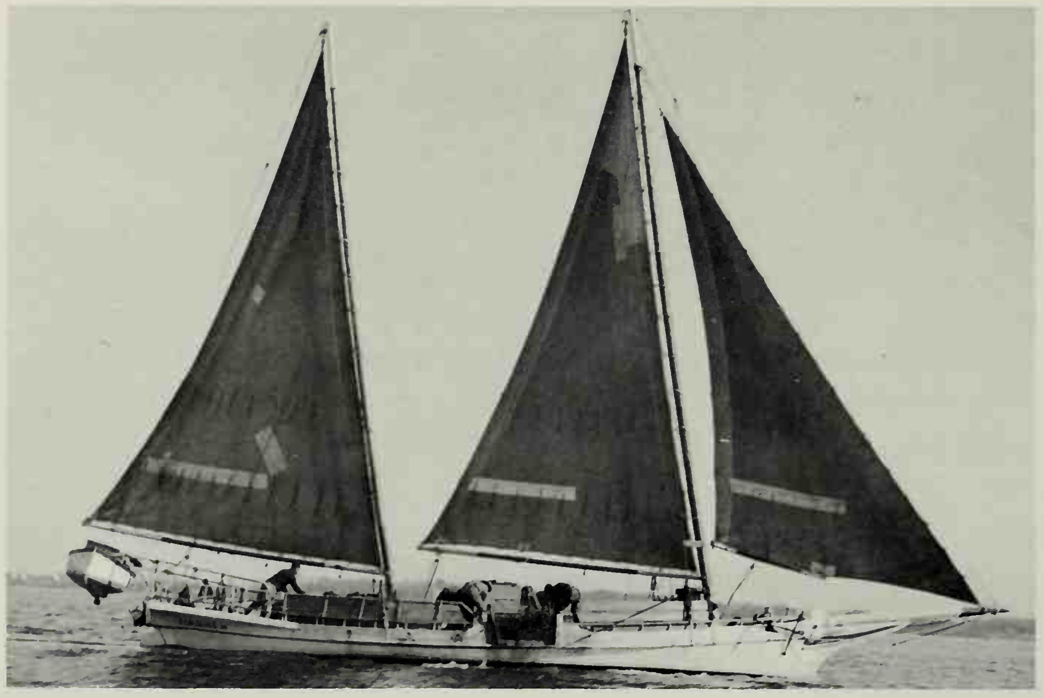

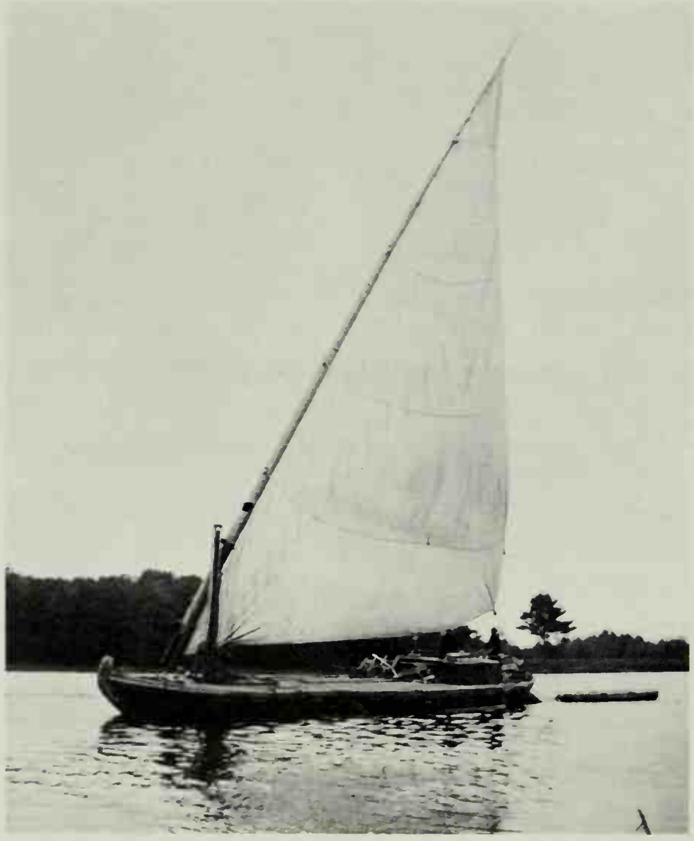

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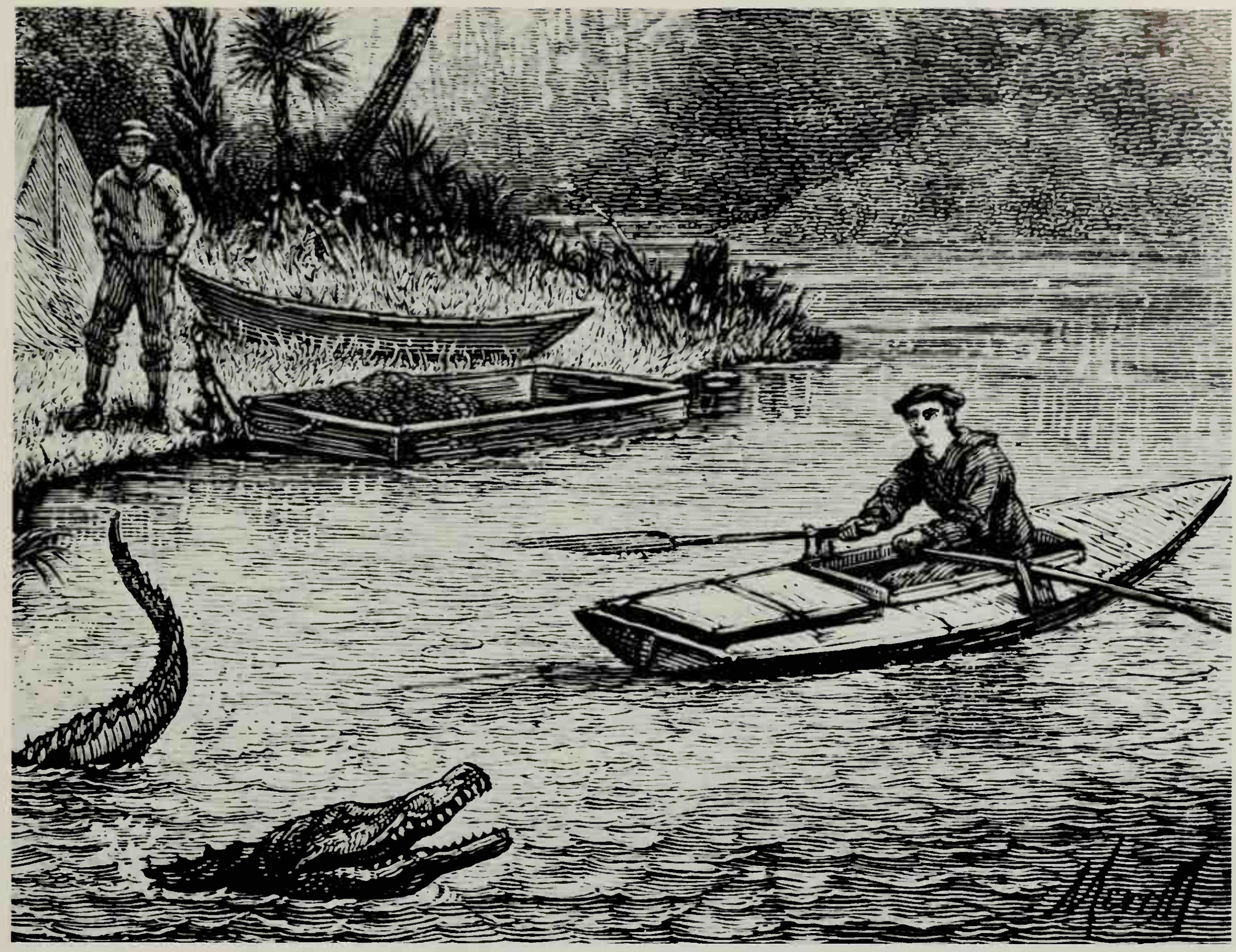
217. A Chesapeake Bay bugeye, *Clarence and Eva,* at work dredging oysters off Rock Hall, Maryland; photograph taken in 1939.

218. *Roaring Bessie,* an exact replica (except for carvel instead of lapstrake planking) of a Block Island cowhorn, photographed in 1911.

219. A gundalow photographed about 1900 on the Squamscot River, New Hampshire.



220

220. A Barnegat sneakbox. An illustration from a book published in 1894 by a travel writer who found a sneakbox just the thing for a trip down the Mississippi and into the southern swamps.

for sportmen's sailboats, the marconi rig (its lofty mast and elaborate wire stays were reminiscent of Guglielmo Marconi's radio towers, which were newly dotting the landscape in those days). The craft that some yachtsmen prefer to the sloop, the broad-beamed catboat with its single sail, must also be credited to America. Its origins are somewhat obscure, but it seems to have developed out of the sloop rig sometime around 1850 and somewhere between Cape Cod and the eastern part of Long Island Sound. The Cape Cod type has become one of the most popular, a roomy yet simple craft that is sturdy enough to go out in fairly heavy weather.

One American gaff-rigged type that remained amazingly constant was the cowhorn of Block Island. Built for fishing in any kind of weather in the open waters about Block Island, it had to be safe yet easy to handle. The rig that did the job, two unstayed masts carrying tall sails with a very short gaff, is almost identical with the rig of its Dutch forefather of the seventeenth century.

Compare Illustrations 206, p. 184; 297, p. 251

America's deep rivers and roomy lakes didn't require the range of special craft that Holland's or England's did. Every now and then, however, a stream posed a particular problem which boatwrights had to meet. This was how the famous "gundalows" of New Hampshire's Piscataqua got their unique rig. These big single-leeboard scows were given a leg-of-mutton which, because of the way it was set, looked for all the world like a lateen.

It was a large triangular sail laced to a very long yard, which was hoisted on a very short mast; the Piscataqua, as it happens, was spanned by a number of low bridges and, with this rig, boatmen did not have to go to the trouble of unstepping the mast to get by—all they had to do was dip the big yard (which was fitted with a counterweight at the heel to make the dipping easier).

A varied group of specialized craft did come into being for use on the shallow bays and marshes and creeks that are so common along the Eastern seaboard. New Jersey, for example, where such waters abound, was the home of a complete series of scows of various sizes, the New Jersey garveys, which ran from eighteen-footers made to be rowed or poled on creeks or marshes to thirty-footers fitted with one or two spritsails for sailing on shallow bays. The best known of New Jersey's shallow-draft boats, however, is the famed Barnegat sneakbox, the light, handy, spoon-shaped little craft developed for use as a gunning skiff in the Barnegat area.

THE MEDITERRANEAN

Placida pellacia ponti—"the smiling sea that seduces"—so the Roman poet Lucretius characterized the ways of the Mediterranean, and with truth. That womanish body of water will lead a boatman on with clear skies and bright smiling ripples and then turn on him with a tigerish squall. So his craft, though basically designed for her prevailing good humors, must be equipped to cope with her tantrums. Long ago he decided that the lateen was the most useful sail for his purpose. The type he came to prefer was not the four-sided shape the Arabs went in for but the triangular, and—again unlike the Arabs—he left it always on one side of the mast, not bothering to shift it over at every tack.

Illustration 221, p. 152

You meet the lateen rig and the sleek, graceful Mediterranean hull, always carvel-built, even before entering the Strait of Gibraltar, for the coasters off Portugal and southern Spain carry lateens, and their hulls are more or less an enlarged version of the most widely used Mediterranean small-boat hull. The Portuguese *muletas,* which work trawl nets at the mouth of the Tagus, set a bewildering assortment of sails to control the rate and direction of their drift, but their basic driver is a big lateen.

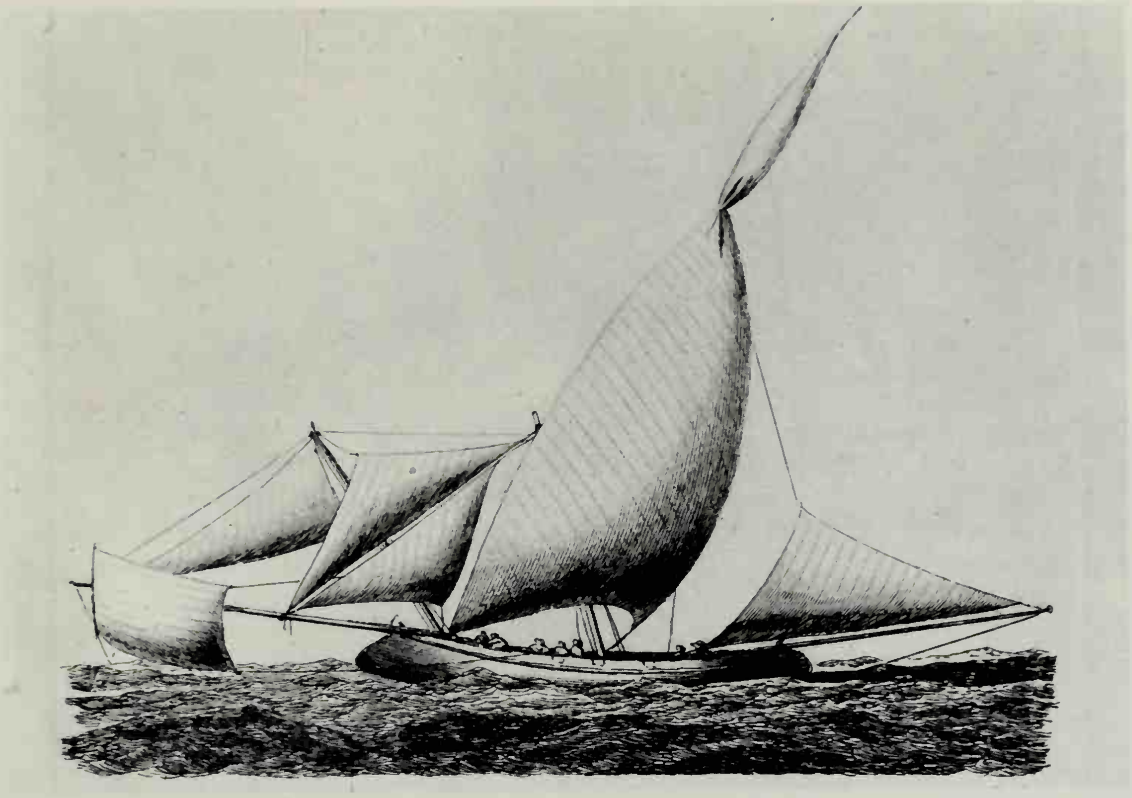
Inside the straits, from Alicante to Alexandria, the standard workaday skiff is the *barquette,* a pleasingly shaped little fellow propelled by sails or oars or both. Today it has a characteristic straight stem and stern, a feature that may be fairly recent, since Mediterranean skiffs of earlier days had raking or rounded extremities.

Illustration 223, p. 153

Illustration 225, p. 153

In the western part of the sea, the typical coaster was for centuries the picturesque *tartane.* The tartane's hull is particularly handsome with its raking rounded stern, its graceful curves, and its clipper bow prolonged to end in a saberlike ram. In its palmy days during the seventeenth and eighteenth centuries, the tartane carried as many as three lateens but, as the years passed, it grew smaller and smaller, until its final versions were chiefly one-masted affairs, the big lateen helped out as in modern northern rigs by a triangular jib and forestaysails.

Eastward of the narrow stretch of water between Sicily and Tunisia, the lateen hasn't ruled as autocratically as it has westward. In the Adriatic, for example, it has had to abdicate in favor of the lugsail. The Italian lug, found from Venice down to Brindisi, is not the



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224

221. Color illustration, page 152.

222. A Portuguese *muleta* of the late eighteenth century. The purpose of all the extra sails is to provide precise control over the direction and rate of movement as the vessel trawls. The basic driver is the big lateen.

223. Color illustration, page 153.

224. Italian fishing boats of the late fourteenth century.

225. Color illustration, page 153.

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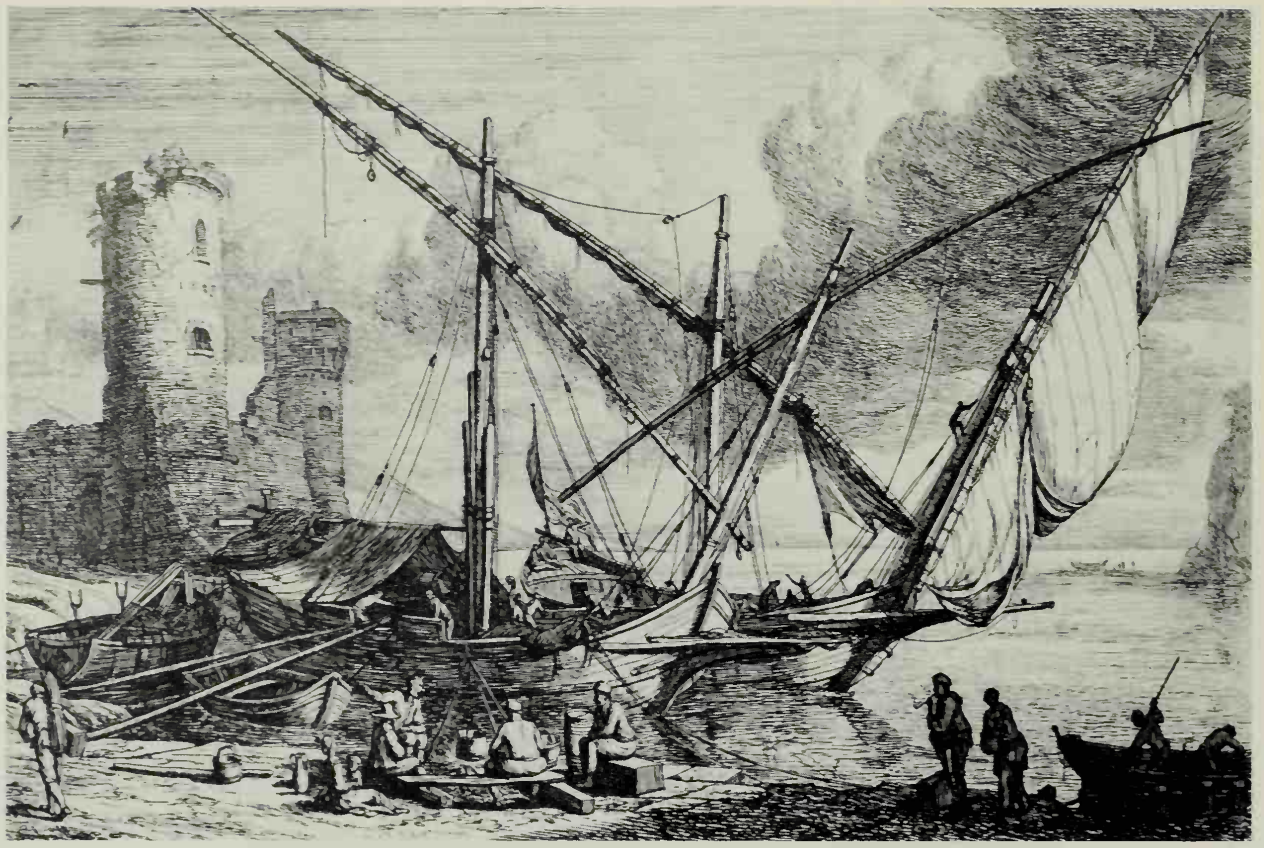

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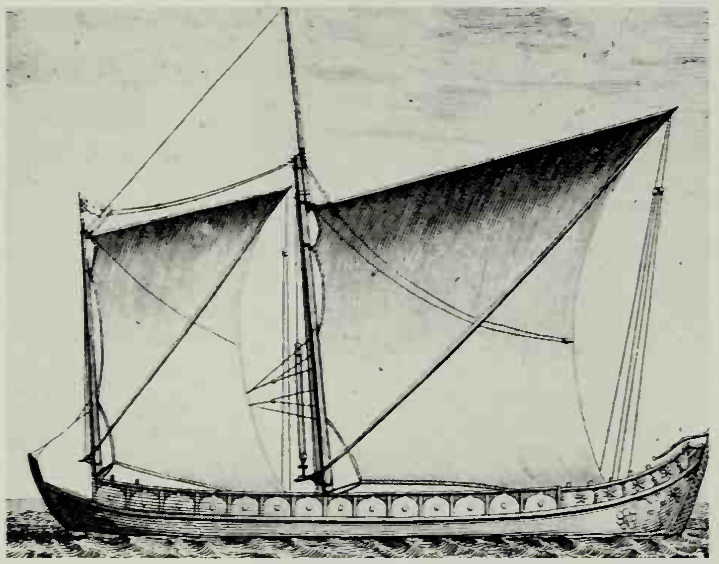


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226. *Tartanes* of the eighteenth century. Both have two masts. The foremast is stepped well up in the bows and rakes forward while the main, somewhat forward of amidships, is perfectly vertical. The prow ends in a long spur—perhaps a reminiscence of galley prows—stiffened by lateral knees.

227. Color illustration, page 164.

228. A small one-masted *trabaccolo,* a type still found along the coast of Yugoslavia. The snub nose, hawseholes made up to look like eyes, and rudder sticking high up over the stern are the hallmark of the *trabaccolo.*

229–231. Color illustrations, pages 164–165.

232. A Turkish sprit-rigged craft of the seventeenth century. The sails of this craft are not peaked up in the way the Dutch favored but are low and square-headed, very much like the spritsails used in this same area fifteen hundred years earlier (see illustrations 71 and 72).

233. Modern model of a Turkish sprit-rigged craft of the nineteenth century. The rig consists of spritsail, square topsail and jib. The canvas strakes raising the waist are common in the area.

228

dipping or standing lug of the north but a balance lug. Balance lugs, like standing lugs, are hung with a good third of the surface forward of the mast and are kept on the same side of the mast on all tacks but, unlike them, are laced along the bottom to a boom instead of being loose-footed. The biggest of the Adriatic luggers is the *trabaccolo,* a sturdy, beamy vessel with a distinctive bashed-in prow and hawseholes made to look like eyes, while the handsomest surely is the *bragozzo,* the flat-bottomed cigar-shaped boats used on Venice's shallow lagoons; its sails are often gorgeously colored.

Illustration 227, p. 164

Illustration 229, p. 164

But the Adriatic's best-known craft carry no sails at all—the gondolas, the slender skiffs that are Venice's carriages, cars, and trucks. There are luxuriously appointed gondolas —Cadillacs and Lincolns, as it were—to tempt well-heeled tourists, there are plain and shabby ones to ferry Venetian workmen and shoppers, and there are oversize plebeian ones to serve as the city's light trucks. Alas, after so long a life, the gondola faces an uncertain future. Its design and make is traditional and it has always been turned out by a select group of artisans who alone knew its special secrets. Now the breed is dying out, for today's young Venetian male isn't interested in taking on the long and exacting apprenticeship required. Probably some shrewd enterpreneur will come to the rescue by making a mold from a surviving specimen and producing overnight a whole fleet of perfect

Illustration 230, p. 165

and indestructible fiber glass gondolas (and no doubt install loudspeakers playing equally perfect canned renditions of the indispensable Venetian love songs).

Illustration 231, p. 165

Compare Illustrations 71, 72, p. 54

In the easternmost part of the Mediterranean, Greek and Turkish sailors share their Adriatic brethren's fondness for the balance lug. But not exclusively: the ubiquitous *caïques,* as the familiar round-sterned, high-bowed coasters of the area are called, are often given a sprit rig, particularly among the Turks. As it happens, the first known examples of the spritsail come from the region of the Bosporus, and their shape shows an amazing similarity to the earliest known type used by Turks, dating from the late seventeenth century. It may be that the rig never died out in the area, that the Turkish boatman is merely the last of a long line of users. It is certainly one of his favorites, for he has worked out a whole series of variations upon it.

THE NEAR AND FAR EAST

Beyond the eastern Mediterranean, the lateen again asserts its authority, and its rule reaches from the Nile to India. Along the west coast of India and the east coast of Africa, in the Red Sea, in the Persian Gulf, the boats that scurry about the harbors or nose along the shores are, by and large, small-size versions of the dhow and carry the four-sided lateen characteristic of the dhow.

Illustration 234, pp. 168–69

On the Nile, sailing conditions fashioned some of its craft, and historical tradition others. The Nile is most kind to its boatmen. Its prevailing wind blows against the current; they can drift downstream and, when it's time to go back, raise sail and be pushed upstream by the wind. Since the banks are high, over the centuries the Nile boatmen have developed their own special lateen, one tall enough to poke its peak into the more dependable breezes higher up. Almost all craft sailing the lower reaches carry it, from the humble, hard-working *ghayassahs* that patiently haul freight to the lordly *dahabiyehs* or houseboats that impatiently haul millionaires. And all craft, too, are equipped with elephantine rudders to give them good leverage against the strong current.

Compare Illustration 17, p. 20

Farther up the Nile, beyond the second cataract, history has asserted itself. Here a fossil lives on, the *nuggar,* a direct descendant of the river boats of ancient Egypt. Its hull is made exactly as Herodotus describes (above, p. 21) the making of hulls in the days of the pharaohs, of short, uneven lengths of wood (nothing better was available in treeless Egypt) nailed one to the other to form a skin strong enough to hold together without a skeleton of keel and ribs. Its rig, however, has been brought up to date: it now carries a lateen, like the other craft on the river. But the mast is supported by a welter of stays, just the way masts were on the boats that sailed the Nile in ancient times.

For better than five thousand years the Nile has been the scene of an active, varied, waterborne traffic. But farther eastward, there are a number of rivers that can match it, if not in years, then in variety and volume of traffic. The Ganges, the Irrawaddy, the Mekong, the Yangtze, and so on, like Egypt's vital stream, are the easiest and quickest line of communication in their respective regions, and their waters have borne boats since the days men first settled near their banks.

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234, 234A. Color illustrations, pages 168–169.

235, 236. The *nuggar,* a type native to the upper Nile. The hull is made up, in ancient Egyptian fashion, of short lengths of wood nailed to each other and not to frames. Today's nuggars are much fatter than their ancestors: their length runs only about 2½ times their width. They come all sizes; the largest are about sixty feet long and twenty-five feet wide.

237. A ceremonial barge of the sixteenth century on the Ganges. The square sail of the large vessel is characteristic; such sails are found on the Ganges today. The hulls are made, in the traditional Arab and Persian fashion, of planks sewn together.

On India's mighty Ganges, for example, you can see the spectrum of river craft: tiny water taxis, medium-sized fishing boats, impressive passenger vessels, lumbering cargo carriers, and so on. The most numerous are the slender and graceful *dinghis,* which range from little skiffs to largish passenger and fishing vessels thirty or forty feet long. In the one-man *dinghi* the stern is lower than the bow; in all others it is higher, and from this lofty vantage point the helmsman, wielding a long steering sweep, easily cons his craft through the heavy traffic while from the low bows the rowers easily operate their oars. *Dinghis* offer passengers little beyond the shelter of an arched, mat-covered cabin amidships; so, for longer journeys, a bigger vessel has been evolved, the *badjra.* These, running thirty to fifty feet long and eight to sixteen broad, boast a substantial cabin, of mat over bamboo frames in boats for the steerage trade, of wood with elaborate appointments inside in boats for the luxury

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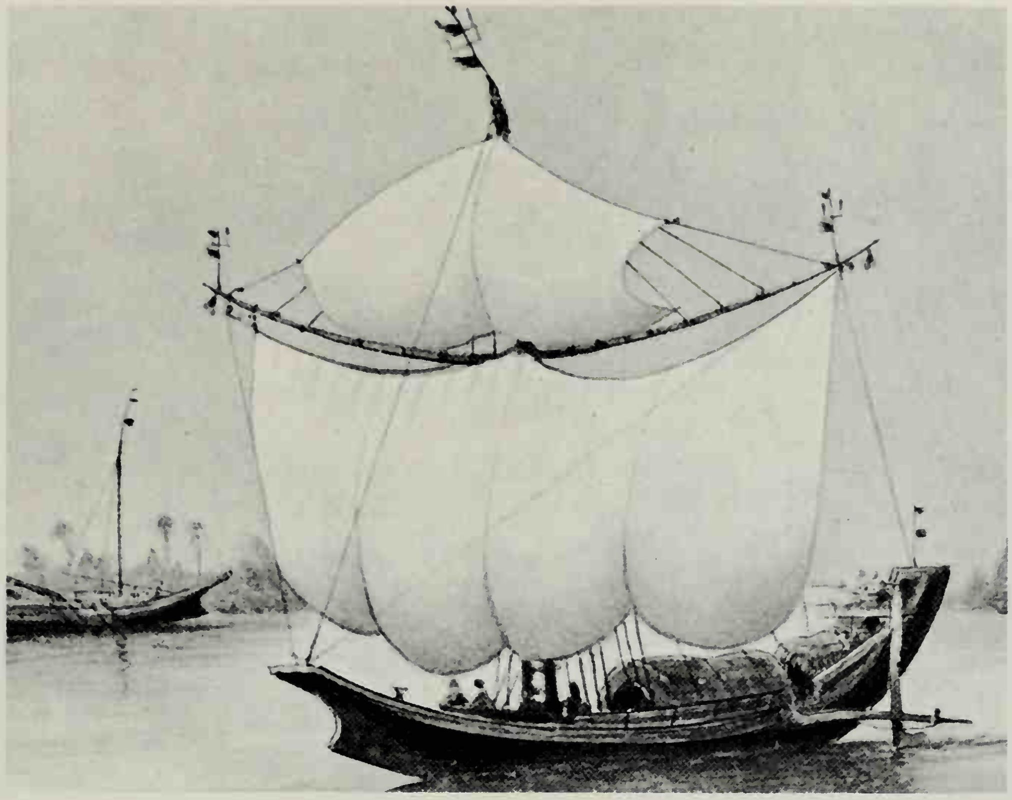
238. Sketch, done in the early nineteenth century, of *patelas* and a *dinghi* on the Ganges. The dinghi is the gondola of the river. The *patelas*, a common type of cargo carrier used on the river are, like a number of other inland Asian craft, clinker-built.

239. Sketch, done in the early nineteenth century, of a big *patela* of Calcutta. This type has a distinctive rudder: it is triangular in shape and is balanced, i.e., has at least a third of its surface forward of the rudder post.



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BURMESE RIVER CRAFT

240, 241. A sketch and modern model of the traditional craft used to bring rice down Burma's Irrawaddy. These boats seem to have stepped out of the ancient world: the tripod mast, upcurved yard, and broad square sail are reminiscent of the Egypt of the pharaohs; the outrigger platform, helmsman's throne, and quarter rudder are reminiscent of Greek galleys. The river sketch was made in the late nineteenth century.

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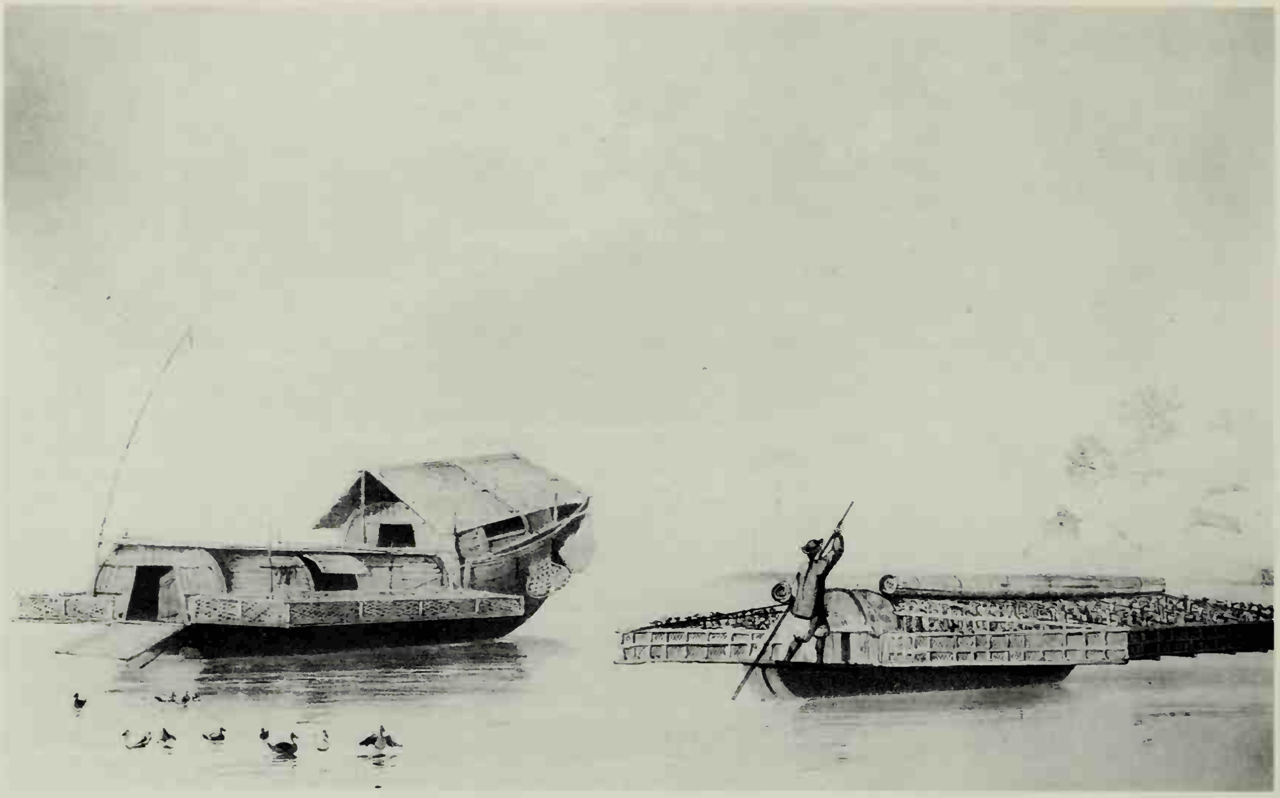

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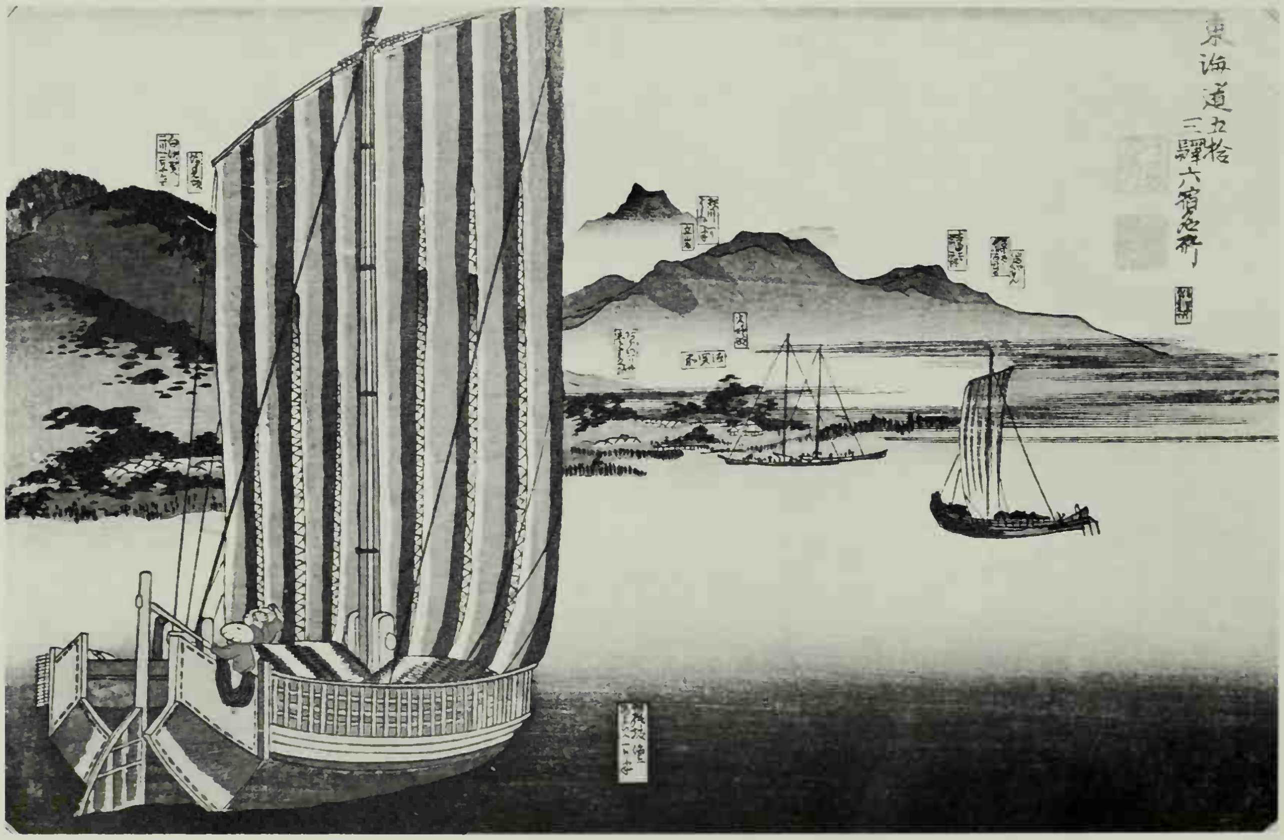


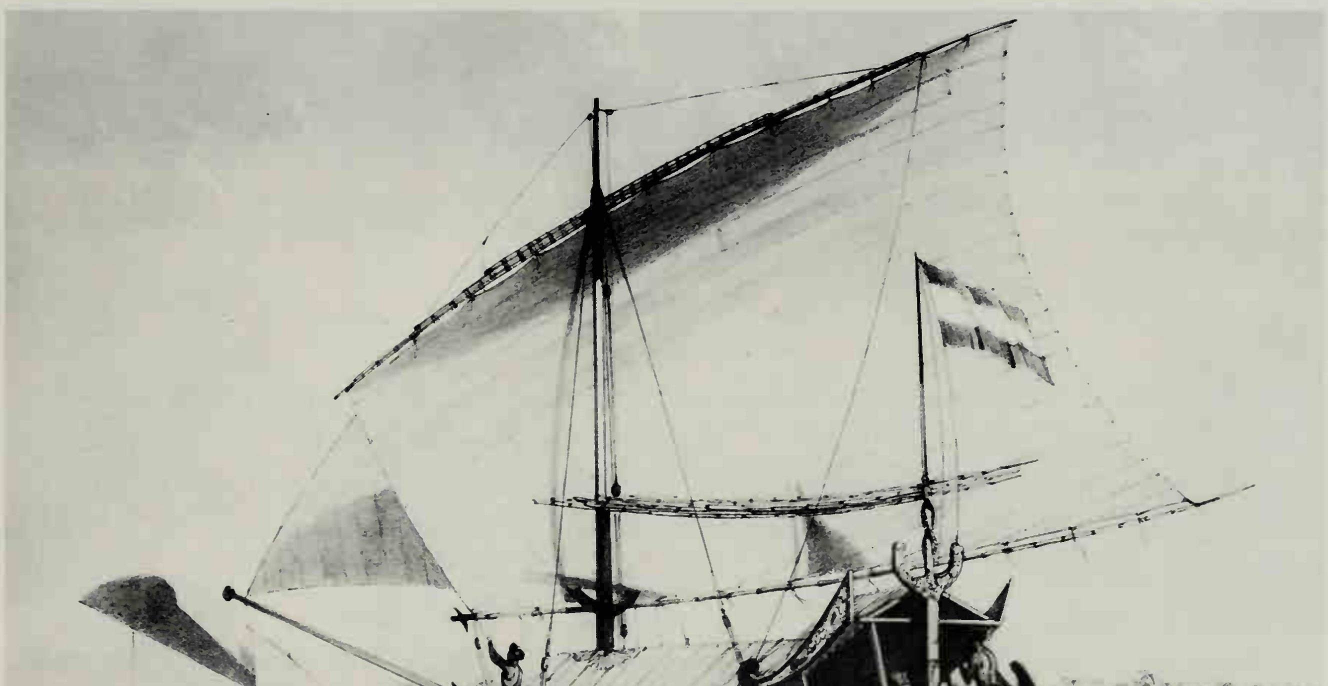
242. Color illustration, page 169.

243. A Cantonese waterborne duck farm of the early nineteenth century. The hull serves as living quarters for the farmer and his family, and the wings as the duck pens. The bow, as on the landing craft used in World War II, opens to form a ramp.

244. Color illustration, page 172.

245. Japanese passenger ferries. The hulls are of sewn planks, and the rig the traditional tall square sail.

246



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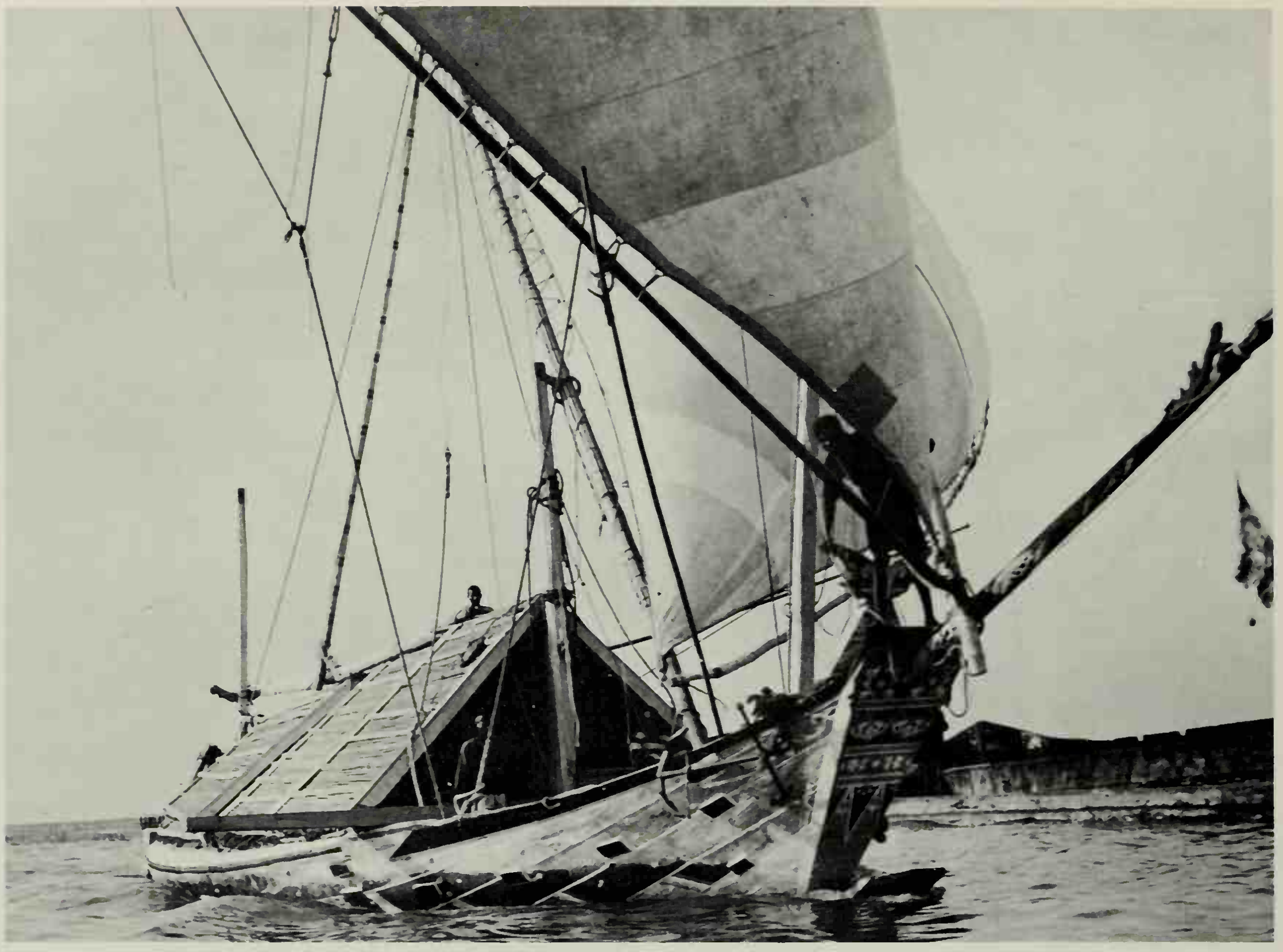
246. A Japanese beach boat of the nineteenth century. The craft is heading for shore, and rowers and helmsman are working manfully to bring its head to port in order to cut through the surf. The sails and cabin top are of matting.

247. A Malay coaster of the nineteenth century. These vessels are small, rarely going beyond fifty or sixty feet in length. They are steered by the centuries-old quarter rudder and carry the traditional Indonesian balance lug.

248



248. A Javanese *prau* under sail. The bamboo pole standing behind the cabin reaches up to the main yard and serves as a prop for it.

trade. A platform of bamboo poles is mounted over the cabin, and from here the helmsman maneuvers his steering oar and the crew poles when punting is in order. A mast amidships carries a square mainsail and topsail. The large cargo boats have the cabin, work platform, and square sail of the passenger carriers but differ in certain other respects. The *patelas* of Benares, for example, have overlapping strakes giving them a clinker-built appearance and, instead of a steering oar, a curious triangular rudder as big as a junk's.

Perhaps the strangest river craft to be found anywhere are the boats that bring rice down Burma's Irrawaddy. When the wind is foul, the crews punt or row, working poles or sweeps from an outrigger much like that on an Athenian trireme (above, p. 32). When the wind is fair, they raise a billowing square sail that, with its curious upcurved yard, looks as if it came from some craft of ancient Egypt. The poop is lavishly embellished with fine carving, almost a match for the stern of a French galley in magnificence. And the helmsman, like an ancient Greek skipper, sits in a thronelike chair and wields a mighty steering oar slung on the quarter.

Compare Illustration 22, p. 23

Illustration 242, p. 169

In China the water is used as a residential area as well as a line of communication. The shores are lined with houseboats—not playthings but actual homes for families—shop boats, restaurant boats, and so on. The number and variety of the craft, naturally, are legion:

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249. A double-outrigger canoe of Java with an Indonesian balance lug.

the tiny wedge-shaped sampans rub shoulders with big barges, ponderous oared craft with agile sailboats, the poor man's plain and shabby hull with the millionaire's gorgeous villa boat. The most unlikely pursuits are carried on aboard boats. Around Canton, for example, where the marshes are ideal for ducks, there are numerous aquatic duck farms: the farmers live and work on special duck boats equipped with quarters for themselves in the hull and for the ducks in enormous winglike appendages.

Compare Illustration 296, p. 248

Illustration 243, p. 202

For their small craft as for their large, the Chinese have always used their special batten-stiffened balance lug. Curiously enough, the neighbors just across the East China Sea made no effort to adopt this able and handy sail: the Japanese, generally so quick to take over anything worthwhile produced by others, were content to continue with the clumsy square sail traditional on all their craft.

Illustration 244, p. 172

Indonesia, as mentioned above, is the home of that ancient and effective sail, the Indonesian lugsail. It is also the home of the *prau,* which boasts a distinctive sail all its own. *Praus* are good-sized boats—some run fifty feet in length—with a raking stem, graceful lines, sharp stern, and a palm-thatched cabin amidships. On the fore deck are set two short masts, each carrying a sail shaped roughly like an isosceles triangle and hung lengthwise so that the apex

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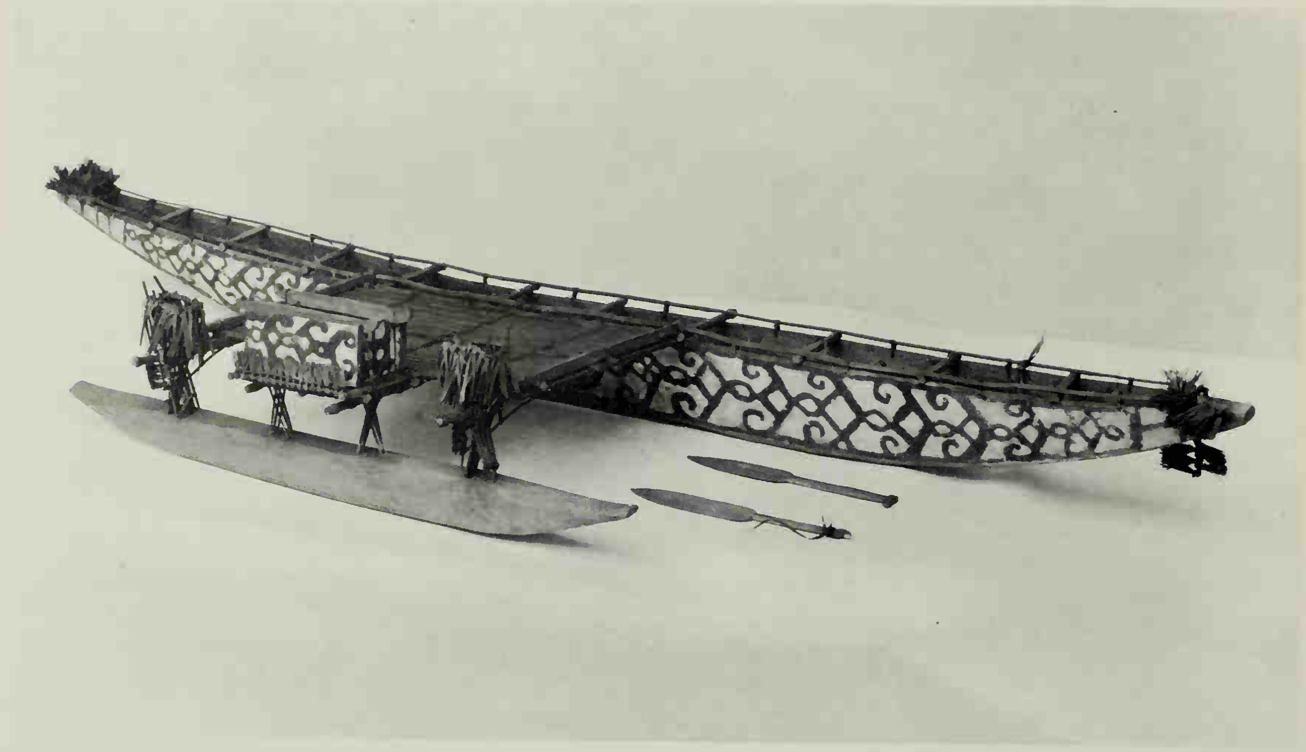

SINGLE-OUTRIGGER CANOES

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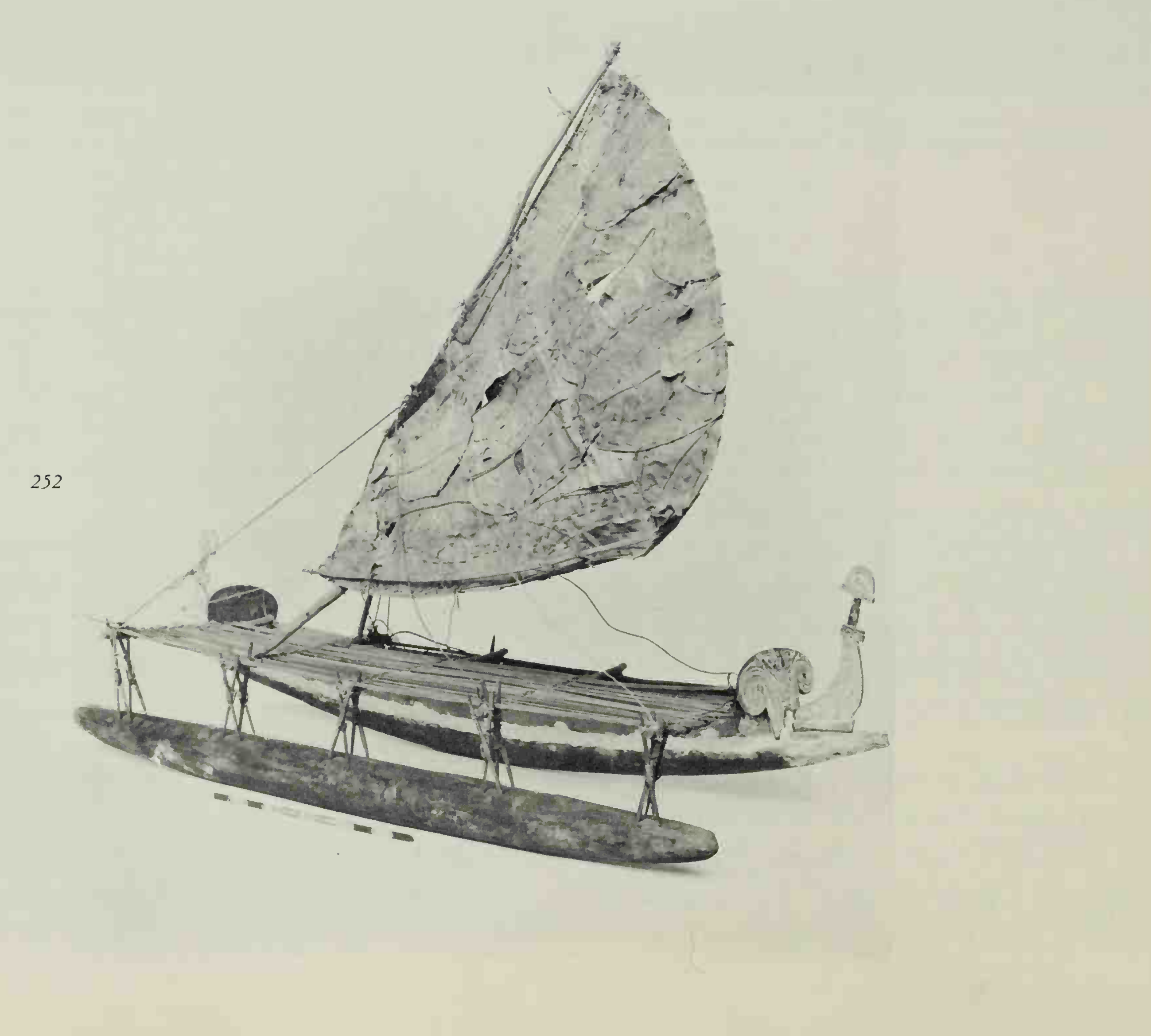

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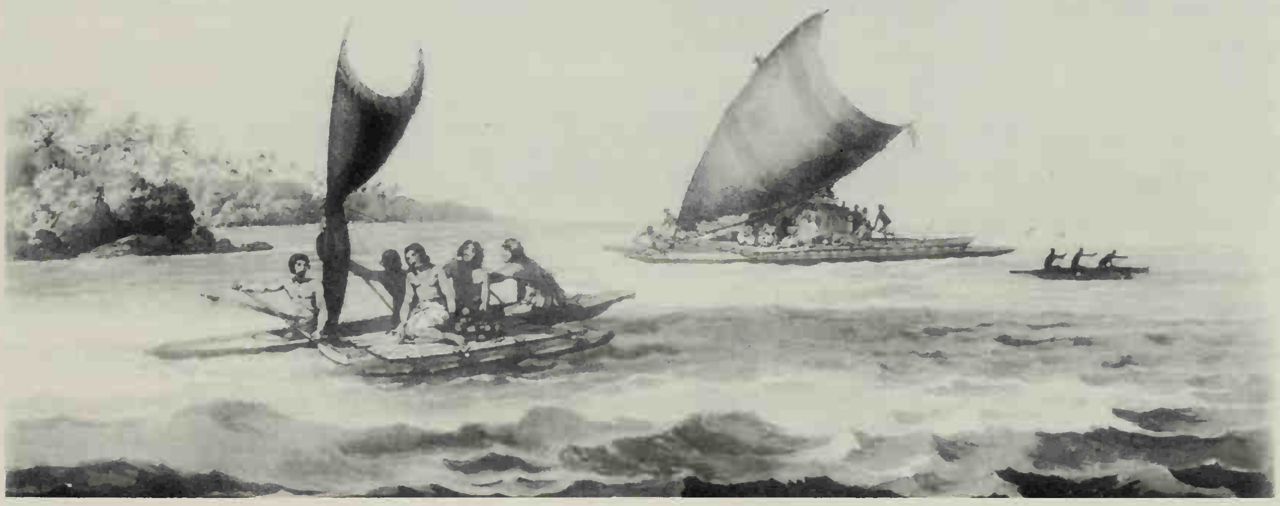


254

250. Model of a well-carved, handsomely decorated canoe of a type used in the Anchorite Islands.

251. Color illustration, page 172.

252. Model of a type of canoe used in the Trobriand Islands in the southwestern Pacific. The sail, of palm leaves, is a version of the triangular "oceanic lateen." Poles covering the booms that run to the outrigger form a platform providing additional cargo space.

253. A double canoe of the type used by the Hawaiian Islanders in the eighteenth century. The sail is the "crab claw" type. The boat is involved in some religious ceremony, for the paddlers are in full regalia.

254. Canoes used by the natives of the Friendly Islands in the southern Pacific in the eighteenth century. In the foreground is a dugout with a single outrigger and a platform on the booms that run out to it; behind is a large double canoe with a platform between the two hulls.

255. Color illustration, page 173.

forms the tack and the base the leech. A bamboo spar stiffens each side, the two meeting at the tack. In effect, the sail is like an Indonesian lug with the yard and boom joining at a point forward instead of remaining parallel.

When we turn to Indonesia's smallest craft we meet again a feature encountered briefly before, the outrigger.

In Indonesia, and for thousands of miles east and south of Indonesia, the dugout canoe has for centuries been the commonest means for crossing water. Now, dugout canoes are rather wobbly affairs, particularly under sail. To supply the needed stability, the outrigger was invented, a float made fast by a pole or poles to the hull. Probably the earliest canoes so equipped carried double outriggers, that is, a float on either side. This is the type found in Indonesian waters. The sail, as in the larger craft of the area, is the Indonesian lug, and in canoes designed for racing it can reach incredible size. A double-outrigger canoe 28′ long and 1′ 10″ wide, for example, will have a mast 40′ tall and a sail 60′ × 26′, or a total of no less than 1560 square feet. On such a craft the outrigger float is set 10½ feet from the hull and is so long it juts three feet beyond prow and stern.

Illustration 249, p. 205

The double outrigger confines itself rather strictly to Indonesia and its environs plus certain localities along the east coast of Africa. The islanders of the Pacific for their innumerable types of dugout prefer the single outrigger, and with good reason.

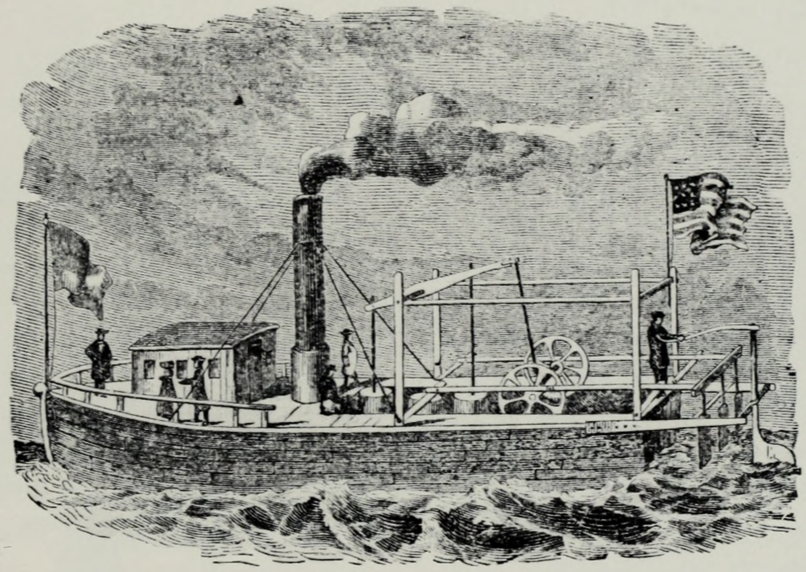
The double outrigger is very efficient—but not in bad weather. When strong winds make the craft heel, the lee float drags, and the pressure, if strong enough, can break the outrigger frame. So the hardy Pacific seamen who had to sail from isle to isle, often over miles and miles of open water, wisely chose to use only one float. In a single-outrigger canoe, the float is generally kept to the weather side. This means that, in tacking, the crew must turn the craft end to end, reset mast and sail, and rerun all lines. An experienced crew can carry out this complicated maneuver with amazing speed, and it's well worth the effort, considering the single outrigger's obvious advantages.

Besides the outrigger, another way of achieving stability was to construct what we today loosely call a catamaran—and it solved the problem of increasing carrying capacity at the same time. To make oversize dugouts was only possible along the shores of British Columbia or in New Zealand, where giant logs were available (hence, e.g., the magnificent Maori war canoes). In some localities, such as Hawaii and the Tuamotu Islands, boat-builders got around this by taking two smaller hulls and connecting them to each other by booms to form a double canoe. This not only provided the needed stability, but doubled the available space at the same time. And, like today's twin-hulled sport catamarans, under a good press of canvas such craft were capable of amazing speeds.

The Pacific islander is partial to sails of triangular shape. He does not hold himself strictly to a geometrical triangle by any means; his sails run the gamut of variation from almost straight-sided affairs to the elegantly curved "crab claw" type. Whatever the shape, they are certainly efficient: they made possible the Polynesians' spectacular voyages (like Thor Heyerdahl's, probably done with big sailing rafts) to New Zealand and Hawaii and other far-flung points, and through the leg-of-mutton sail they may have been the inspiration for the ubiquitous triangular yacht sails of today.

Illustration 251, p. 172

Part Three
THE AGE OF POWER



256

256. The world's first successful steamboat: the vessel Fitch sailed on a regular schedule between Burlington and Philadelphia the summer of 1790. The dimensions are unknown and we're not even sure of the name; it may have been called *Thornton* after one of Fitch's wealthier backers.

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257. Fulton's first successful steamboat, popularly known as the *Clermont*, as sketched by the inventor himself. Her dimensions were: 140 feet long, fifteen feet wide, seven feet deep in the hold. The Survey of New York, accustomed to registering only sailboats, described her as "a square-sterned boat, has a square tuck:—no quarter galleries and no figure head." The engine, designed by James Watt, had one cylinder, two feet in diameter. The paddle wheels were four feet wide and fifteen feet in diameter.

CHAPTER THIRTEEN

Merchantmen

See! see! (I cried) she tacks no more!
Hither to work us weal,—
Without a breeze, without a tide,
She steadies with upright keel!

IT was a ghost ship that Coleridge's Ancient Mariner spied sailing eerily along while his own vessel lay motionless in a dead calm. Who gets the credit for creating a boat not of ectoplasm but of wood which, hour after hour and day after day, could miraculously travel without a breeze or without a tide, even against breeze and tide? *Illustration 255, p. 173*

Does the honor go to Jonathan Hulls, an obscure Gloucester clockmaker who in 1736 patented a crazy contraption of a steamboat? Or to the Marquis de Jouffroy d'Abbans, a French nobleman at home amid the elegance of Versaille, who in 1783 made a steamboat that moved (at a snail's pace to be sure, but it moved) up the Saône while thousands of Lyonese lined the banks and marveled? Or to James Rumsey, the swaggering charmer whose inventive abilities George Washington himself vouched for, and who in 1787 twice drove a steam launch for short trial runs on the Potomac? Or to the gangling, poverty-ridden John Fitch, his eyes glowing like a fanatic's with the fire of his passion to succeed, who finally created a steamboat, pushed by paddles flailing at the stern, that at six miles an hour or better chugged up and down the Delaware on schedule for the whole summer of 1790, covering a total of perhaps two to three thousand miles? Or to William Symington, an English millwright's son who, working in a mine pumped free of water by one of James Watt's steam engines, played with the idea of driving a boat with the same kind of power and finally built a steam tug with a paddle wheel at the stern that in 1803 towed two heavily laden barges 19½ miles along one of England's canals against a brisk head wind in six hours? Or to the man who is usually given the credit, the handsome and debonair Robert Fulton, one of the first Americans to rise from rags to riches, whose *The Steamboat*[1] in 1807, its big side paddle wheels turning steadily, steamed 150 miles up the Hudson, from New York to Albany, at five miles per hour?

Jouffroy tried again in 1816; his boat was a failure. Rumsey rejected an offer to work in partnership with James Watt and thereby threw away a sure chance to win the glory; the efforts he made on his own went from bad to worse. Fitch could boast of having built an operating steamboat—but it was the result of inspired tinkering (in his isolated workshop he practically reinvented Watt's engine) plus luck, and, since the public was not yet ready, commercially it was a flop; it ran but one summer, and he never completed another boat. The patron on whom Symington had pinned all his hopes died, and the inventor simply

[1] So he named it originally; later he called it *The North River Steamboat of Clermont,* which the public abbreviated to *Clermont.*

gave up. But Fulton, not a mere mechanic with a bright idea but an architect and engineer able to take advantage of the best scientific thought available and consequently in a position to turn every mistake into a step forward, and working when public acceptance was readier and profits were assured, went on from *The Steamboat* to build twenty others that plied most of the local waters about New York and even part of that hazardous stream, the Mississippi; all were money-makers, and the *Chancellor Livingston,* the last to leave his drawing board, had already begun to show signs of the luxury that was to become the hallmark of power-driven passenger ships.[2]

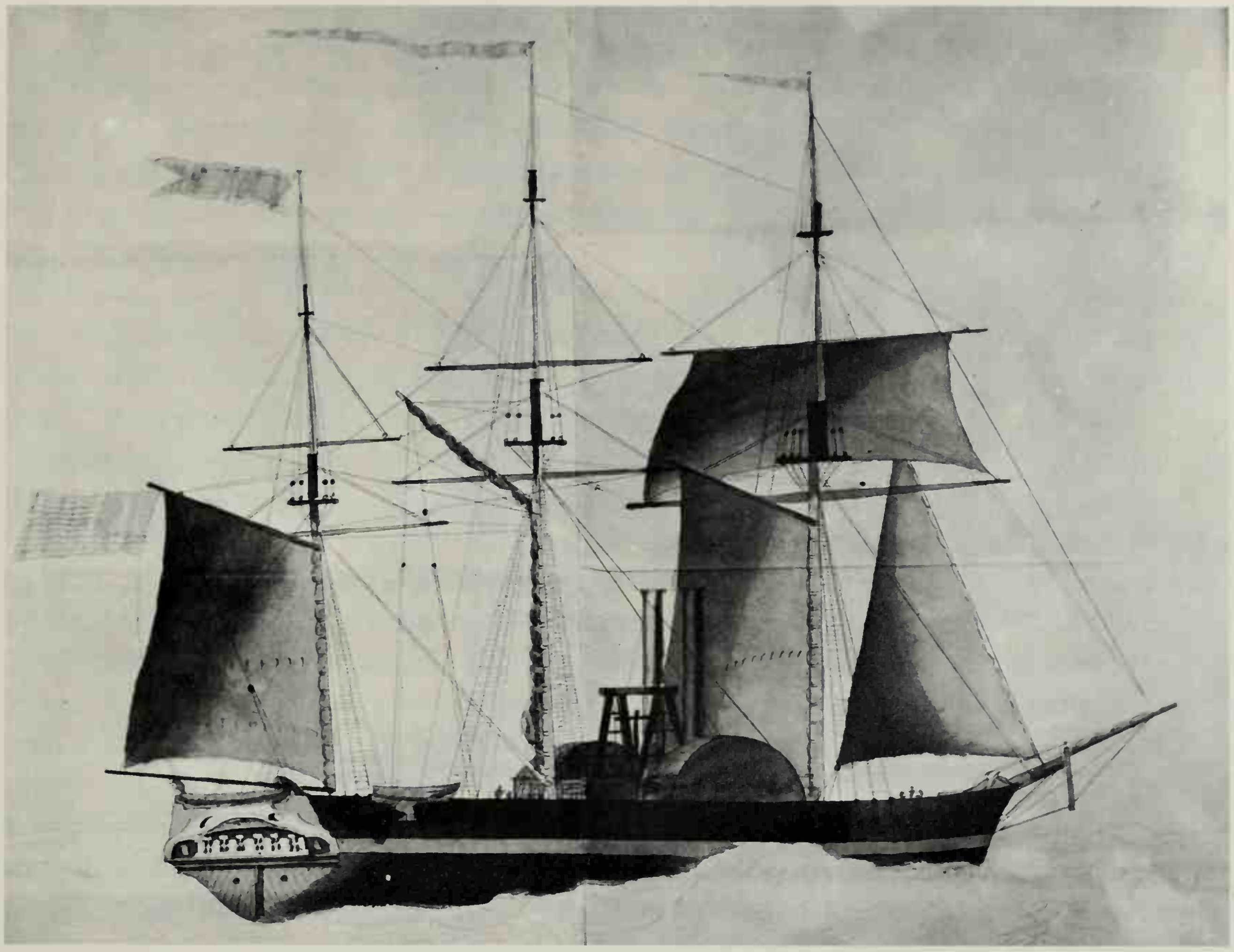
Fulton's boats puffed along successfully—but only on quiet streams and bays where waves wouldn't lift the paddles out of the water. The first steamboat to brave the open sea was the *Phoenix* in 1809. "Brave" isn't quite the word; what, with timid stops en route to wait for absolutely calm weather, it took her thirteen days to get from New York to Philadelphia; any self-respecting sailboat could have done it in two. This explains why steamboat building lagged behind in Europe: America was a young, big country so mantled with forest that in many areas the only practicable way to travel was by water; Europe had long since lost her forests, ancient Rome had left her a splendid network of roads, stagecoach service was extensive and efficient—in short, steamboats had to offer a lot more than Fulton's stately five miles per hour to compete. To interest Europe they either had to go faster or be able to travel on other than inland waters. Henry Bell, a Glasgow tinkerer who was the first European to run a steamboat after Symington, was well aware of this and, like a canny Scot, paid less attention to people who really wanted to get from Glasgow to the nearby points he served than he did to excursion passengers who were interested in the ride as a novelty.

Illustration 258, p. 173

But Europe soon woke up. If the first chapter of the story of the steamboat stars America, England is the hero of the next. For England quickly realized how useful the new invention could be on her coastal routes and the run to Ireland or across the Channel. And soon an unexpected jab from America turned her attention to ocean crossings.

In America steamboats were multiplying steadily on bays and rivers. Then, in 1819, Henry Eckford launched the *Robert Fulton,* the first ship actually designed as an ocean-going sailer-steamer, to ply between New York, Charleston, and Havana. The very same year, Moses Rogers, who had skippered the *Phoenix* on her epoch-making, albeit snail's-paced, open-sea run, talked a shipping company into tackling the Atlantic and on June 20, to the accompaniment of amazed cheering from the bystanders, proudly steamed up the Mersey to Liverpool. He was aboard the *Savannah,* a 110-foot full-rigged ship equipped with steam and paddle wheels as auxiliary power, which he had conned out of New York Harbor twenty-nine days earlier, the decks piled high with cordwood to feed into her furnace's maw (wood was more easily available than coal in America then, and most of her early steamers were woodburners); it must have been a satisfaction to him to have covered nearly half the Atlantic in the time it had once taken him to get from New York to Philadelphia. Actually, Rogers had the engines going for no more than eighty-five hours; the rest of the time the big (fifteen-foot diameter) paddle wheels had sat, folded like fans, on the deck. It was enough, however, to convince English shippers that steam power had a place on the high seas.

[2] The big dining saloon at the stern, lined with upper and lower berths screened by curtains, set a pattern for all subsequent river boats—and all of America's railroad sleeping cars.

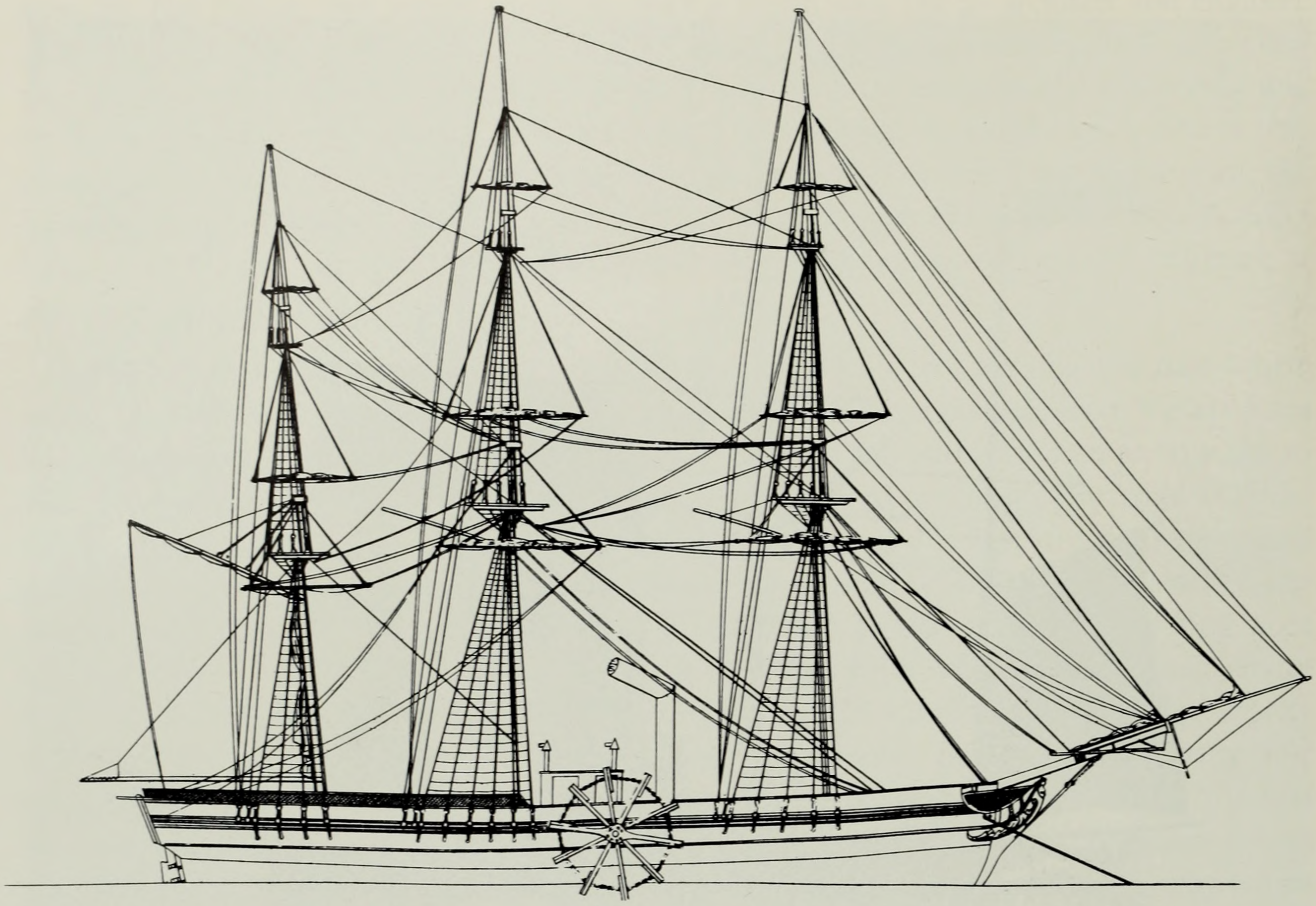
 259

258. Color illustration, page 173.

259. The *Robert Fulton,* built in 1819, America's first seagoing steamboat. Her dimensions were: 158 feet long, thirty-three feet wide, fifteen feet deep in the hold.

It took time, though, to put it there. The first to traverse the Atlantic were, like the *Savannah,* vessels which used steam and paddle wheels merely as auxiliary power, and they were a mixed bag: a British warship furtively slinking across to help a revolution in Chile, a French and an English naval unit, a steamer intended for Canada's inland waters. Then, in 1838, the *Sirius* arrived in New York Harbor. Though she had two masts carrying a topsail schooner rig, the *Sirius* was a steamer first and a sailing ship second, and to her goes the honor of being the first vessel to cross the Atlantic entirely under power; she did the voyage in 18½ days. A day later the *Great Western* followed her in, after fifteen days on the water.

The *Sirius* had been intended for the English Channel, had made the Atlantic run as an emergency measure and, after one more crossing, returned to the Channel. But the *Great Western* had been designed specifically as an Atlantic liner by Isambard Brunel, the hero, as will be seen in a moment, of the tale of transatlantic liners. She was 236 feet long and thirty-five feet wide and, to ensure safety and strength, had a hull made with the massive materials and powerful construction hitherto lavished only on men-of-war. Four boilers supplied the steam for two mighty cylinders, each more than six feet in diameter, turning great side wheels which drove the vessel an average of nearly nine knots. In England coal was *Illustration 261, p. 218*



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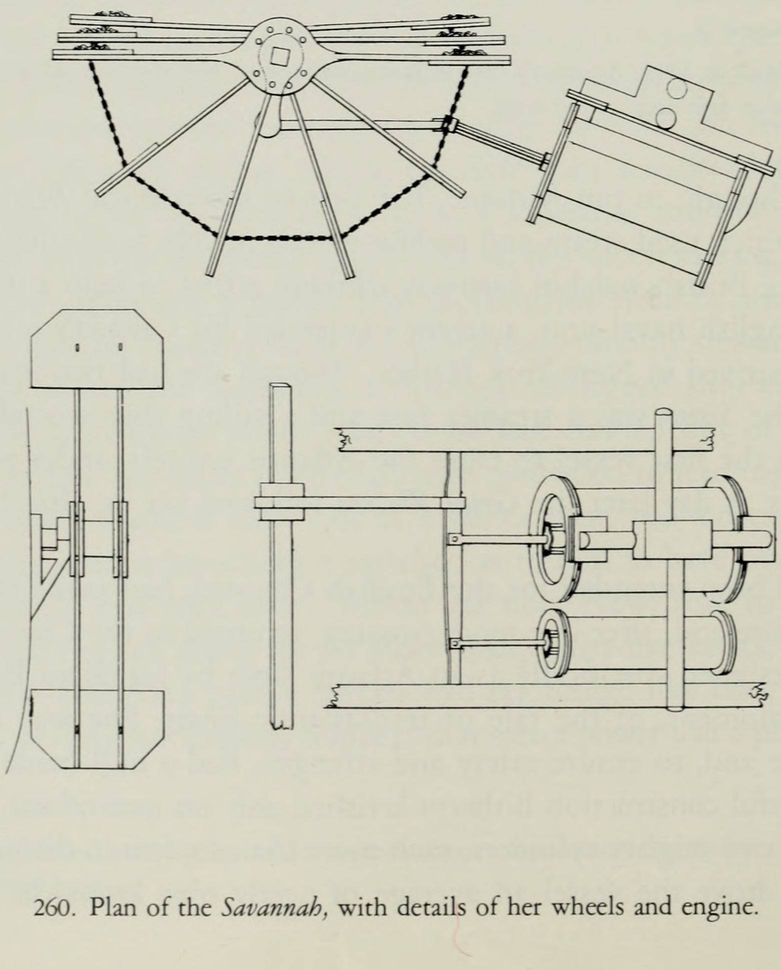

260. Plan of the *Savannah,* with details of her wheels and engine.

common and wood scarce, so British steamers were all coalburners; there was space in the *Great Western's* bunkers for eight hundred tons, and her furnaces devoured thirty per day. She could do the voyage to New York in a little over two weeks; the sailing packets (above, p. 143) did as well or even better on occasion—but only on occasion. The *Great Western* could count on doing it voyage in and voyage out. She was to ply between Great Britain and America for the next two decades. A scant three years after she had been put in service, Samuel Cunard's newly formed company to carry mail and passengers between Liverpool, Halifax, and Boston was sending its first steamers across the Atlantic, forerunners of a fleet that, a century later, would include the gigantic *Queen Mary* and *Queen Elizabeth.* For those who could see it, the handwriting was on the wall: the day was not far off when sailing ships would get only the leavings in overseas travel.

But England, hub of the world's maritime commerce at the time, had more than the Atlantic to think about. For her the long run to India was equally important. This involved special problems: if the ships went by way of the Mediterranean and Red Sea, passengers had somehow to be gotten over the Isthmus of Suez; if by way of the Cape of Good Hope, where coaling stations were few and far between, no steamer yet built had the bunkers to carry enough fuel. Between 1830 and 1840, both obstacles were surmounted. For the former route, an effective caravan service was set up which successfully hauled passengers from Alexandria to Suez despite sand, heat, insects, and bandits; for the latter, England's shipwrights turned to sailing ships with steam auxiliary: East Indiamen of this period, for example, were given paddle wheels to use when they hit the calms of the Indian Ocean and elsewhere.

By 1850 steamers were paddling their way all around the world, hauling passengers and, perhaps even more important, mail—more important because the government paid them well for carrying it and they needed the money: fares and freight alone couldn't cover the cost of the vast quantities of coal their inefficient power plants gorged. Yet, expensive as they were, it was well worth it to have ships that could run, wind or calm; that could stick to a fixed schedule; and that could take the shortest distance between two points, no matter what the wind direction was. As a result, the steamer did for the mid-nineteenth century what the airplane has done for the mid-twentieth: it made the world suddenly much smaller. For the Atlantic crossing, two weeks or better became the accepted thing. A clipper captain, driving vessel and crew like a fury, would cover himself with glory by bringing his passengers from New York to San Francisco in less than one hundred days (above, p. 151); the Pacific Mail Steamship Company, taking their customers to Panama on one ship, then across the isthmus by railroad, and then up the Pacific coast by another ship, deposited them on the pier at San Francisco in twenty and at Yokohama across the Pacific in another twenty. But even this was only the beginning: two radical improvements were in the offing which were soon to render obsolete the waddling wooden sidewheeler: the screw propeller and the iron hull.

Like the steamboat, the story of the screw propeller begins centuries before the device was ever put to practical use. It had been in men's minds at least as early as the seventeenth century. In the eighteenth, both an Englishman and a Frenchman patented rudimentary forms of it. A number of hand-operated types had been tried, among them the version devised by David Bushnell in 1775 for his ingenious one-man submarine. And, in 1804, John Stevens and his son Robert (who was later to gain fame on his own; below, pp. 230

and 250) had chugged about the lower Hudson in the *Little Juliana,* a twenty-five foot launch that had not one screw but twin screws—and not only that but high-pressure steam and a primitive form of turbine to boot; all in all, an example of inventive precocity that still makes engineers marvel. But the materials and workmen and tools available were not up to Stevens' ideas, and his later craft, such as the *Phoenix* were, like Fulton's, driven by low-pressure engines turning paddle wheels.

It took another three decades to produce a practicable screw-driven steamer, and two inventors achieved it almost simultaneously. Francis Pettit Smith of England patented a screw propeller in May of 1836, and just six weeks later, in June, John Ericsson, who ten years earlier had left Sweden to come to England, patented another. Ericsson built first one and then a second screw-driven launch and, by way of demonstration, towed a 630-ton sailing vessel at five miles per hour and hauled up and down the Thames a bargeful of admirals. These, in the best brass-hat tradition, stubbornly stuck to their conviction that a boat driven from the stern couldn't be steered, so Ericsson listened to the blandishments of the United States Navy, came to America, replaced paddle-wheelers with screw steamers on America's waterways at a great rate, built the first screw-driven warship, and eventually went on to win his greatest fame as designer of the historic *Monitor.* Francis Smith also built two screw-driven craft, the second of which (aptly named *Archimedes,* after the great ancient Greek who is credited with inventing the screw) was a seagoing boat whose effectiveness Smith demonstrated by steaming completely around England. En route he put in at Bristol, where the latest and biggest and best liner of the day, the *Great Britain,* happened to be under construction. Her designer, Brunel, architect of the *Great Western,* was so impressed by the *Archimedes* that he added a propeller to his new ship, and in 1845 she became the first screw-driven liner to cross the Atlantic. The *Great Britain* has a second claim to fame as well—she was also the first all-iron ship to do it.

Iron ships were nothing new or startling in 1845. Decades earlier, builders had been aware that iron was much superior to wood, which, moreover, was steadily getting scarcer. An iron vessel was stronger; it could be built to any length without fear of hogging (above, p. 107); spared the weight of massive timbers, it actually was lighter than a wooden ship of comparable size and, spared the space their bulk displaced, could hold more cargo; and it didn't develop dry rot under the hot boilers as wooden ships tended to do. But it took time to convince people that iron, really and truly, would float. An iron barge had been tried out in England as early as 1787, and in 1818 Thomas Wilson had launched the *Vulcan,* an all-iron sailing collier which, sixty years later, was still hale and hearty and hard at work. In 1821 an iron paddle-wheeler was built at Birmingham, the *Aaron Manby;* it puffed across to France and plied the Seine for a number of years. Finally, between 1828 and 1834, England's shipyards started turning out good numbers of iron vessels—but all small, mostly sailing craft for river and lake use. Then came the incident of the *Garry Owen.*

The *Garry Owen* was a small iron steamer, not much to look at but as sturdy as she was ugly. On her first voyage out she was caught in a gale and, along with some wooden ships, thrown on the coast. Her consorts ended up either total losses or badly mauled; the *Garry Owen* ended up with little more than a few dents. People were convinced.

The story of iron oceangoing ships is inextricably bound up with the career of the brilliant Isambard Brunel. His father, Sir Marc Brunel, a gifted architect and engineer, had fled from France during the Revolution, come to America, served for a while as city architect of New York, gone to England, and made a name there as an engineer and inventor. The son was even more able. As a child he revealed prodigious gifts in mathematics and drafting. When he was only nineteen he was in charge of his father's epoch-making undertaking, the digging of a tunnel under the Thames. At twenty-seven he was named chief engineer in the construction of the Great Western Railway. And then, turning to ships, he designed in quick succession the *Great Western* and the *Great Britain.*

When the *Great Britain* was launched, the newspapers bandied about such superlatives as "stupendous" and "unparalleled." She deserved them. Few wooden and no iron ships near her size (322′ × 50′ × 32′; the main saloon was 110′ × 48′) had ever been built. She was driven by a screw as well as paddle wheels. Her auxiliary sail, instead of the usual lofty square rig, consisted of low masts carrying mostly fore-and-aft sails. Her construction was monumentally strong—and a good thing too, for, after her successful maiden voyage to America she ran aground on the Irish coast and lay there helpless, buffeted by sea and wind, for eleven months before she could be refloated. A wooden ship would have ended up as kindling; the *Great Britain* was only bruised, and went on to remain in active service as steamer, then sailing vessel, then coal hulk for well nigh a century.

But the *Great Britain,* mighty as she was, was simply a warm-up for Brunel's next venture: an iron steamer to be not merely bigger but four times bigger than any ship on the water. And so, in 1852, he set about designing the *Great Eastern.* She was just short of seven hundred feet long (the *Queen Mary* is 975). She had accommodations for four thousand passengers (the *Queen Mary* takes twenty-one hundred—but no doubt more comfortably) or, in times of war, ten thousand troops. Four boilers, each fired by ten furnaces, turned two paddle wheels and a screw. Her bunkers held twelve thousand tons of coal, which she gobbled up at the rate of 330 per day. Under both wheels and screw she averaged fourteen knots. For maximum strength and safety she was given two skins: the *Great Eastern* was virtually two ships, one inside the other, and her construction was such as to divide her into multitudinous watertight compartments. She once gashed herself on a pointed rock and slit open over one hundred feet of her bottom yet, thanks to the inner skin, stayed afloat. Brunel had designed her to make the long voyage to India under steam without having to refuel en route. A disastrous launching skyrocketed her costs, and it was decided to put her on the Atlantic instead. On her maiden voyage she carried the grand total of thirty-six passengers out and 212 back, and kept losing money steadily. She was premature: the times simply couldn't supply the freight, human or otherwise, that would cover her astronomical costs—at least on the Atlantic run. Finally luck came her way between 1865 and 1873: Cyrus Field was busy linking Europe and America by telegraph, and the *Great Eastern's* capacious belly proved ideal for stowing miles of transatlantic cable. In 1888 she was sold to be broken up for scrap. Brunel lived only to see her launched; the financial and other crises he had to cope with in the seven years since she had left his drawing board had taken all his strength.

Basically, what plagued the *Great Eastern* was what plagued all oceangoing steamships of the period: they were fast enough, they could keep to a schedule in a way no sailing ship ever could—but they cost too much to run; without healthy infusions of the taxpayers' money

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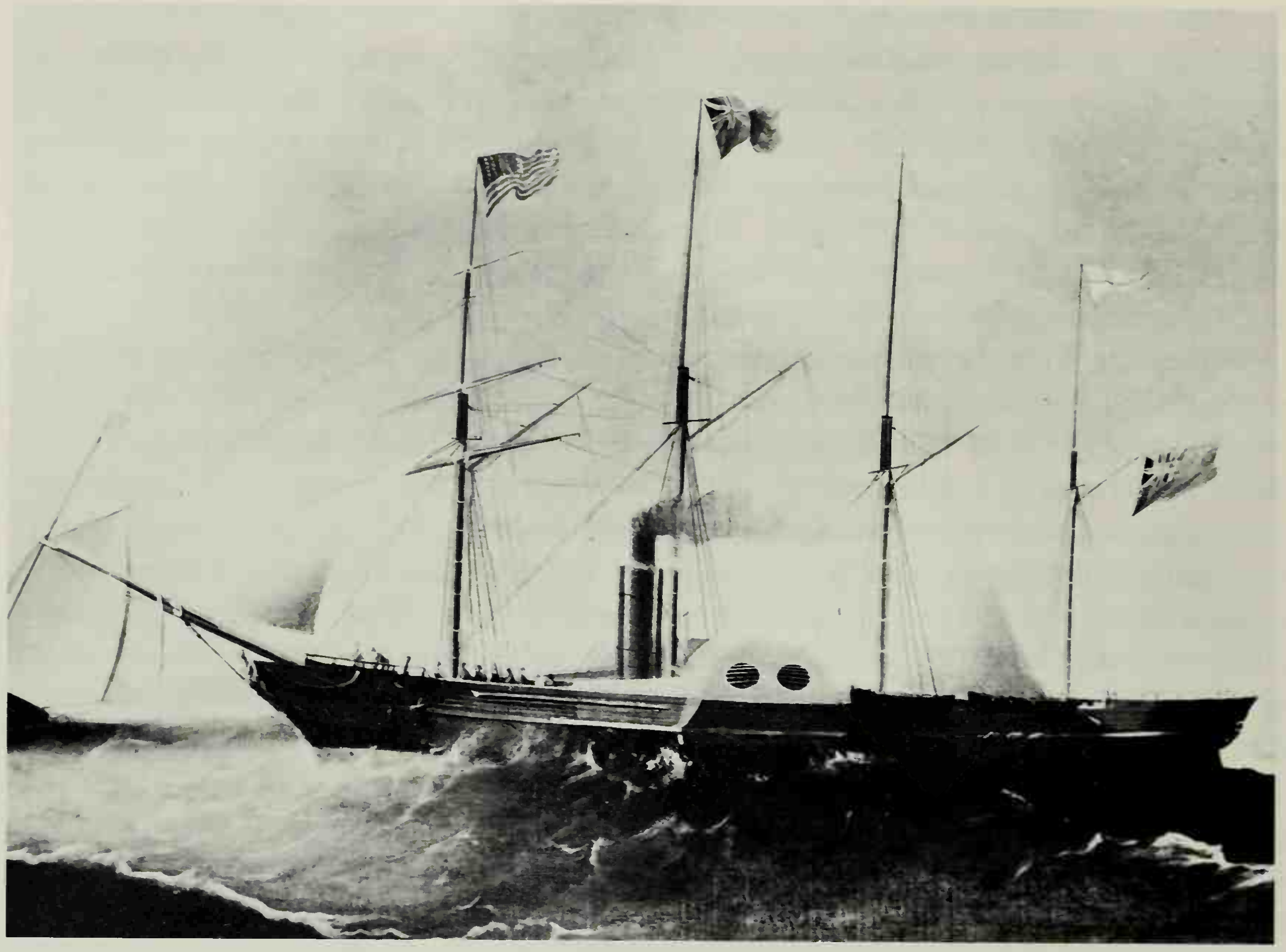

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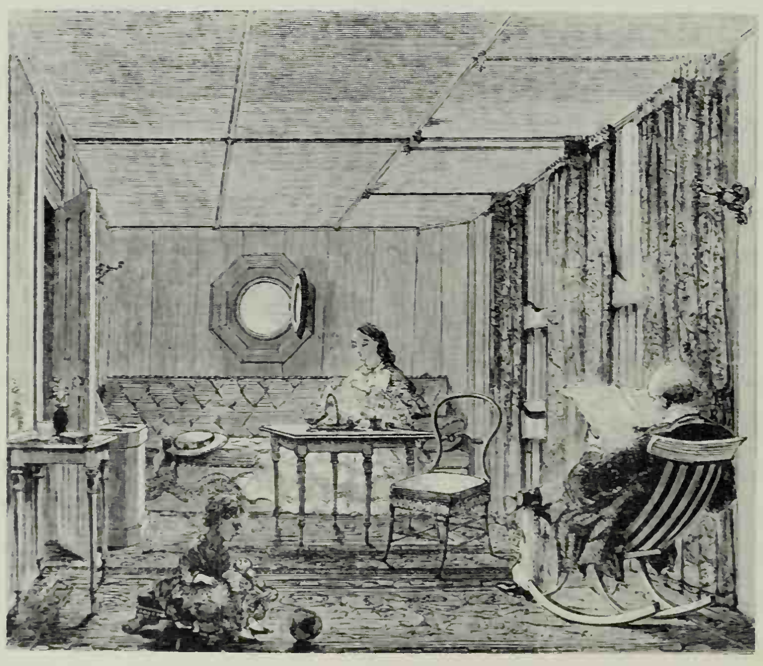
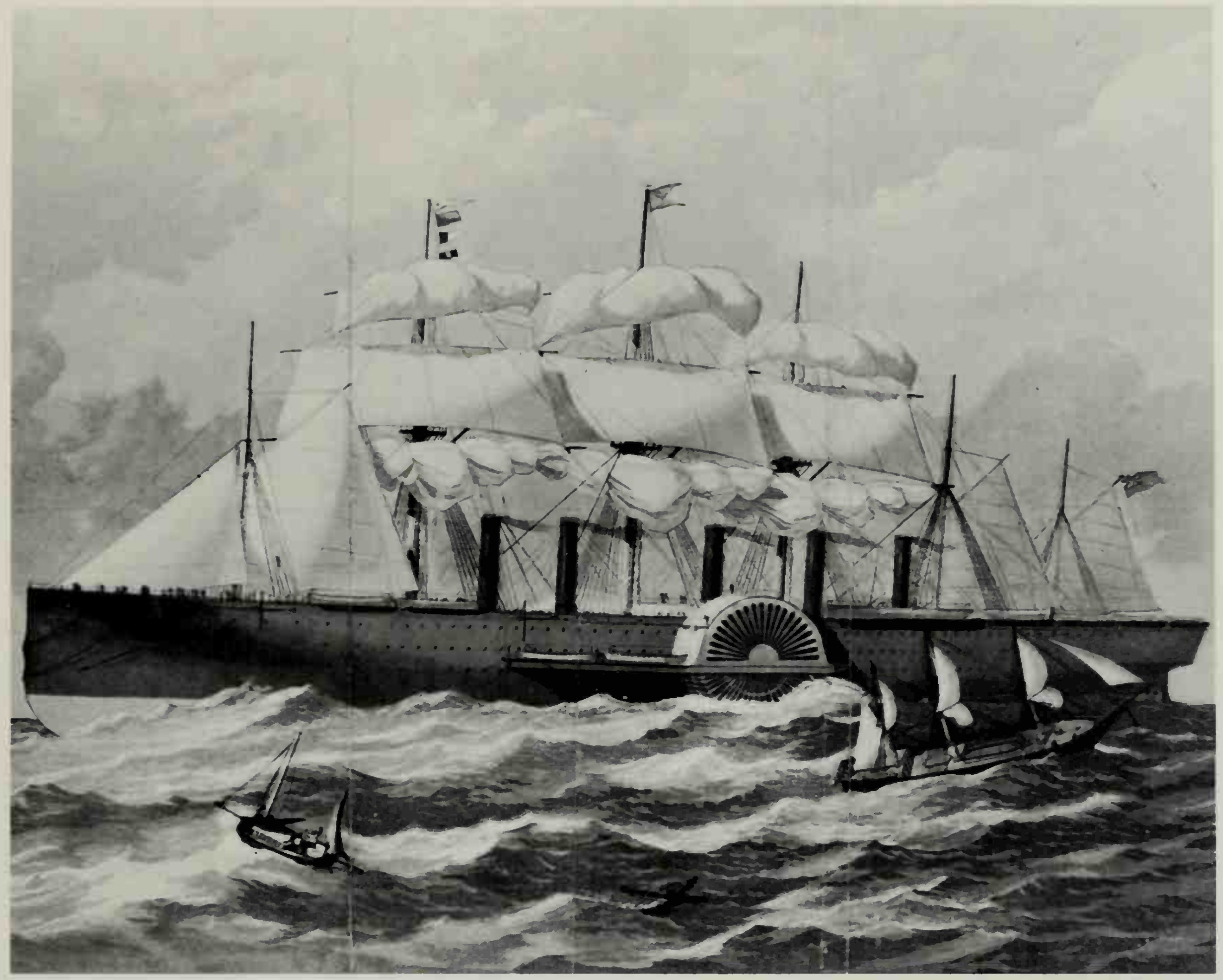


261. The *Great Western*, the first steamship designed specifically to serve as a transatlantic liner.

262. The *Great Eastern*.

263. One of the *Great Eastern's* family cabins.

264. The twin-hulled *Calais-Douvres*. Her dimensions were 302′ long, 63′ wide, 13′ 9″ deep in the hold. She could carry up to 1080 passengers.



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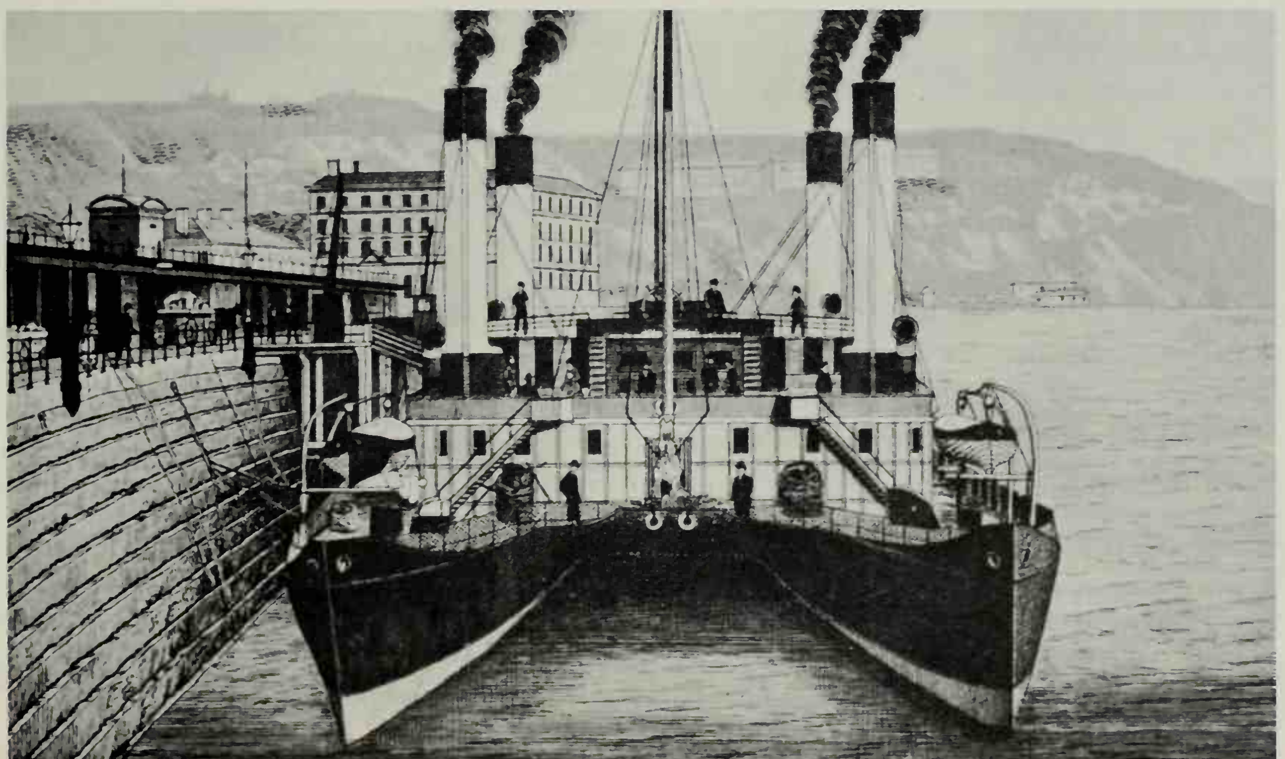

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in the form of contracts for carrying mail, it was impossible to stay out of the red. When E. K. Collins in 1847 tried to wrest a part of the transatlantic traffic away from England for America by founding his Collins Line, the first thing he did was apply to Congress for a subsidy. To attract customers he continued the American packet tradition (above, p. 144) of providing de luxe accommodations. His very first ship, the *Atlantic,* offered an innovation that must have been greeted with accolades—steam heat in every stateroom. She even had—taking a leaf from the book of contemporary river steamboats—"bridal suites," oversize and particularly elegant cabins for honeymooners. Father Neptune treated the line to more than its fair share of marine disasters but this wasn't fatal; the *coup de grâce* came when the United States government withdrew its subsidy in 1858. Then Collins had to give up.

The engines were the root of the evil: they burned too much coal for the power they produced. The first real breakthrough on this front came in 1856, when a Scotsman named John Elder started putting the compound engine in oceangoing ships. The power plants in use hitherto had always produced more steam than the cylinders needed, and the excess simply went to waste. The compound engine was so designed that the steam one cylinder couldn't use was passed on to run a second. As a result, fuel consumption dropped dramatically, as much as 50 per cent. The next major step forward was increasing the steam pressure. The *Savannah's* engines had run at less than one pound per square inch, the *Great Western's* at five, the *Great Eastern's* at twenty-four. About 1860, improvement in boilermaking and steamfitting and in the system of condensing the steam raised the ceiling, and with the use of higher pressure, more efficient engines became possible with still further savings in fuel. Finally, in 1896 Charles Parsons equipped his *Turbinia* with three of his newly perfected turbine engines, the simplest and most efficient of all, and dramatically demonstrated them by racing up and down the Thames at an unheard of thirty-five knots. In 1840, five pounds of coal could produce some ten pounds of pressure; seventy years later less than a third that much coal could produce two hundred.

All this brought joy to the hearts of the ship-owners. But engineers and designers were hard at work to bring joy to the customers' hearts too. Collins had set the pace with elegant staterooms and steam heat. In 1848 America's Pacific Mail Steamship Company was founded to handle the run between America and the Far East; within a few years the line had ships in service which carried all kinds of livestock to ensure daily fresh meat and fowl for the table, had all outside staterooms (very important in pre-electricity days), provided baths with hot and cold running water, and even maintained, as a convenience for those interested, a shipboard opium den. The White Star line on the Atlantic run was also particularly passenger-minded. The designers of its first steamship, the *Oceanic,* launched in 1870, located the main saloon amidships instead of at the stern where adherence to the time-honored sailing ship tradition that the poop is officers' country (above, p. 100) had put it hitherto and where, in a screw steamer, the vibration must have rattled a passenger's very bones. The White Star people also experimented with Bessemer's pivoted saloon (see below) but had no better luck than he; apparently only gyrostabilizers were to be the answer to a ship's rolling, and these took a long time in coming. Perhaps the greatest boon to passengers came in 1879, when electric lighting replaced candles and oil and gas lamps, and the ships were finally able to get rid of their dungeonlike gloom—to say nothing of the fire hazard.

Not all the plans for making the customers comfortable worked out. The English Channel, because of the misery it inflicted on the many who had to cross it, came in for considerable attention from the engineers, and witnessed some expensive failures. One ingenious architect tried to get the better of its nasty chop by means of a steam and iron version of the double canoe on the theory that a broad, shallow structure would give increased stability. And so, in 1872, the twin-hulled *Castalia* came into being. The hulls, long and narrow (400′ × 20′), were set thirty-five feet apart, and the interval was spanned by powerful girders; the engines were mounted in the hulls, the paddle wheel between them, and the passenger accommodations on top of the girders. The *Castalia* turned out to be too slow, and was replaced by the *Calais-Douvres,* built on the same principles but bigger and stronger. She proved to be no faster, there were as many seasick passengers as ever, so, after a few trips, she, too, was withdrawn from service. In 1874 Henry Bessemer, famous for the steelmaking process that bears his name, launched a channel steamer of his own design, the *Bessemer;* its key feature was a great main saloon hung on pivots and fitted with a gyroscope to keep it perfectly still and level no matter how much the ship rolled. It didn't work—and neither did a number of other bright ideas Bessemer tried out in her.

So long as steam remained expensive, the wind continued to move most of the cargoes that crossed the water. But, as the new improvements gradually cut down fuel costs, the iron steamer gradually cut into the sailing ship's monopoly. The process was given a fillip in the 1850s by the introduction of water ballast. Ballast had always been a headache for shipowners. Every freighter, after delivering a cargo, had to replace part of the weight with tons of unwieldy ballast; the time spent laboriously loading it aboard and the money it cost to do so was a total loss, a loss that was doubled when the whole procedure had to be repeated in reverse once the ship was back home. In 1852 the *John Bowes* was fitted with tanks on her floor to carry water ballast—and the problem was solved: a freighter simply pumped in as much water as was needed to ballast her for the return trip, and pumped it out on arrival. Within a year the final step was taken of making the tanks an integral part of the hull. By the beginning of the twentieth century the steam freighter was so efficient and economical that it had taken from the sailing ship all but the cheapest and most unattractive cargoes (above, pp. 156–57).

At first iron cargo carriers were all pretty much alike, members for the most part of the "three-island" family, i.e., with forecastle for the crew forming an island at the prow, poop or quarter-deck with accommodation for officers and passengers forming another at the stern, and bridge and engine room forming the third amidships. From the 1870s on, special ships for special cargoes began to make their appearance, and in these the engines were frequently moved aft to create an unbroken space for cargo. A good example is the Great Lakes steamer, which is a sort of elongated steel box with a forecastle to house the crew sticking up at one end and a poop to house the engines at the other. The shape, vaguely reminiscent of a gigantic dachshund, provides a long, unobstructed bin for the vessel's chief cargo, iron ore. Another very special type of freighter is the tanker. In 1861 a 224-ton brig carried the first overseas shipment of oil; it was stowed away in her hold in barrels. Obviously, if the oil could be sent in bulk, the savings in time, money, and space would be tremendous. In 1863 a wooden sailing vessel was fitted out with tanks and, in 1872, an iron steamer. Then, four years later, Ludwig Nobel, brother of the founder of the famous peace prize, set about de-

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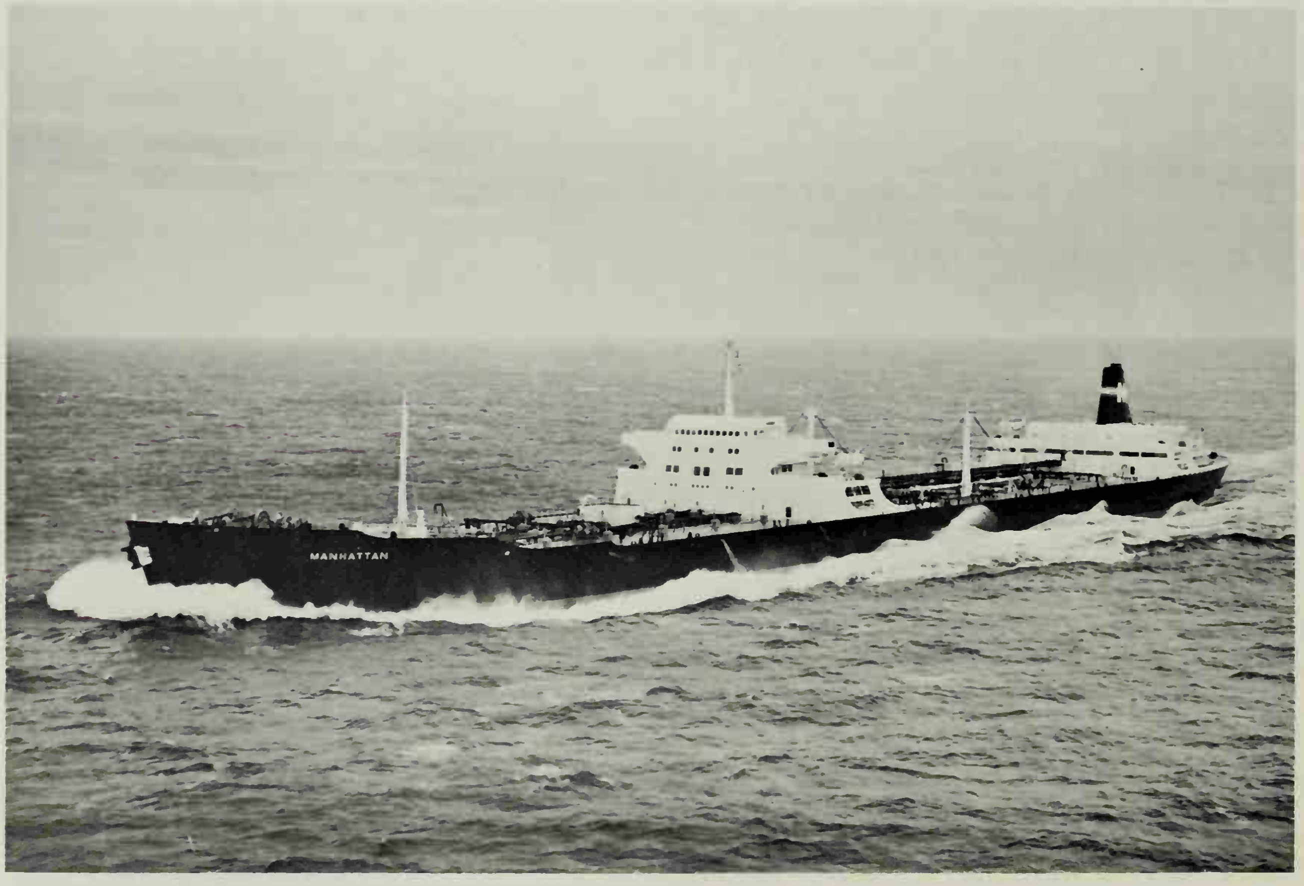
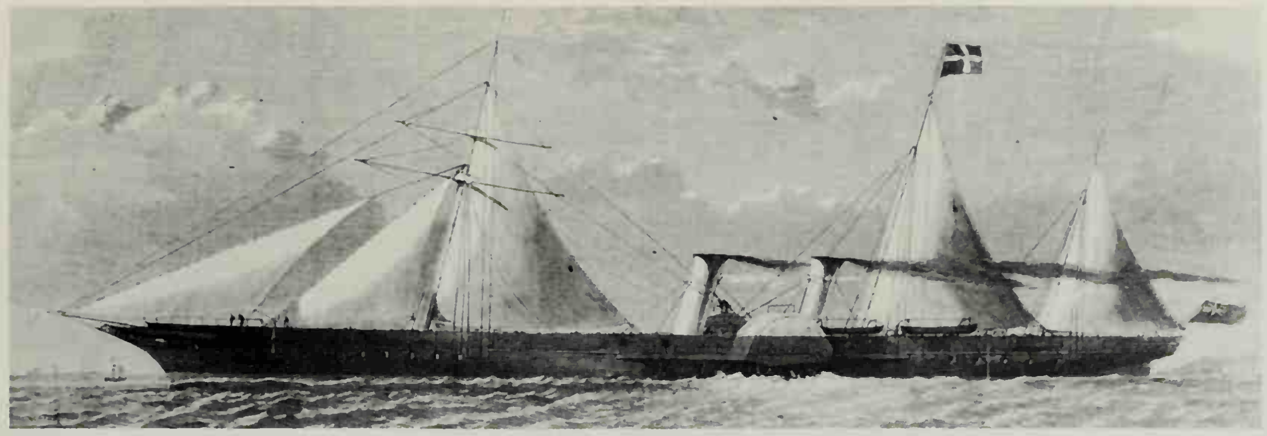


265. A Great Lakes ore carrier. Launched in 1906 as the *Henry W. Hawgood,* she was given her present name, *W. W. Holloway,* in 1937.

266. A monster modern tanker: the 130,000-ton *Manhattan.*



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267. One of the last of the paddle-wheel steamers, the *Lye-ee-moon.* She was a "clipper steamer," as the vessels built for the Chinese opium trade, in which speed was essential, were called. Though all of 270 feet long, she had a beam of slightly over twenty-seven feet. Her speed was an impressive eighteen knots.

signing a ship that wouldn't waste space with tanks but would be one great tank itself; the plates of the hull would hold the oil. The end result was the *Zoroaster,* launched in 1878 to haul oil from the Baku fields over the Caspian Sea. The first such vessel built to cross the ocean was Germany's *Glückauf;* with her tanks amidships and machinery aft, she was to all intents and purposes the prototype of the modern bulk carrier. On her maiden voyage she arrived in New York on July 30, 1886, and ran into difficulties: longshoremen, oilmen, and coopers, fearing this forerunner of automation, did all they could to delay unloading, and it took the help of the police to get the job done.

The *Glückauf,* twenty-three hundred gross tons and capable of nine knots at sea, was no mean cargo carrier for her time. Today, when freighters do better than twenty knots and brobdingnagian tankers of over one hundred thousand tons are being built, she would be a snail's-paced pygmy. Even the mighty *Great Eastern,* so far ahead of her time, belongs to the stone age of ocean travel compared with a crack modern liner. Power-driven vessels are now made not of iron but of lighter and stronger steel; their power plants are efficient, economical diesels or oil-fed steam turbines, driving two, three, even four screws; radar enables them to sniff out anything in their path or to pick their way through blinding fog; radio equipment, tuning in on beams, plots their exact position; there are high-speed pumps to handle fluid freight, hydraulic lifts to handle solid freight—and swimming pools, dance floors, dance bands, movies, air conditioning, gyrostabilizers, and whatnot to handle human freight.

The introduction of the screw propeller by no means killed off the paddle wheel. True, a mortal blow was given to the oceangoing side-wheelers—though these took some time to feel it; they continued to be built, in their final years with iron hulls, as late as 1863. But on shallow inland waterways, where screws would be either too deep or too likely to get fouled on marine growth, the paddle wheel had a long life ahead of it and in many areas is still very much alive.

Probably the best-known members of the paddle-wheel family are the celebrated boats that plied the Mississippi during most of the nineteenth century. Before the advent of steam,

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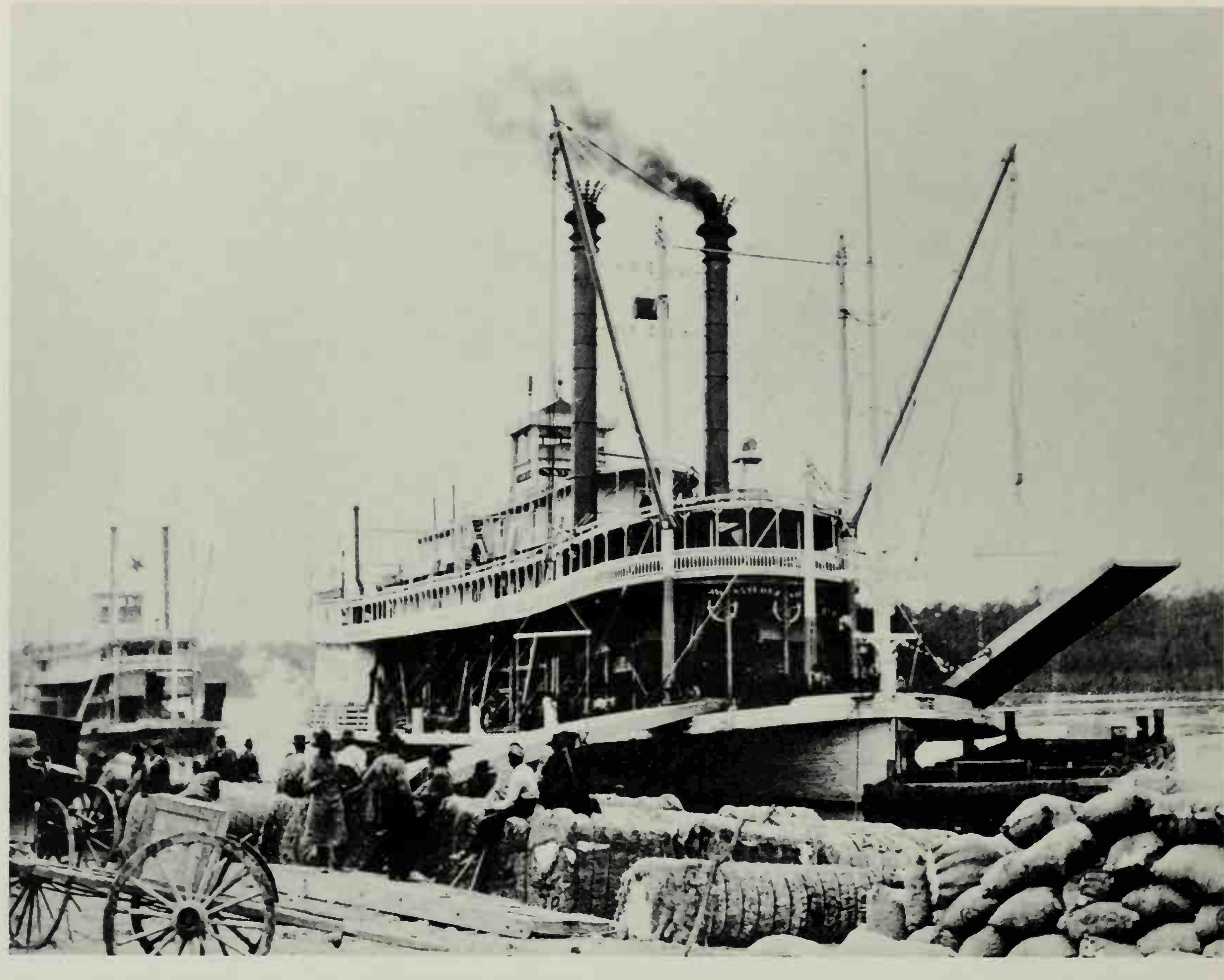

268. The *Natchez* (the eighth of the name), built in 1891. She was a sternwheeler 225 feet long, forty feet wide, and six feet deep in the hold.

the sole means of transportation on the river were the keelboats, big barges that drifted lazily downstream at the speed of the current and were painfully poled upstream at an even slower pace. Fulton, after succeeding in the east, quickly turned to the Mississippi and got a few boats going, but only on the easier lower reaches; the kind of steamer he knew how to build was fine for the roomy Hudson but not for the Father of Waters with its lurking shallows and vicious currents. It took a Westerner to figure out what was needed. Henry Shreve (the same who gave his name to Shrevesport, Louisiana) started on the river as a bargeman and quickly graduated to steamboat captain. In 1816 he launched a ship of his own design, the *Washington,* sailed it from the Ohio down to New Orleans, and—what's more important—sailed it back upriver to Louisville. The *Washington* was like no other steamboat of the time—to keep her draught to a minimum, she was built almost like a huge raft. Shreve accomplished this by getting the happy notion of making her a two-decker and locating the engine room on the first deck (not in the hold as Fulton had done) and the passenger accommodations up on the second. Her engines, unlike those Fulton used, worked on high pressure, not low: Shreve no doubt chose this type because it was cheaper, took up less space and, being simpler, could be more easily turned out in an area where tools, materials, and skilled workmen were scarce. The features he gave the *Washington* became the hallmark of

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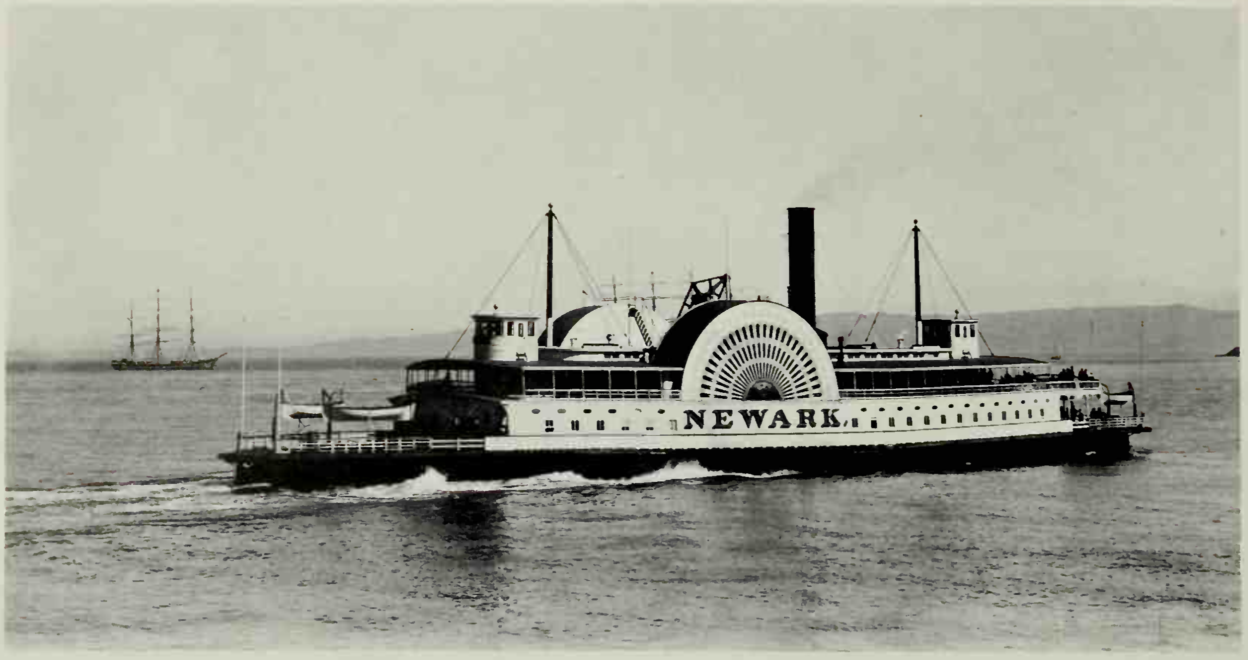
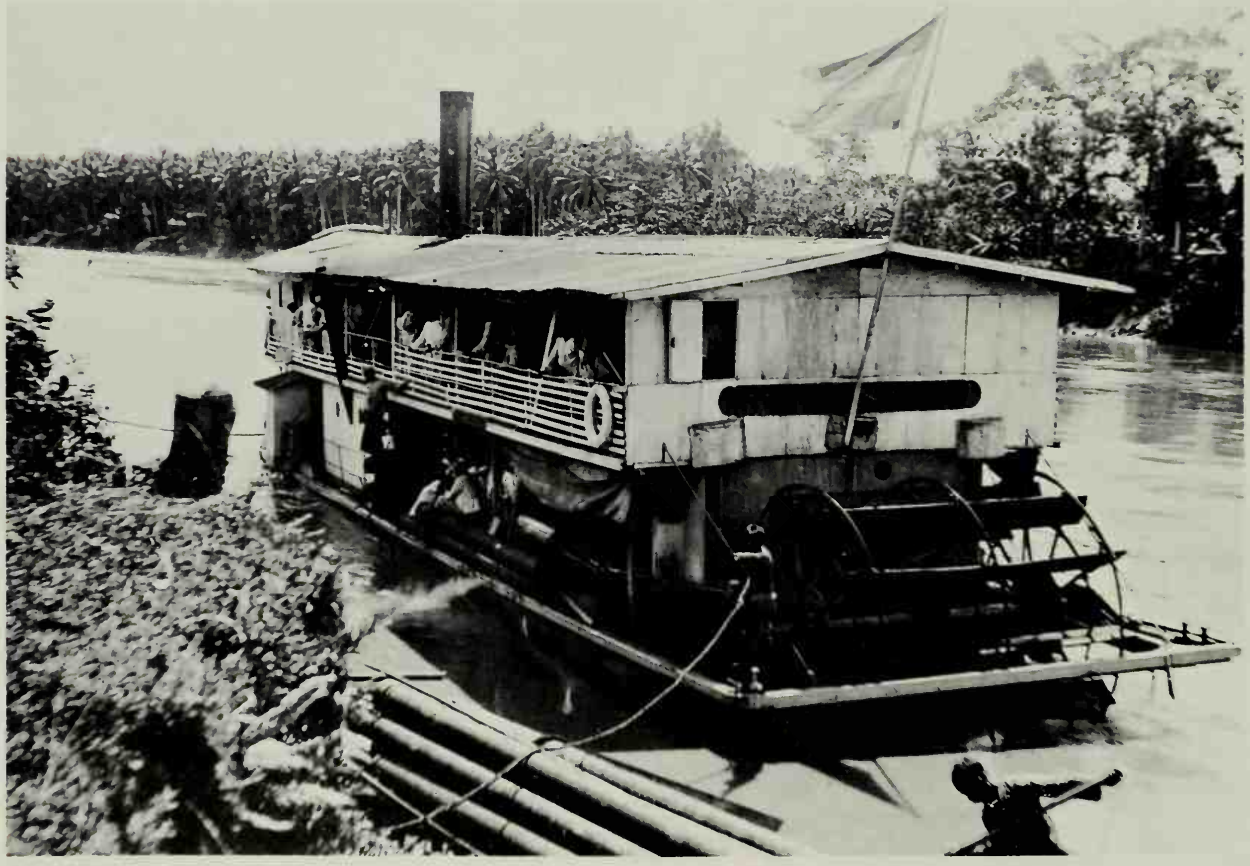
269. The sumptuous cabin of the Mississippi steamboat *Grand Republic.*

270 

271 

270. The *Newark,* built in 1877 for use in San Francisco Bay, was a giant of a ferry, 294 feet long and eighty feet wide, with paddle wheels forty-two feet in diameter, the largest carried by any ferry before or since. After forty-five years of service she was retired, and a good many of her old bones were still sound enough to go into a new ferry, the *Sacramento,* launched in 1923.

271. A modern sternwheeler on a stream in Sumatra.

the Mississippi steamboat: shallow draught (the biggest ever built rarely had more than eight or nine feet depth in the hold); two decks, with passenger accommodations on the upper and the engine room on the lower; and high-pressure engines. Since wood was plentiful and carpenters available, the second deck, as time went on, became the very last word in elegance and comfort; since metal was costly and metalworkers scarce, the boilermaking and steamfitting was just the opposite—hardly the thing for any engines, let alone high-pressure engines. When oceangoing steamers of the time were puffing along at a modest twenty pounds or less, Mississippi boats averaged one hundred and, to pass spots where the current was exceptionally strong, upped this to 150. As a result, they had a nasty habit of blowing up and sending goodly numbers of crew and customers to kingdom come—a state of affairs that was not helped any by their skippers' inability to resist holding informal races whenever two boats found themselves on the same course, on which occasions the sky was the limit and not what the boilers could take.

Eventually, toward the end of the century, prosaic tugs towing long lines of barges drove these elegant queens from the river. Elsewhere, e.g., the Hudson and Long Island Sound, their sisters, never quite as handsomely gotten up but handsome enough in their way, lasted a while longer, some into this century. Those that lasted the longest were the homeliest of the family, the paddle-wheel ferries. In fact, there are a few old, old ladies, with better than a half-century of service behind them, still carrying cars and people over crossings where the traffic doesn't justify the cost of a modern replacement or of a bridge.

But it is in the tropics that the paddle wheel has proved most durable. Here, where choked, shallow waterways often provide the only practicable way of getting through jungle, paddle-wheelers—usually with the drive at the stern to avoid excessive width—still thrive.

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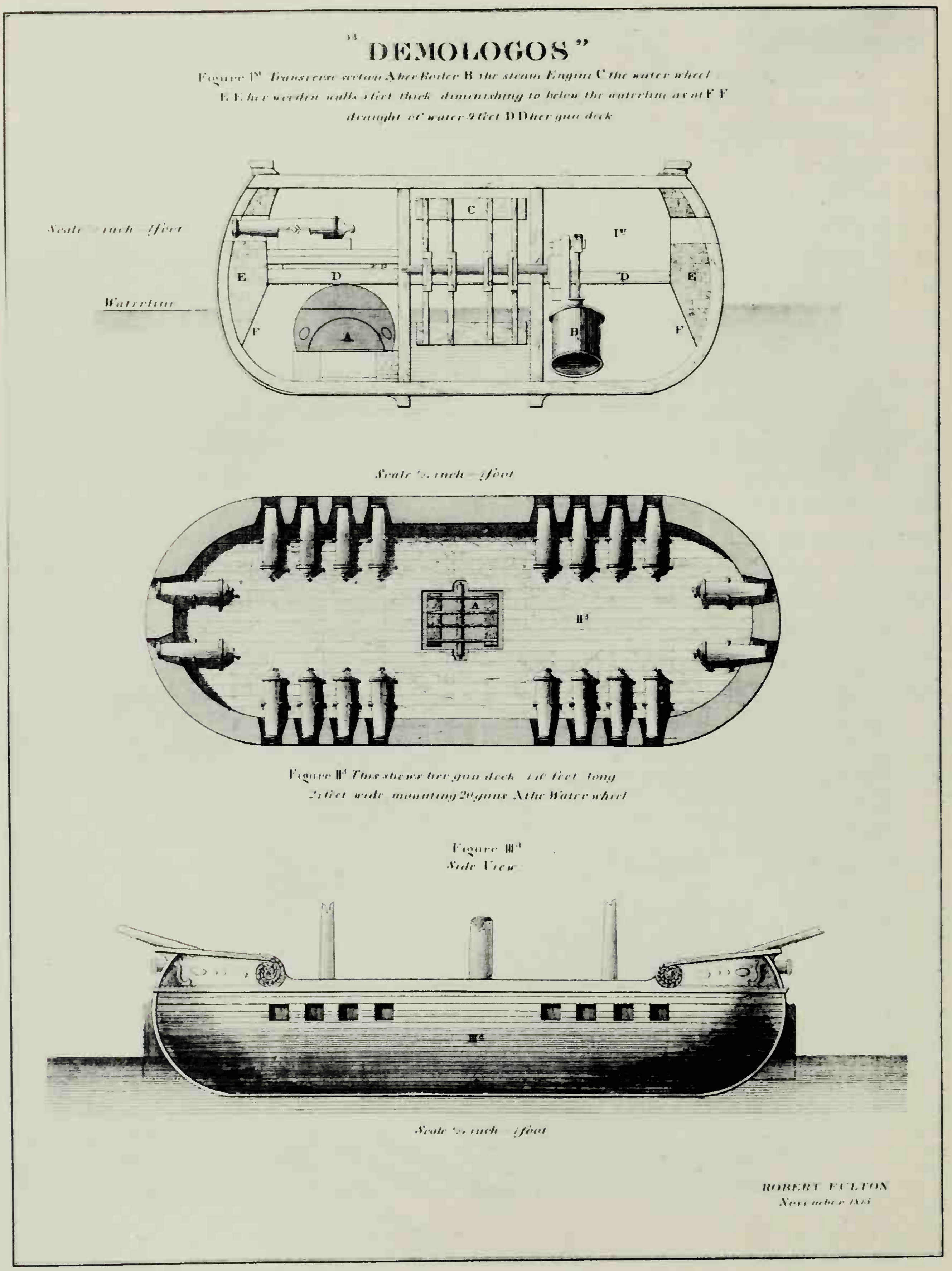


272. The first steam-driven man-of-war: Fulton's *Demologos.*

CHAPTER FOURTEEN

Iron Men-of-War

IRONICALLY, the steamboat came into being just as the sailing man-of-war was reaching its zenith. While Fitch was tinkering in his shop and Fulton sketching on his drawing board, England's shipwrights were turning out the great three-deckers that fought under Nelson at Trafalgar and New England's the formidable frigates that performed so nobly in the War of 1812. It was the agile-brained Fulton who gets the credit for the first steam-powered warship, and this time there are no rivals to enter counterclaims; the achievement was all his. In 1814 he launched for the U. S. Navy the *Demologos,* "the people's word." He designed her with twin hulls that, Siamese twin-like, joined together at stem and stern; the boiler was in one, the engine in the other, and the paddle wheel nestled safe from enemy fire in a slot, sixty feet long and fifteen broad, between them. In order to mount a mighty broadside of thirty thirty-two-pounders, Fulton gave the *Demologos* a length of 167 feet and a width of fifty-six and, in order to make her impregnable, fortified her with walls fully five feet thick.[1] This behemoth could only waddle at a scant 5½ knots, but that made little difference; she was intended purely for harbor defense.

Yet Fulton set off no explosion in naval circles. The *Demologos,* the only warship in the world able to move by means other than muscle or wind, gathered barnacles in the Brooklyn Navy Yard until she blew up by accident in 1829. Both in America and Europe, steamers were chugging along the coasts, across bays, and up and down rivers, but navies used the new power only for tugs and other working craft. This wasn't all brass-hatted resistance to change. The *Demologos* was fine for defending a harbor, but admirals had to think of oceans. And a seagoing man-of-war, though it could make very good use of steam's maneuverability, could ill afford to pay the price: the engines of the day burned coal so extravagantly that too much precious space would have to be taken away from guns and crew and given to bunkers; one shot on the frail paddle wheels—and even an early nineteenth-century gunner with an early nineteenth-century gun had to be pretty bad to miss so juicy a target—and a ship was a sitting duck; and one shot on the engines and a ship was an exploding one as well. "Mr. Speaker," explained Lord Napier before Britain's Parliament, "when we enter His Majesty's naval service . . . we go prepared to be riddled with bullets or to be blown to bits by shell and shot; but, Mr. Speaker, we do not go prepared to be boiled alive."

It was the screw propeller that made steam warships possible. The vessel's vital drive mechanism could now be tucked safely below the water, and its engines tucked safely deep in the hold. The United States Navy brought John Ericsson from Britain to America in 1839 where he forthwith started work on the first screw-propelled warship, the *Princeton,* a small

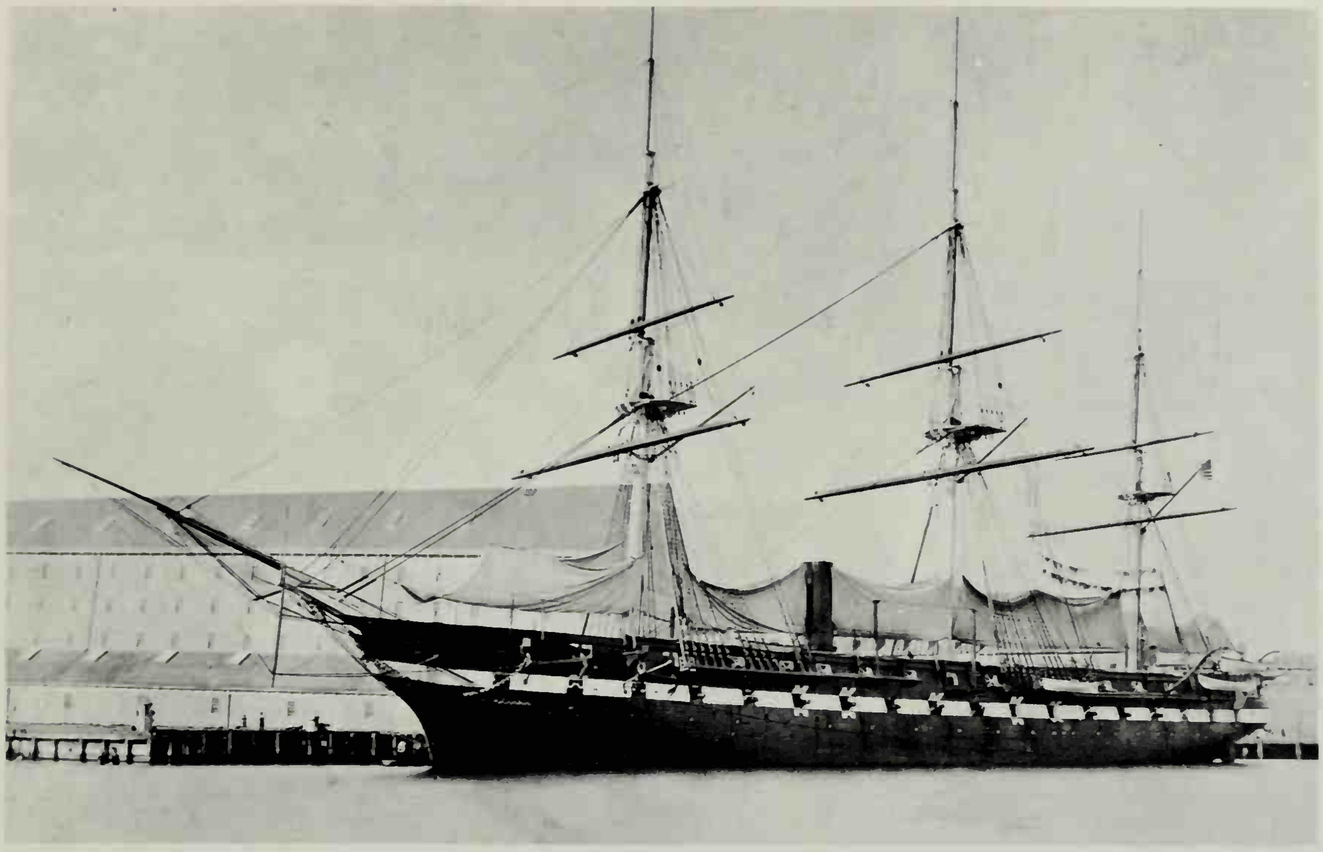
[1] A typically Fultonesque touch was a steam-pressure pump and hose—to flush sailors from the enemy's deck and drench his guns so they wouldn't fire.

(164′ × 30½′) but powerful sloop of war (it mounted a pair of giant twelve-inch guns in addition to ten forty-two-pound carronades). Across the water Francis Smith (above, p. 216) about the same time finally roused some interest among England's apathetic admirals. They had reservations, however, and, to resolve all doubts held a mighty tug-of-warships. In 1845 they took the *Rattler,* a screw warship that had been built at their orders, hitched her stern-to-stern to a paddle-wheel steamer, and ordered the skippers of both to open the throttle wide; the *Rattler* towed off her opponent at 2½ knots. The admirals still weren't sure: maybe this proved only that the *Rattler* was the stronger ship. So, finally, in 1849—five years after Ericsson's *Princeton* had been commissioned—they got around to repeating the experiment with two evenly matched vessels; again the screw propeller won, and the Admiralty gave the signal to switch from sail to sail plus steam. All other navies were doing the same. Yet, though iron merchantmen were being built all over the world—the *Great Eastern,* as a matter of fact, was on the stocks at the time—for these new steam-driven men-of-war wood was still used almost exclusively. Then came the Battle of Sinop Roads.

Russia and Turkey were at war. On November 30, 1853, a Russian squadron of ten vessels steamed into the Black Sea port of Sinop, where a Turkish fleet of twelve lay at anchor. The Russian ships were equipped with the gun which Henri Joseph Paixhans of the French Army devised in 1819 to fire an explosive shell horizontally and which, since 1822, he had enthusiastically been promoting for shipboard use. What took place was not a fight but a massacre: solid shot wooden ships could stomach—it punctured neat, patchable holes—but bursting shells tore great, gaping gashes; when the Russians left after two hours only one Turkish craft was afloat.

The French, reacting first, summoned the blacksmiths to the rescue and scrambled to produce some ironclad, steam-driven floating batteries, and England followed suit. These did such a good job in the Crimean War against Russian shore batteries, whose shells merely dented the iron overcoats, that France followed up with armored men-of-war and in 1859 got out a seagoing ship, *La Gloire,* a good-sized (255′ × 55′) wooden frigate swathed in a 4¾-inch coat of wrought iron armor. Sinop Roads hadn't scared the British Admiralty into anything more than floating batteries, but *La Gloire* did: the very next year England had an ironclad of her own in the water, the *Warrior,* 420 feet over-all and fifty-eight wide, with a broadside of twenty-eight seven-inch guns. *La Gloire* was merely a wooden ship covered with armor; the *Warrior* pointed to the future, for she was an armored iron ship: her plates were protected along the broadside by a swath of tough teak eighteen inches thick covered with a 4½-inch crust of iron.

In America there were a number of men of imagination who read the future—but could do little about it. The first iron man-of-war, like the first propelled by a screw, was made in America: sixteen years before Britain's *Warrior*—she was only the first *armored* warship of iron—a little (163′ × 27′) sloop-of-war, the *Michigan,* driven by a full set of sails in addition to her two paddle wheels, and mounting one eighteen-pounder, was launched on the Great Lakes to patrol the waters (where, never seeing action, she stayed alive for at least a century). But the *Michigan* was left a stepchild. Robert Livingston Stevens, son of John Stevens and one of the crew during the *Phoenix's* epoch-making ride (above, p. 212), had submitted plans for a powerful steam-driven, twin-screw ironclad for coast defense as far back as 1841; in 1854 it was actually under construction, a vessel as big as the *Warrior* was to be six years later. But it was never completed: in that very year the United States Navy,



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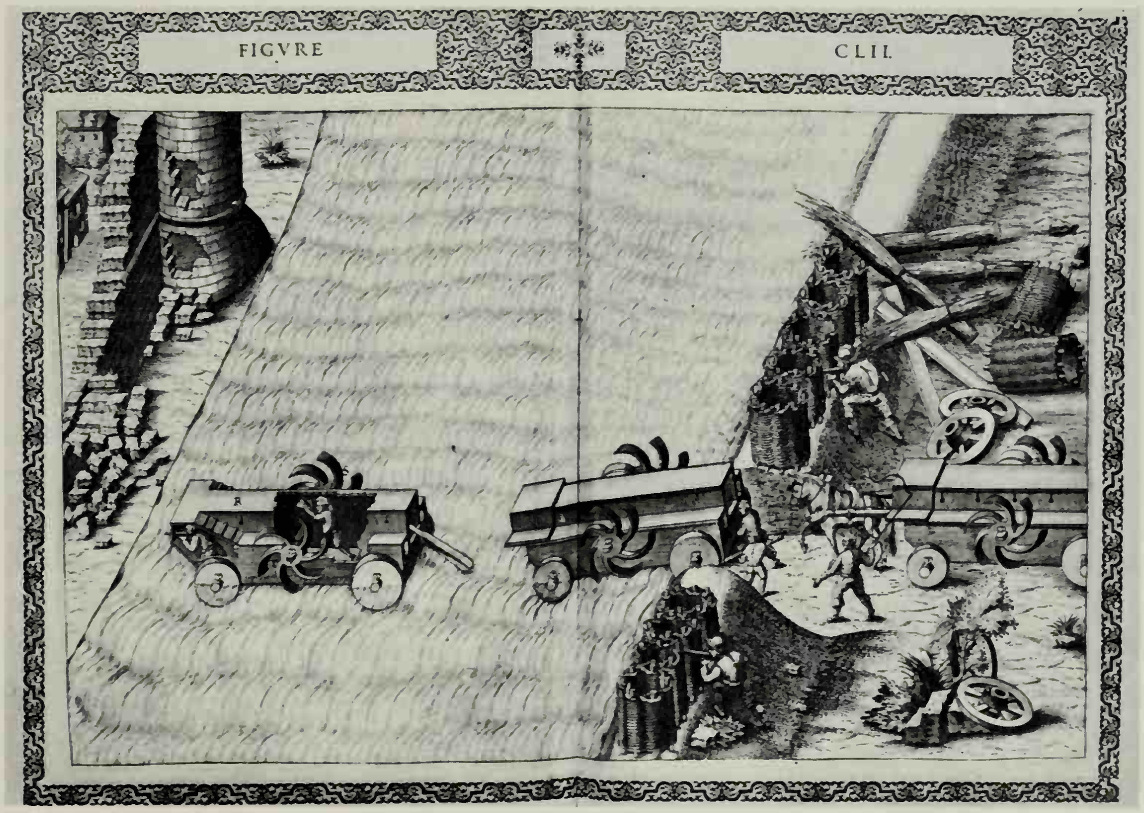

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273. A steam-powered wooden man-of-war: The United States Navy's *Minnesota,* a forty-gun frigate launched in 1861. This old photograph was taken several decades later, after she had been laid up.

274. A sixteenth-century inventor's suggestion for an ironclad paddle-driven amphibious craft. A series of these, by snuggling up end to end, were to form an armored bridge which would enable attackers to cross the moat of a castle or fort.

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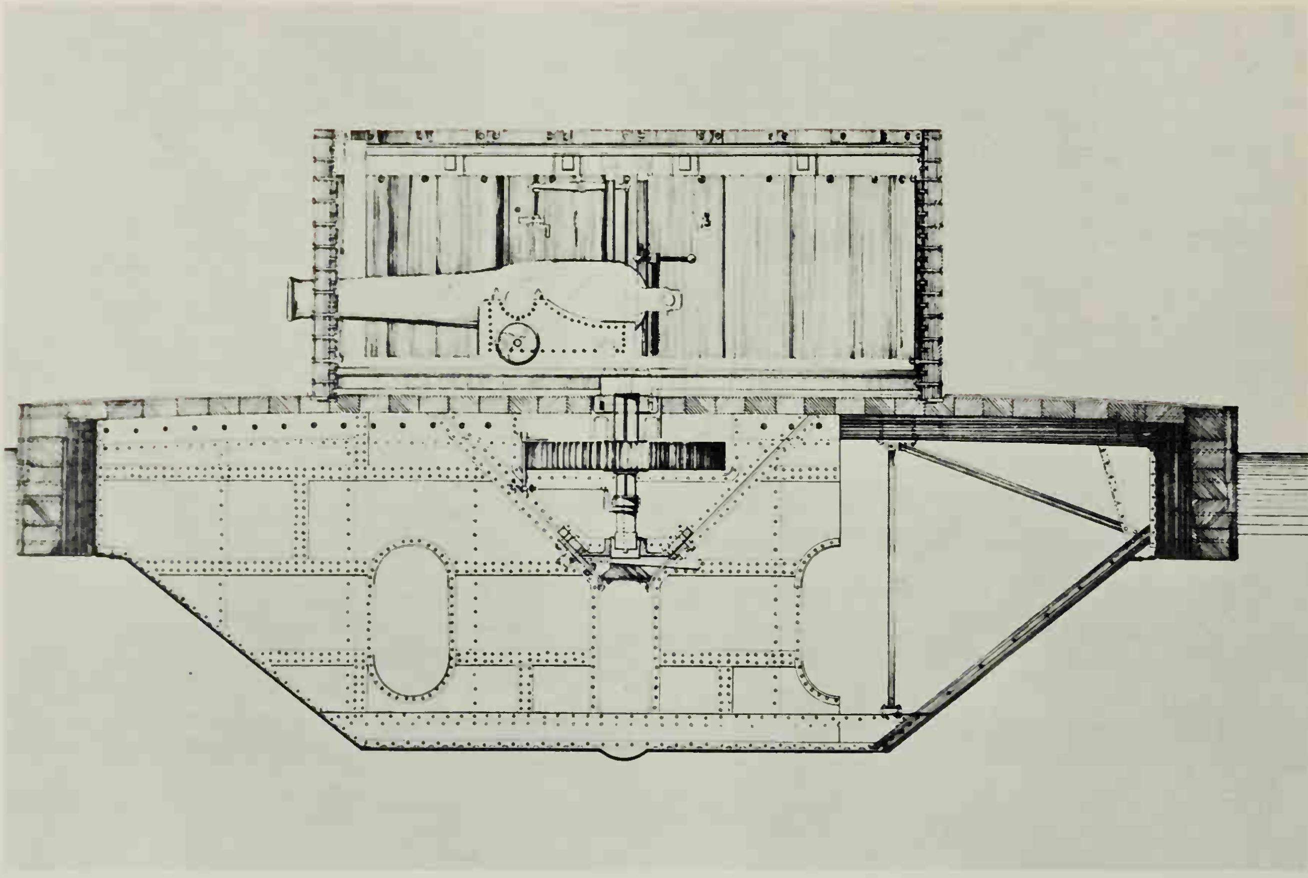
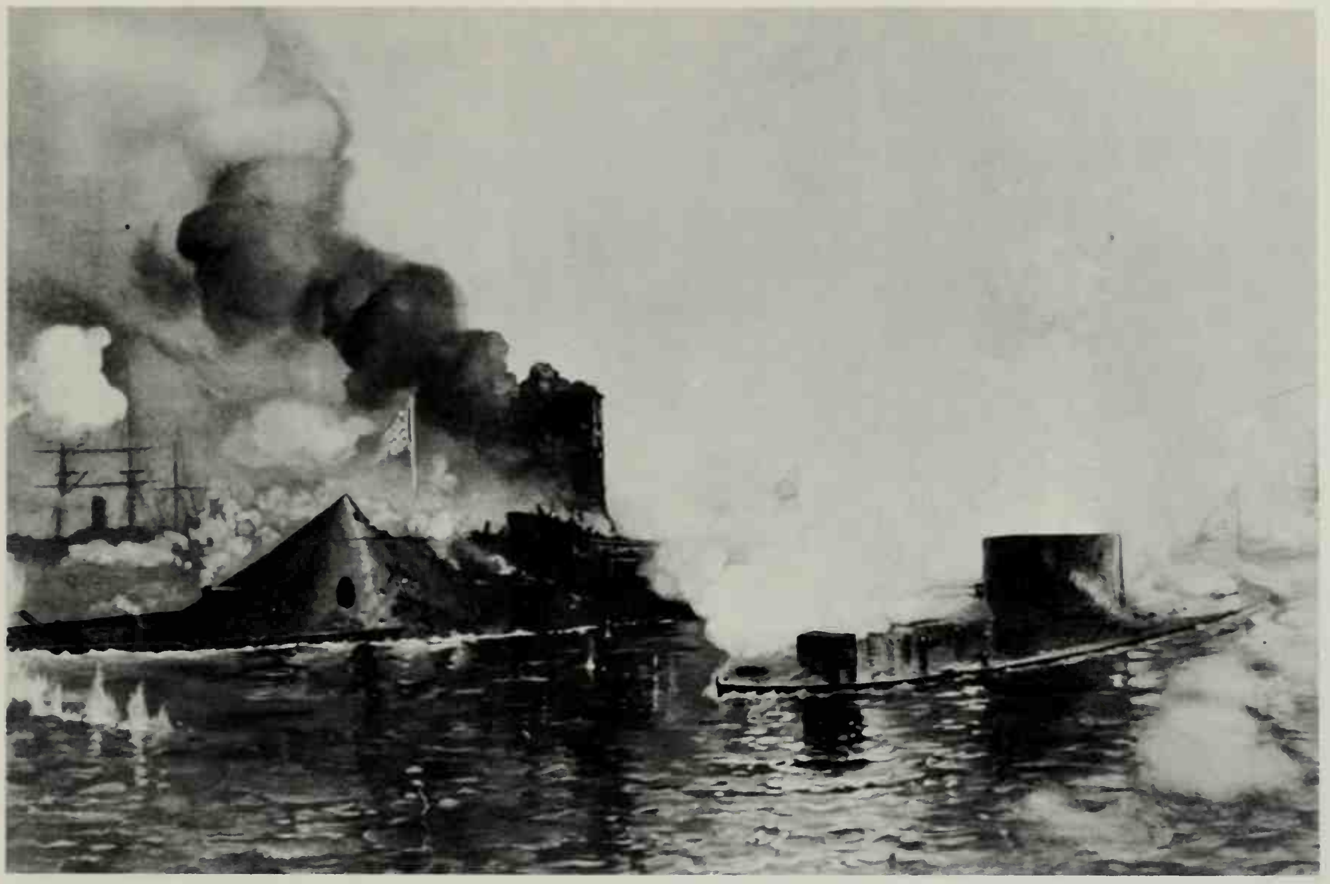


275. Ericsson's plan for the *Monitor's* turret.

blithely ignoring the lesson of Sinop Roads, started building six of the finest steam-driven wooden frigates afloat—which other navies forthwith studied and admiringly copied; America had no monopoly on shortsightedness. One of these ships was to make history in a way its builders never planned—the *Merrimack.*

In 1861 the Civil War broke out, and very soon after came the uncomfortable news that the ingenious Confederates, having salvaged the *Merrimack,* which Union forces had sunk when they hastily evacuated the Norfolk Navy Yard, were bundling her in iron. The admirals finally had to face the facts. So, when Ericsson, dusting off some plans he had tried to sell Napoleon III for the Crimean War, offered the *Monitor,* the Navy grabbed it. Ericsson's brainchild was a raftlike vessel (its freeboard was a scant two feet) that carried a round box mounting two cannon. The engines were safe in the hold below water level, the hull had five inches of armor to protect the sides and one inch the deck, and the box was girdled with no less than eight inches. The armor, of course, was nothing new. What was new was the armament—instead of a fixed broadside of many guns there were only two, but both big (eleven-inch) and mounted in a turret that, swiveled by steam power, was able to be quickly aimed in any direction.

On March 8, 1862, the *Virginia* (nee *Merrimack*) steamed out to take on the Union blockading squadron. The enemy's shot bounced harmlessly off her iron coat as she proceeded to ram the sloop of war *Cumberland,* sink it with gunfire, and then batter the frigate *Congress* into surrender. During these very hours Ericsson's *Monitor* was racing to the rescue. It arrived



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276. The *Monitor* and *Merrimack,* a watercolor by Oscar Parkes, the great modern British naval historian.

that night and, when the *Virginia* came out cockily the next morning, she found a lot tougher opponent than the soft-bellied ones of the day before. The two vessels pounded each other at point-blank range for hours and finally drew apart at nightfall. Neither had drawn blood (the fight from that point of view was about a draw), but the *Monitor,* to the North's vast relief, had stymied the South's serious threat.

March 8, 1862, didn't write the death warrant of the wooden warship. That had been issued some time before, although a good many admirals had refused to read it. What the day did do—or should have done—was consign to the graveyard the fixed broadside battery. Ericsson's turret showed the way to what lay ahead: now only the gun had to be aimed, not the whole ship.

The *Monitor* had proved itself, so the United States Navy enthusiastically committed itself to building more like it, even though its low freeboard and scant accommodations limited it to coastal defense. The Navy actually turned out some big models for seagoing service but, though they handled wind and weather better than anyone expected, there were other factors to consider. The skipper of a Monitor which was sent to the Pacific around Cape Horn reported that the temperature in the fireroom ranged from 120° to 140° F. during the passage. "Sixteen men of the fireroom force have been removed from the fireroom in a state of insensibility," he reported laconically. Clearly the Monitor was not the warship of the future. By a quirk of fate, a craft that pointed toward the future, the *Roanoke,* at that moment was gathering barnacles on harbor duty. It was the second of the wooden frigates of 1854 that was historical in a way the Navy had never intended.

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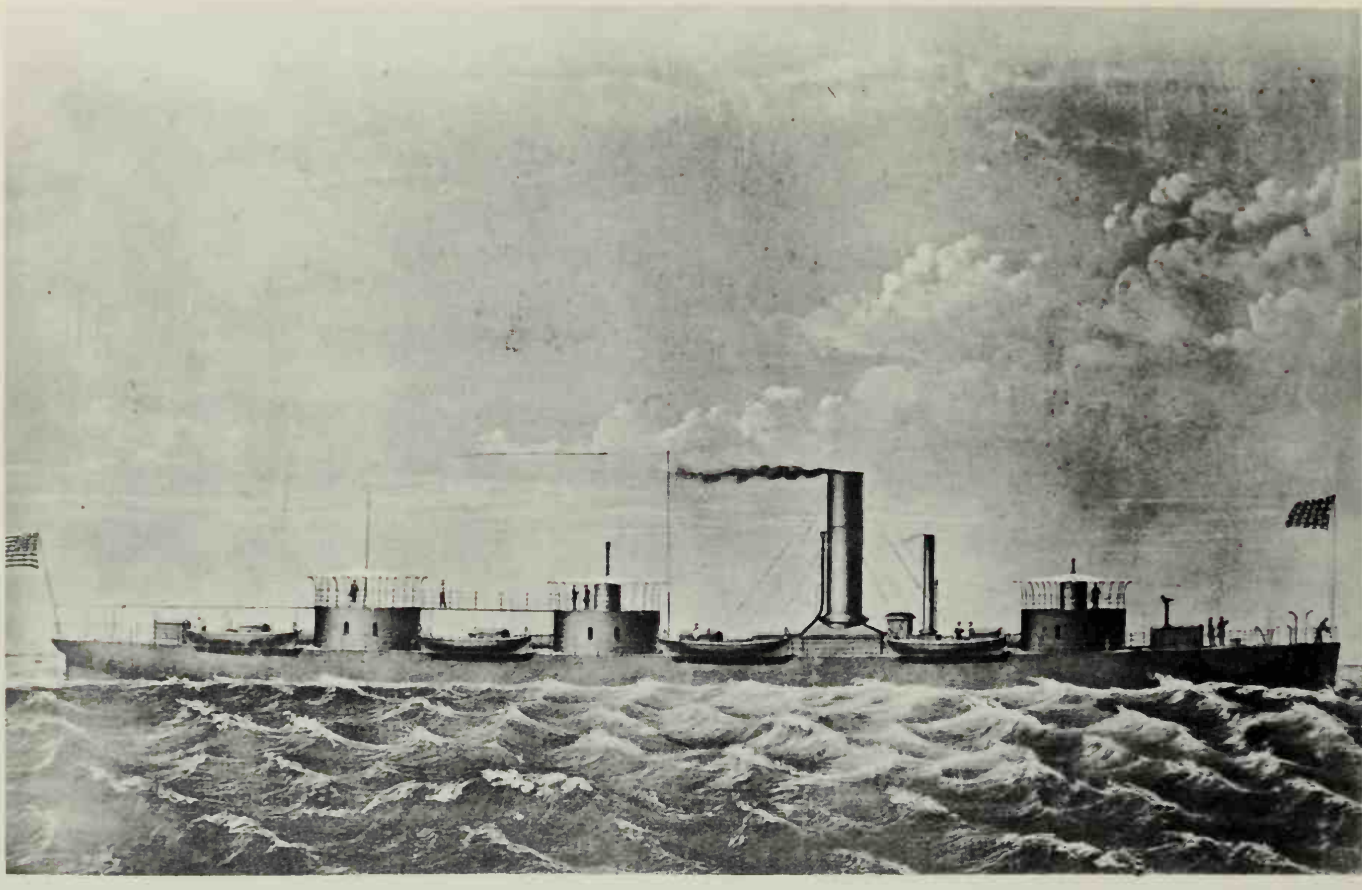

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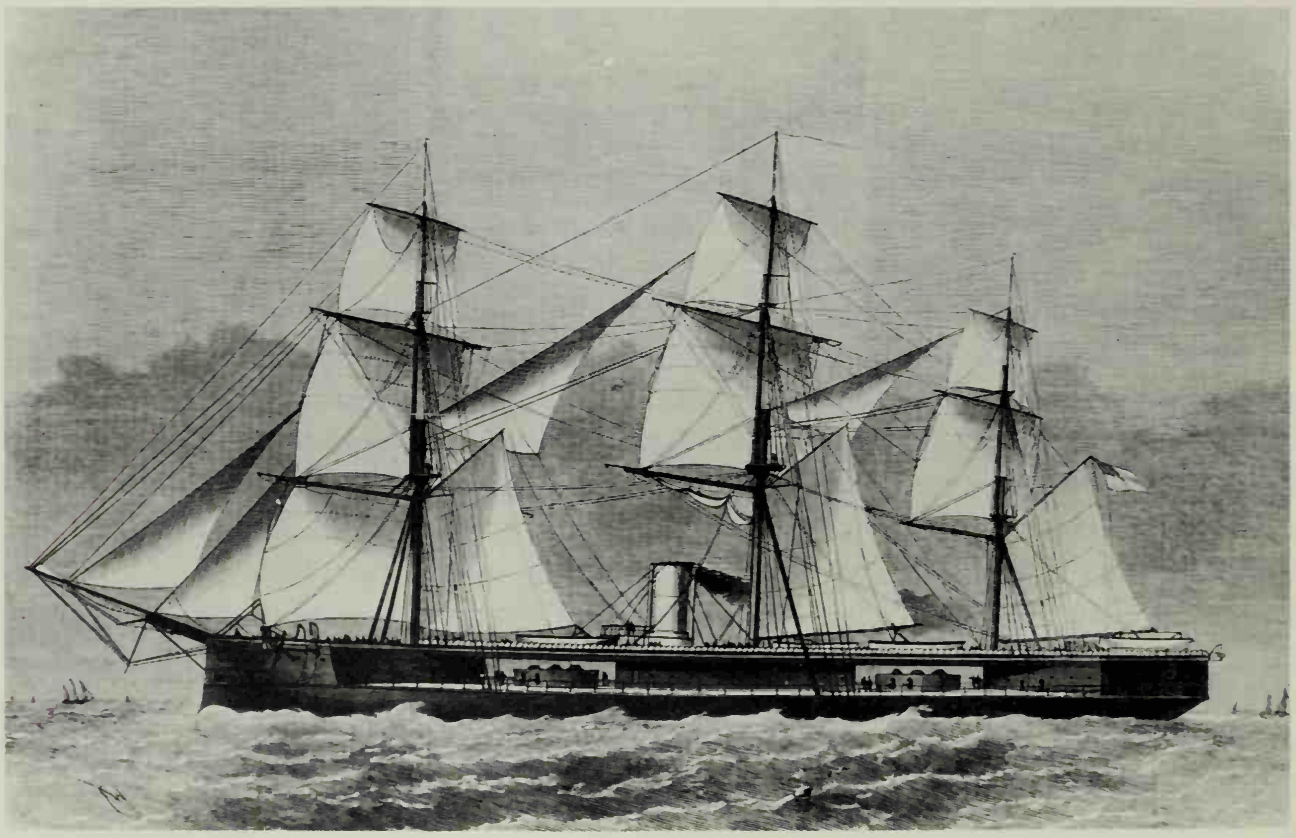
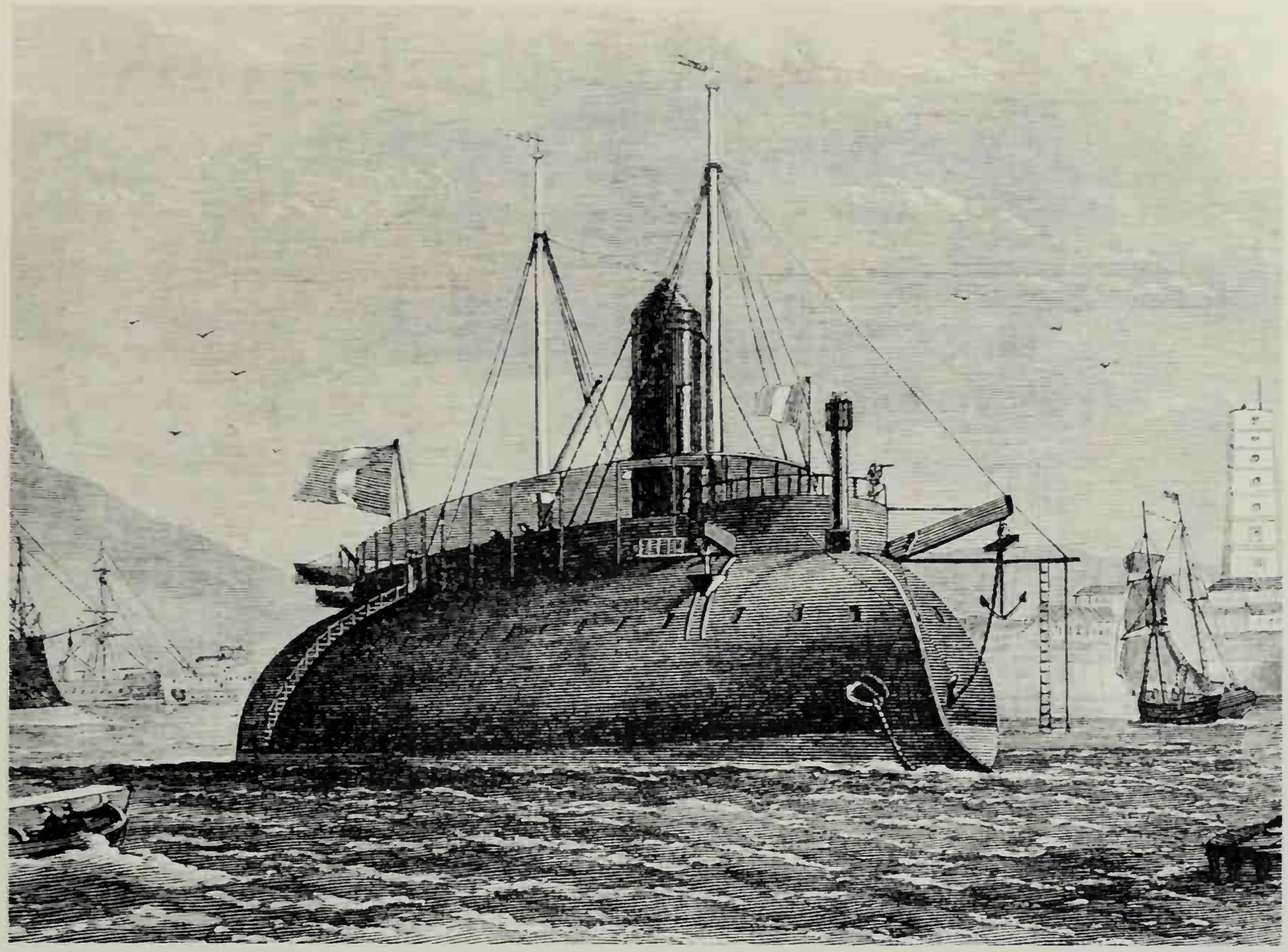


277. The *Roanoke* after her conversion to a turret-gunned ironclad powered by steam alone.

278. The ill-fated *Captain* which capsized in 1869, a year after her launching.

279. The French ram *Taureau*, an experimental ironclad of 1866.



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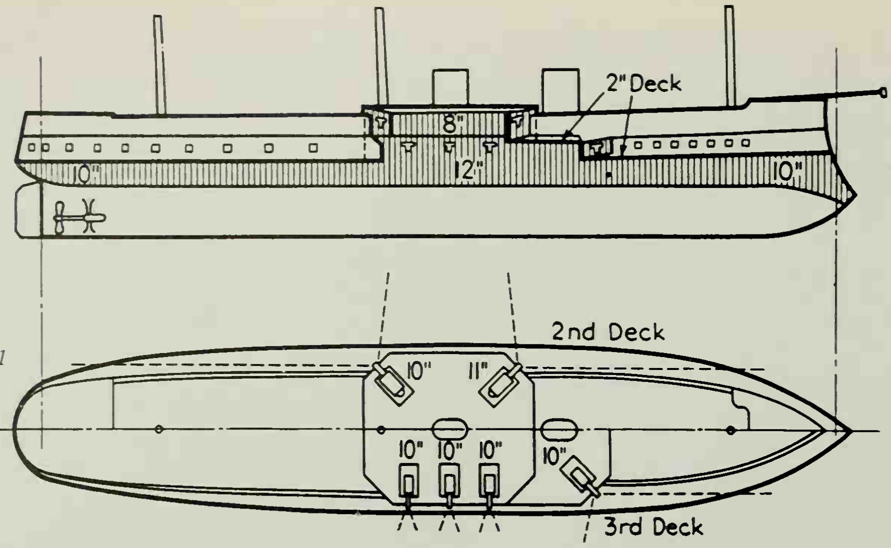
Ericsson, as it happens, wasn't the only man to come up with the idea of mounting guns in turrets. In 1859, Captain Cowper Coles of the British Navy had proposed a ship with guns set in hemispherical armored "cupolas" and, a few weeks before the *Monitor* fought its renowned battle, work began on the *Prince Albert,* a man-of-war based on his designs. About the same time, America's Chief Naval Constructor John Lenthall and Engineer in Chief Benjamin Franklin Isherwood, who were familiar with Coles' ideas, pleaded for real seagoing ships with turrets, not Ericsson's slablike contraption with its limited range. But nothing succeeds like success, and after the *Monitor* had covered itself with glory, the Navy would hear of nothing else. However, Isherwood and Lenthall were given one of the *Merrimack's* sisters, the *Roanoke,* to play with. They stripped her down to the deck and mounted along the centerline three turrets with two big guns in each (mostly fifteen-inch and eleven-inch)—in other words, they gave her the fundamental features of a modern warship: big guns mounted in turrets aligned over the keel. But the *Roanoke* had been born too soon. She was destined to blush unseen at anchor in various naval bases the rest of her days.

Nor did Coles fare much better in England. The *Prince Albert* was finally launched in 1866, a 240-foot ironclad driven by a full suit of sails as well as steam, and carrying four turrets with one nine-inch gun in each. Yet, like the *Roanoke,* the *Prince Albert* was treated as a stepchild. Coles himself hardly helped matters. He turned to a bigger and stronger ship, the *Captain,* and, although he equipped her with a lofty, full ship-rig, he gave her so little freeboard that, in 1869, a year after her launching, she capsized in a gale, taking her designer with her.



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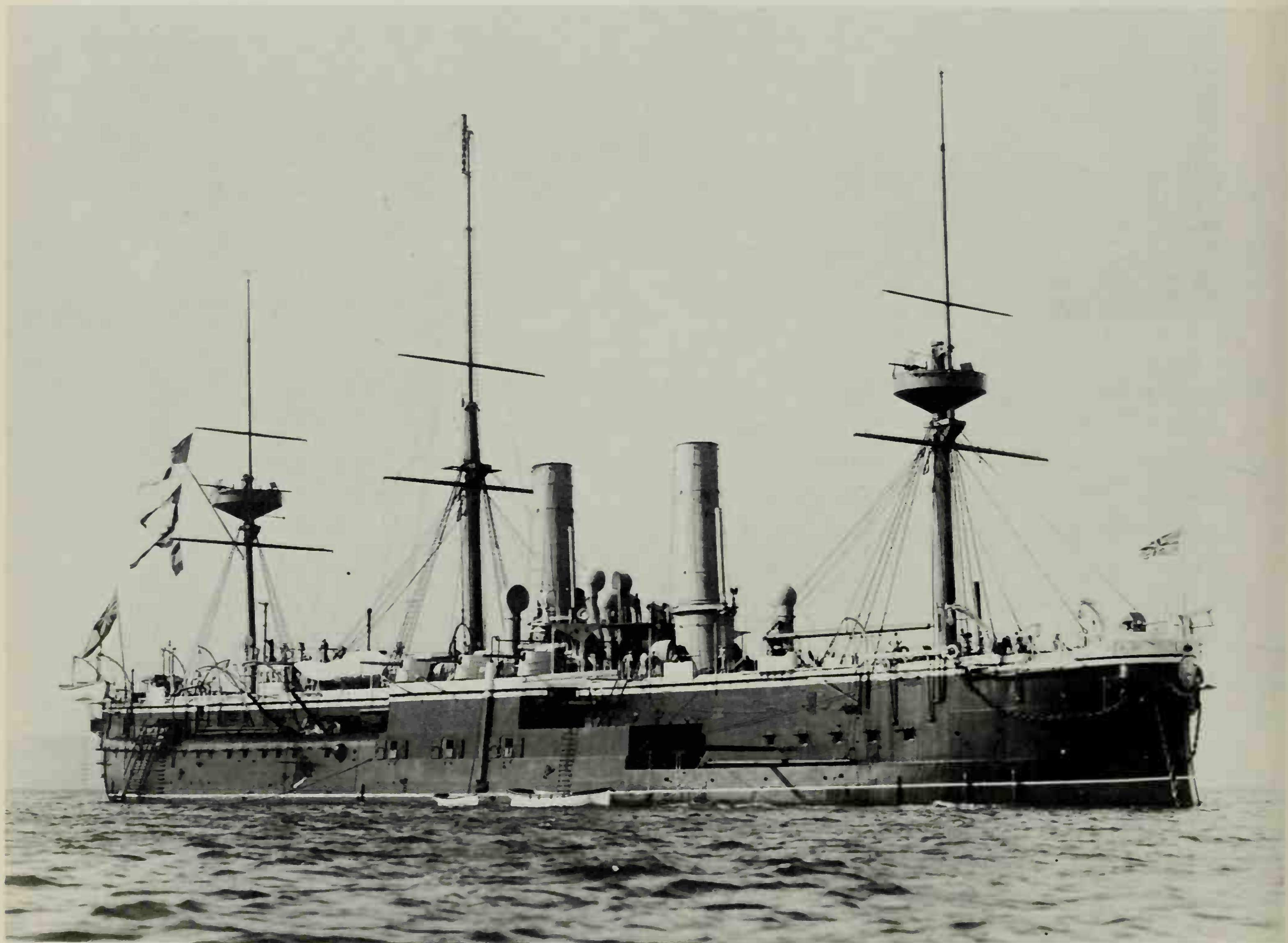

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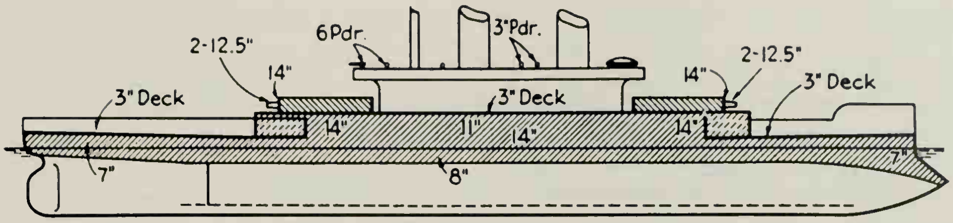
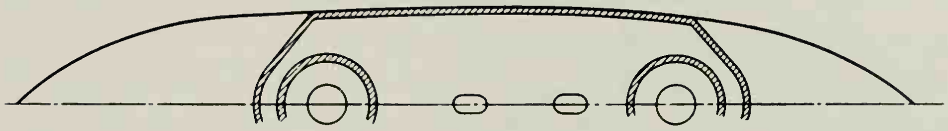
280, 281. The *Alexandra*, 325′ × 63.8′, 9490 tons; launched in 1875. She was the last and most powerful of Britain's "casemate" type of battleship. The armored casemate was amidships and two decks high. The upper half of the plan shows the upper deck, which had two eleven-inch guns in the forward corners and two ten-inch guns in the after corners; the lower half shows the lower deck, which had three ten-inch guns on each broadside. The *Alexandra* could make fifteen knots.





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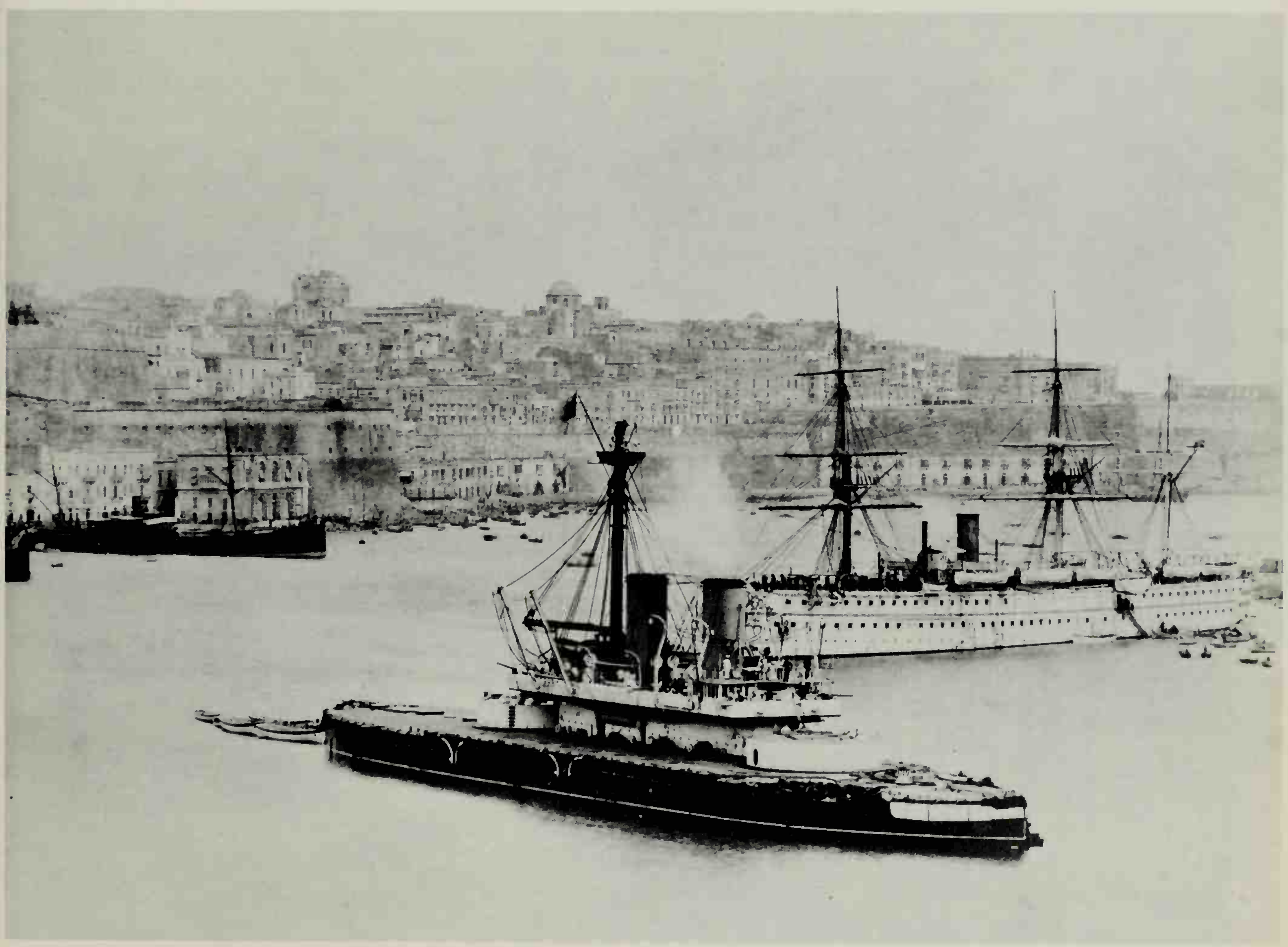

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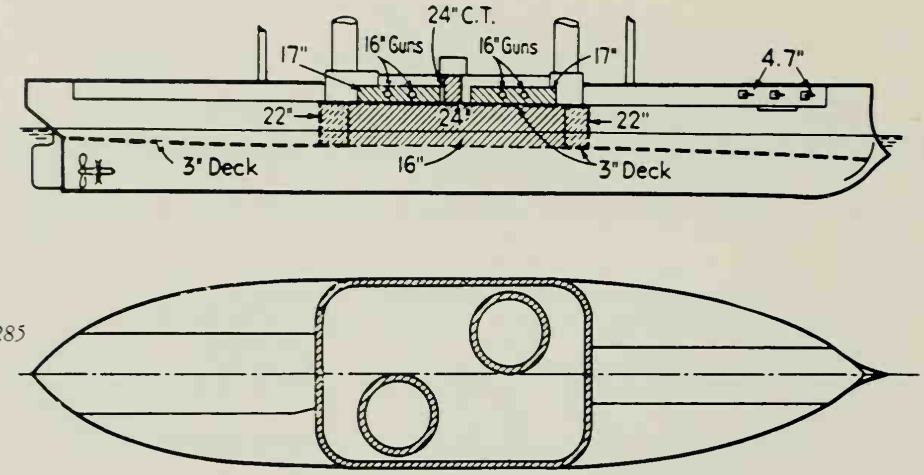
282, 283. The *Dreadnought,* 320′ × 63.8′, 10,886 tons; launched in 1875. She was the most powerful of Britain's "breastwork monitor" type of battleship. The *Dreadnought* could make 14.2 knots. She is seen here in Malta Harbor.



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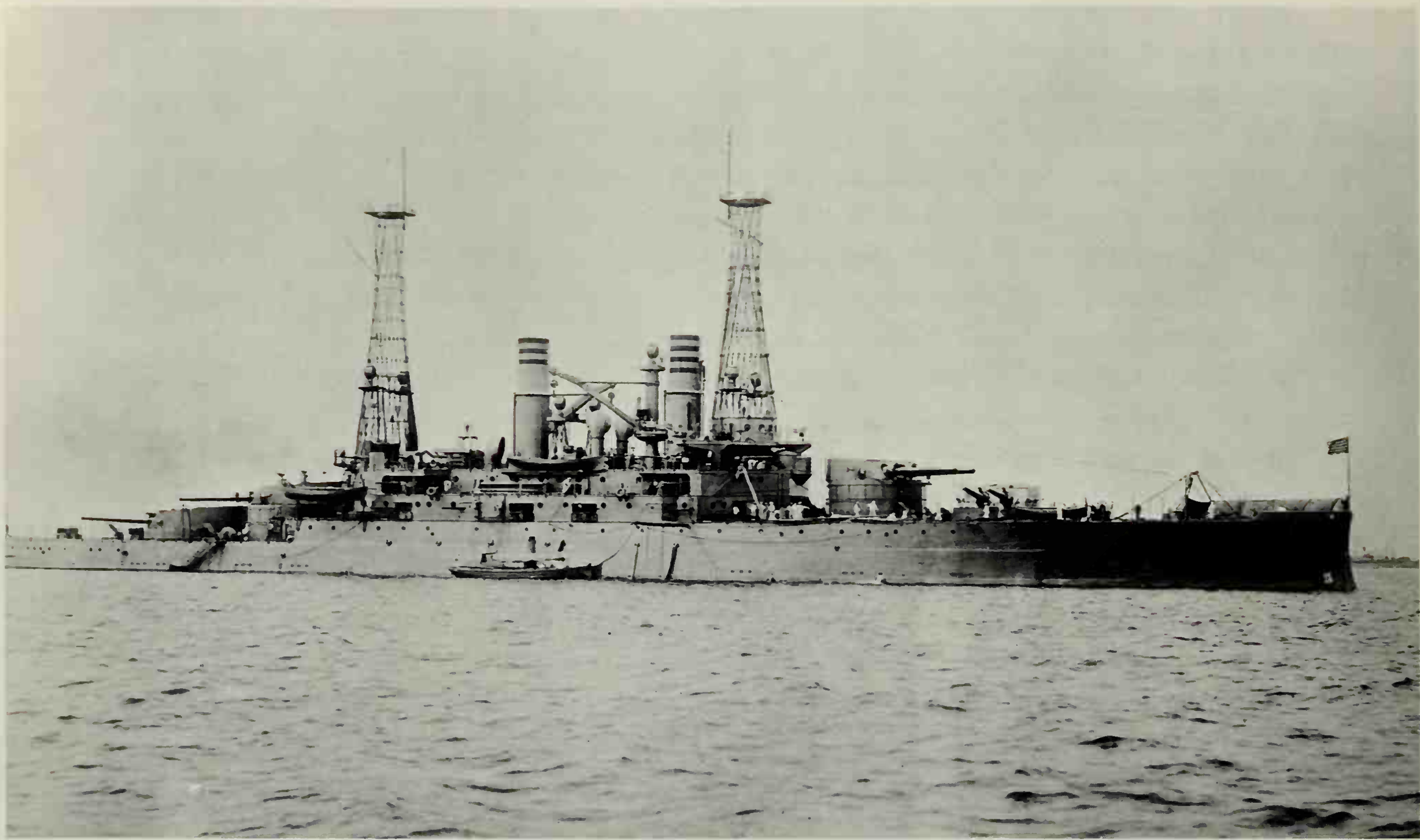
284, 285. The *Inflexible*, 320′ × 75′, 11,880 tons; launched in 1876. She was one of Britain's "central citadel" type of battleship. Everything in the central citadel was extra-strong: the armor there was twenty-four inches thick and the guns were giant sixteen-inch muzzle-loaders. The *Inflexible* could make only 12.8 knots. She is seen here in Malta Harbor.

For the next forty years or so, naval development muddled along in a curious, helter-skelter fashion. Every navy had to go in for increasingly heavy armor, for guns were getting bigger and better—the muzzle-loading smoothbore was growing up into the breech-loading rifle. The *Monitor's* five inches of iron was an eggshell compared with the two-foot girdle battleships wore no more than fifteen years later. A warship's hull now had to carry thousands of tons of armor plate as well as the massive new cannon—and still provide for the power plant and bunkers to drive all this dead weight through the water at a fair speed. Moreover, the guns themselves had to be so mounted that they would have at least some of the mobility of Coles' and Ericsson's turrets. As if all this wasn't enough to drive a naval architect to distraction, old shellbacks insisted on a full spread of sail, and old and young, influenced by the Battle of Lissa in 1866, in which an Austrian battleship rammed and sank one of Italy's newest and best ironclads, insisted on beefing up the bow into a ponderous, powerful ram. Inevitably warships grew bigger and bigger: Britain's *Warrior* had been about nine thousand tons displacement; the *Inflexible,* launched in 1876, was 11,880. By the 1870s, engines were so efficient and dependable that some ships had even given up their precious sails and were beginning to look unmistakably like modern warcraft. But one problem resisted all efforts: the placing of the guns. No navy was able to come up with an arrangement so demonstrably superior that all rivals followed suit. Each nation, tackling the problem in its own way, produced its own series of curious failures that, after a short life, had to be scrapped.

All designers went in for a central battery instead of a broadside, i.e., bunched the guns in an armored stronghold amidships, but that's as far as the resemblances went. The British had some ships with the big guns along the sides of a large armored box (the "casemate" type of battleship), some that were like oversize Monitors with a turret at either end of an armored redoubt (the "breastwork monitor"), and some with a short and massively armored box mounting one turret to port and one to starboard (the "central citadel" type). The French put the big guns on top of armored tubes, protecting the crews with metal shields that reached up to the barrels (the "barbette" type). The Italians had their system, the Russians theirs—and the United States, not much interested in a navy at the time, was back in the stone age, fussing halfheartedly with Monitors. Many systems included a mixture of big and smaller guns, many still showed a nostalgic tendency to mount guns on the broadside, and none had the freewheeling flexibility of the turrets on the aging, neglected *Roanoke.*

Finally, by the beginning of the twentieth century, the warships of the world again began to look alike as they had in the days of wood and canvas. For the naval architects at last realized that the most efficient arrangement for the guns was in turrets placed, whenever possible, over the centerline. Once this was done, other improvements followed rapidly. The turrets themselves were mounted on top of cylindrical armored barbettes which enclosed and protected the mechanism for swiveling the turret, the ammunition hoist, and the like. In 1906 Britain set a basic pattern with her *Dreadnought* which, abandoning secondary batteries almost completely, relied on a main battery of ten twelve-inch guns in turrets. Then, in 1909, the United States, by that time well out of her naval lethargy, launched the battleship *Michigan,* whose designers not only put all the turrets, each mounting two twelve-inch guns, along the centerline but set them in tiered pairs, i.e., with one behind and slightly higher so that its guns could shoot over the other's and all guns could bear on either broad-



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286. The U.S.S. *Michigan* of 1909, 452.8′ × 80.3′ × 24.6′, 16,000 tons, the first battleship equipped with superfiring turrets.

side; the *Michigan* had two fewer guns than the *Dreadnought* and was two thousand tons less in displacement, yet was her match in a fight, thanks to the superfiring turrets. All other navies quickly adopted the system and it has remained in use ever since.

The *Michigan* was the last step, as it were. All that was left was to perfect and increase, and this was done so effectively that, by World War II, the United States, for example, was able to send into battle giants which had a displacement of forty-five thousand tons, mounted nine sixteen-inch guns—and yet were able to dash at the well nigh incredible speed of thirty-one knots.

But, just about the time that the problems of the ironclad man-of-war were being solved, the instrument that was soon to force it to abdicate appeared on the horizon: the airplane. With the airplane and the other all-important military inventions of the twentieth century, the guided missile and atomic weapons, a crucial point in naval history has been reached. The warships of the future are the aircraft carriers (a type that came into being only a few decades ago), the fast-stepping cruisers and destroyers that serve as carriers for missiles, and the missile-carrying submarines. Bombs and missiles have spiked the battleship's mighty batteries as Ericsson's and Coles' turrets did the wooden ship's broadside.

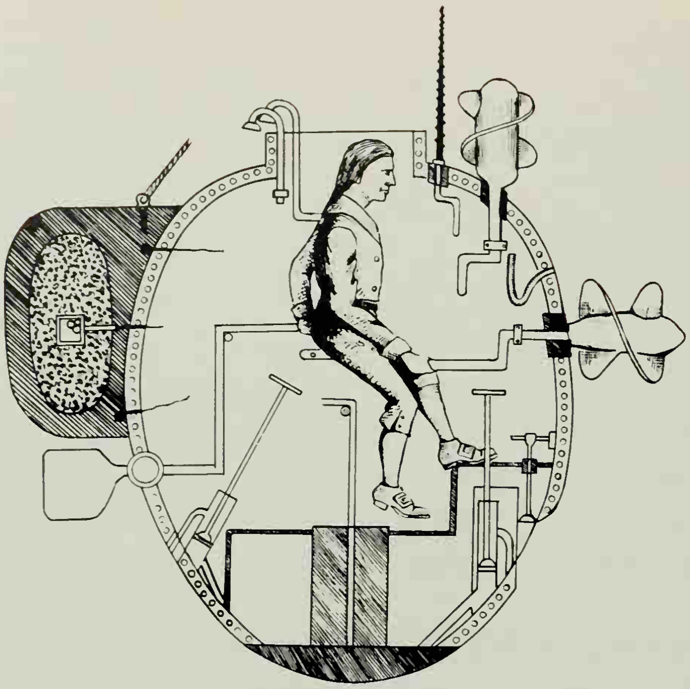
CHAPTER FIFTEEN

Under the Sea

A LITTLE BOY, pushed around by a big one, dreams of a weapon that will give him a chance to even the score. In a very real sense, this was the sort of thinking that produced the submarine. Ever since the defeat of the Spanish Armada, England had lorded it over the seas. To cut the bully down to size, to create an instrument that, striking swiftly, unseen, unheard, and with deadly effect, would destroy Britannia's rule, was the end most pioneers of the submarine had in mind.

Men had played with the possibility of traveling underwater for centuries. Though some of Europe's best minds had tackled the problem, the credit for the first tangible success goes to an obscure young American, David Bushnell, who started thinking about submarines when a freshman at Yale in 1771. Four years later, seeking to do his part in the American Revolution by creating a weapon to annihilate the British fleet, he built his *American Turtle.* He named it so because, made of oak strapped with iron bands, it looked for all the world like two six-foot turtle shells pressed together, with a conning tower sticking up where the head would be. Hand-operated screws drove it—this incredibly gifted youngster was the father not only of the submarine but of the propeller as well. Inside there was room for but one man, who must have kept busier than the proverbial paperhanger. He cranked a screw in front to drive the craft forward, steered with a tiller attached to a rudder, opened a valve to let water into a tank on the bottom when he wanted to submerge, operated a pump with his foot to empty the tank and at the same time cranked a screw on top when he wanted to rise, made sure as he went under that the automatic valves to close the two vents that rose from the conning tower (one let out foul air from around his head and the other let in fresh around his feet) were working, and, when underwater, kept his eyes glued on the water gauge and compass which had certain points picked out with phosphorus to glow in the dark. When he was finally under an enemy hull, he stopped cranking the screw and started cranking an auger connected through a watertight fitting to a bit that stuck out of the top of the hull like a unicorn's horn. The bit was made fast to a length of line, on the other end of which was a 150-pound keg of gunpowder with a fuse controlled by a time clock; the keg rode piggyback on the *Turtle* to the target. Once the bit had bored in, by an ingenious arrangement the operator was able to let the keg float free and to set the mechanism ticking—and then started cranking for dear life since he had only thirty minutes to get clear, not very much considering his speed. In 1776 the *Turtle* actually got under the keel of a British ship but the bit wouldn't penetrate the copper sheathing; some other tries were made, none successful, and the *Turtle* vanished from the stage of naval history.

But success or no success, Bushnell's inventive genius had produced three key features all submarines were to have: screw propulsion, water ballast, and a conning tower. Two more were added by Robert Fulton. Before he turned to steamboats, Fulton, then living in Paris,



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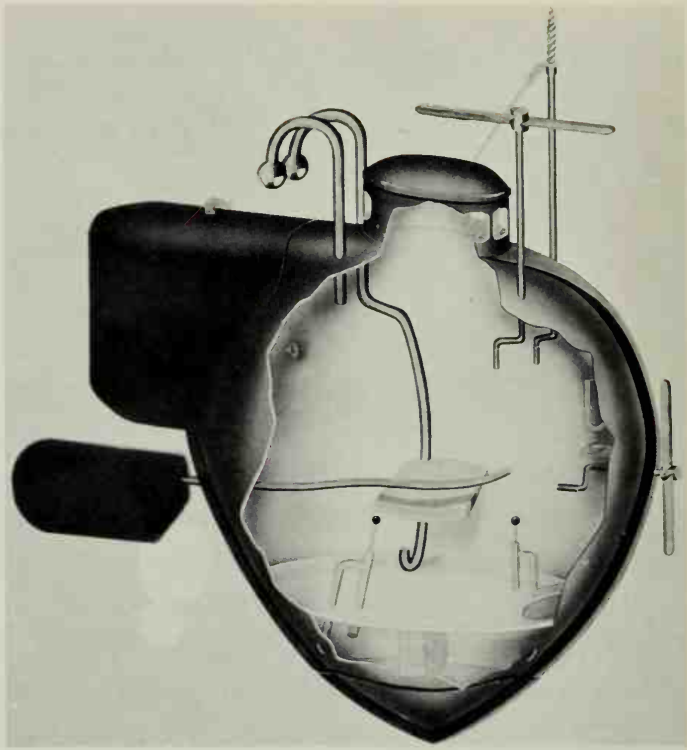

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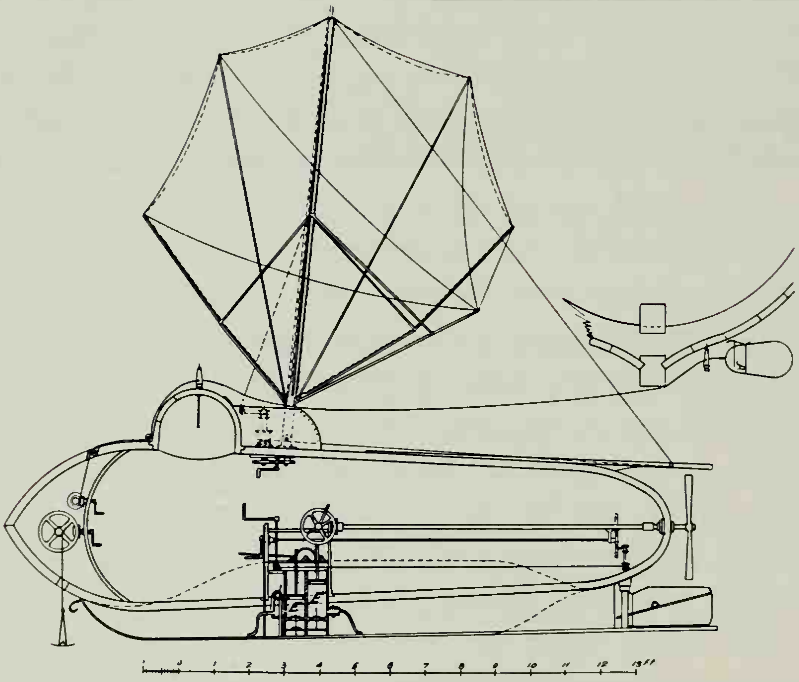

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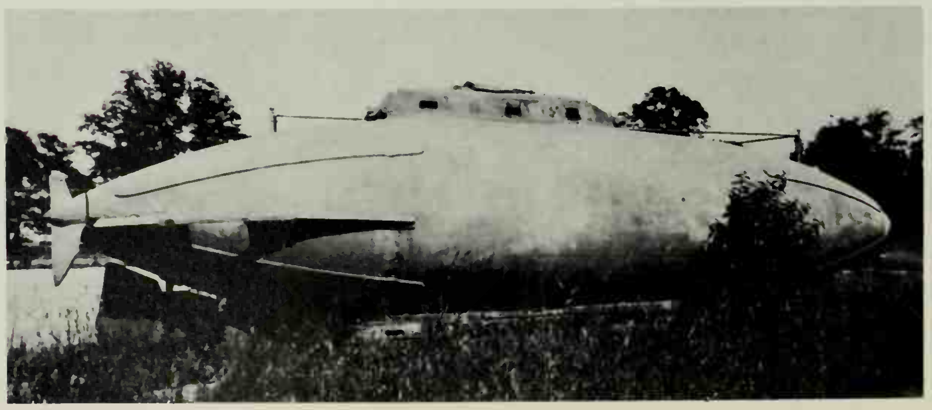

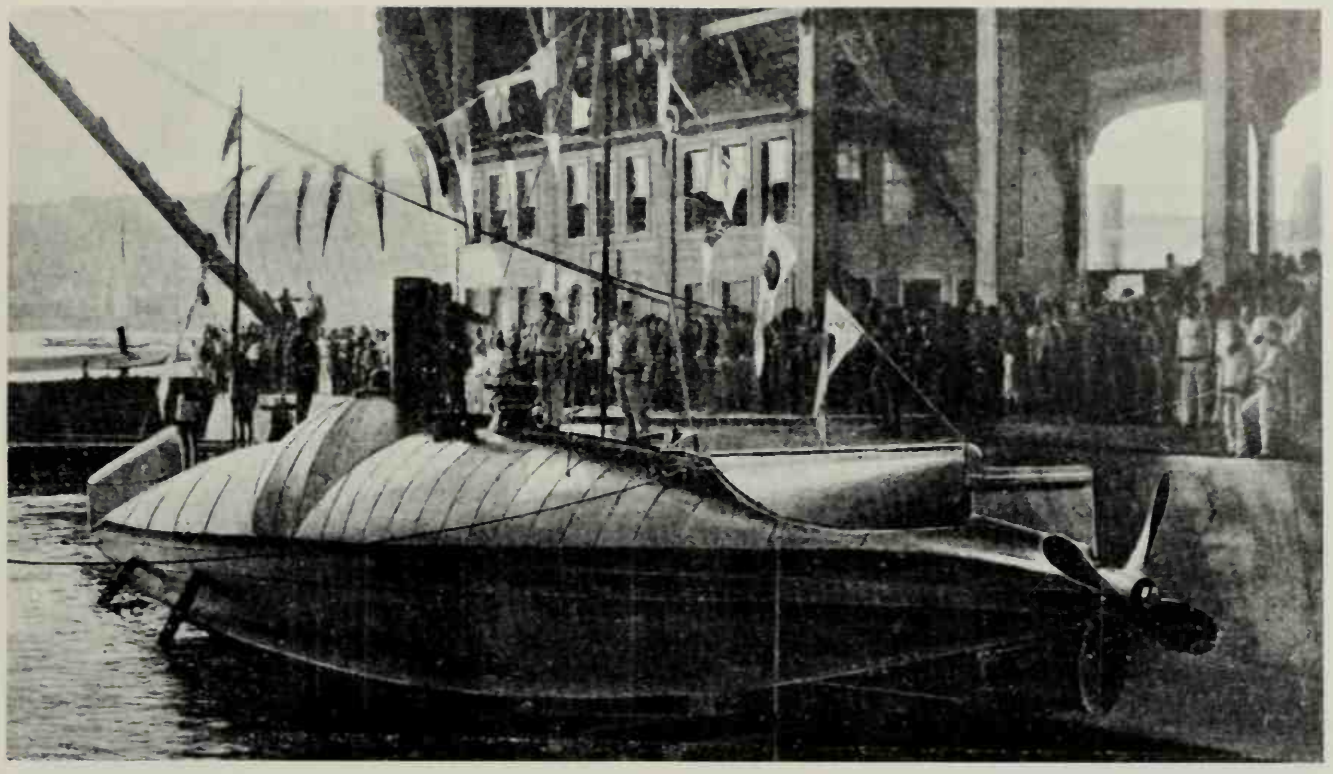

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287. Reconstruction of the interior of the *Turtle.* The screws should probably be of the type shown in illustration 288.

288. Another possible reconstruction of the *Turtle.*

289. Fulton's plans for his *Nautilus.*

290. One of the submarines Nordenfelt and Garrett sold to the Turks alongside a dock in Constantinople in 1887.

291. Holland's *Fenian Ram* at Classen Point Military Academy, L.I. Today it is in a memorial collection in Westside Park, Paterson, N.J.

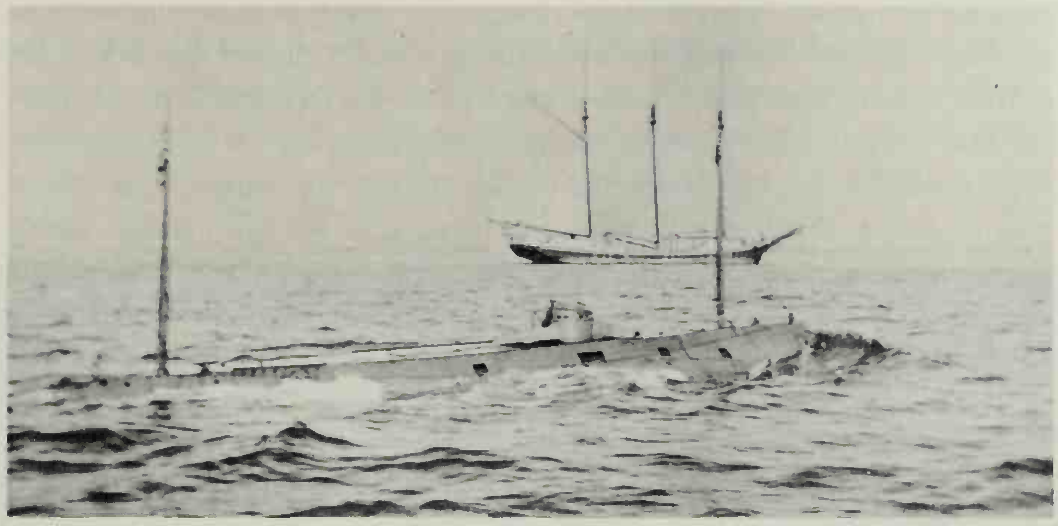
was trying hard to make his name as an inventor of submarines. The French government was interested; if Fulton's brainchild turned out to be all he was saying it would, France could take on the bully: she could wipe out the British fleet. In 1800 Fulton launched his *Nautilus,* a cigar-shaped shell of iron about twenty-one feet long and six in diameter, manned by himself and two others. Like the *Turtle,* it was driven by a hand-operated propeller and submerged by taking in water as ballast. But Fulton added two other features that were to become standard on subsequent undersea craft: horizontal rudders near the stern to control depth (instead of Bushnell's vertical screw), and a separate system of propulsion for traveling on the surface—in this case a sail that folded flat against the hull when the *Nautilus* dived. On September 12, the world's first submarine skipper led his crew of two muscular French sailors aboard their little craft and set forth to cut the British Navy down to size. They sailed as close to some ships on blockade duty as they dared, submerged, cranked like mad—and then found the tide had changed and all their cranking was getting them nowhere. So Fulton raised the ventilator pipe, and the *Nautilus* lay submerged for the next six hours. Down ventilator, back to the crank—and when Fulton next took a look from the conning tower, the enemy for some reason had raised sail and was unconcernedly making off. This sort of thing happened twice. With no news of the promised spectacular triumphs, Napoleon lost interest, and Fulton promptly entered into negotiations with the British, whom he alarmed sufficiently—Fulton was as good at publicity as at inventing—to offer to pay him for *not* making submarines.

In the next seventy years or so, though the designing and launching of various types of submarines went on apace, no fundamental steps forward were made. The reason was simple: so long as the only power available was muscle and the only weapon a bomb that had to be tacked to an enemy hull, no real progress was possible. The two inventions which were to make possible the modern era of the submarine, the electric motor and the self-propelled torpedo, still lay in the future. In the meantime, however, fertile inventors turned out a stream of contraptions, a few of which made genuine contributions. Thus, in 1860 Charles Brun designed and constructed *Le Plongeur* for the French navy, a craft driven by compressed air. Compressed air was better than muscles for driving a submarine but it had its limitations, too. However, Brun also used it in place of brawn for pumping out the tanks, and this has remained the practice ever since.

By 1866, Robert Whitehead, an Englishman living in the Fiume, had perfected the self-propelling torpedo, which solved one of the submarine's last pressing problems. The first inventor to incorporate the use of torpedoes in his design—and to sell his ships, even though they weren't much good, to various navies—was Thorsten Nordenfelt, a Swedish engineer working in collaboration with G. W. Garrett, an English clergyman who apparently divided his time between serving God and tinkering with submarines. In 1886 they launched their first successful craft, using steam for power: a full-fledged steam plant drove the vessel on the surface and, when submerged, a big cauldron of pre-heated water gave off enough steam to last twenty miles. Nordenfelt never solved a problem that had bothered practically all the inventors: how to keep his ship on an even keel when submerged. Every time the water in the boiler or in the cauldron sloshed about, the whole vessel rocked like a balance wheel; after discharging a torpedo no one could be sure what she would do next; she once ended up sitting on her tail. The Turks and Russians, however, were so hungry for the new weapon that, in spite of its limited range and obvious shortcomings, they bought—and, of course, never accomplished anything with their purchases.

During the 1880s there were some who took advantage of the great strides in electricity to design craft driven by electric motors running off storage batteries. In France Claude Goubet turned out some successful small submarines (his biggest was only a two-man affair, a scant twenty-five feet long) and Gustave Zédé a big one. In 1893, Zédé's successor, Romazotti, launched the *Gustave Zédé* for the French Navy, a sizable vessel over 160 feet long, all electric powered, with a cruising range of two hundred miles at six knots and a maximum speed of 13.5 knots for emergencies. It remained in service for over ten years and was an eminently usable instrument—so long as there was a place handy where it could recharge the batteries.

While the French were experimenting with all-electric craft, an indefatigable, ingenious Irish-American was developing the plans that have earned him the right to be called the father of the modern submarine. John Holland came from western Ireland and, like Bushnell and Fulton, turned to the submarine as a weapon in the fight against England. As a matter of fact, his first workable model was made for the American Fenian Society, a wild-eyed bunch that planned to spring it as a surprise in the struggle for an Irish Republic.



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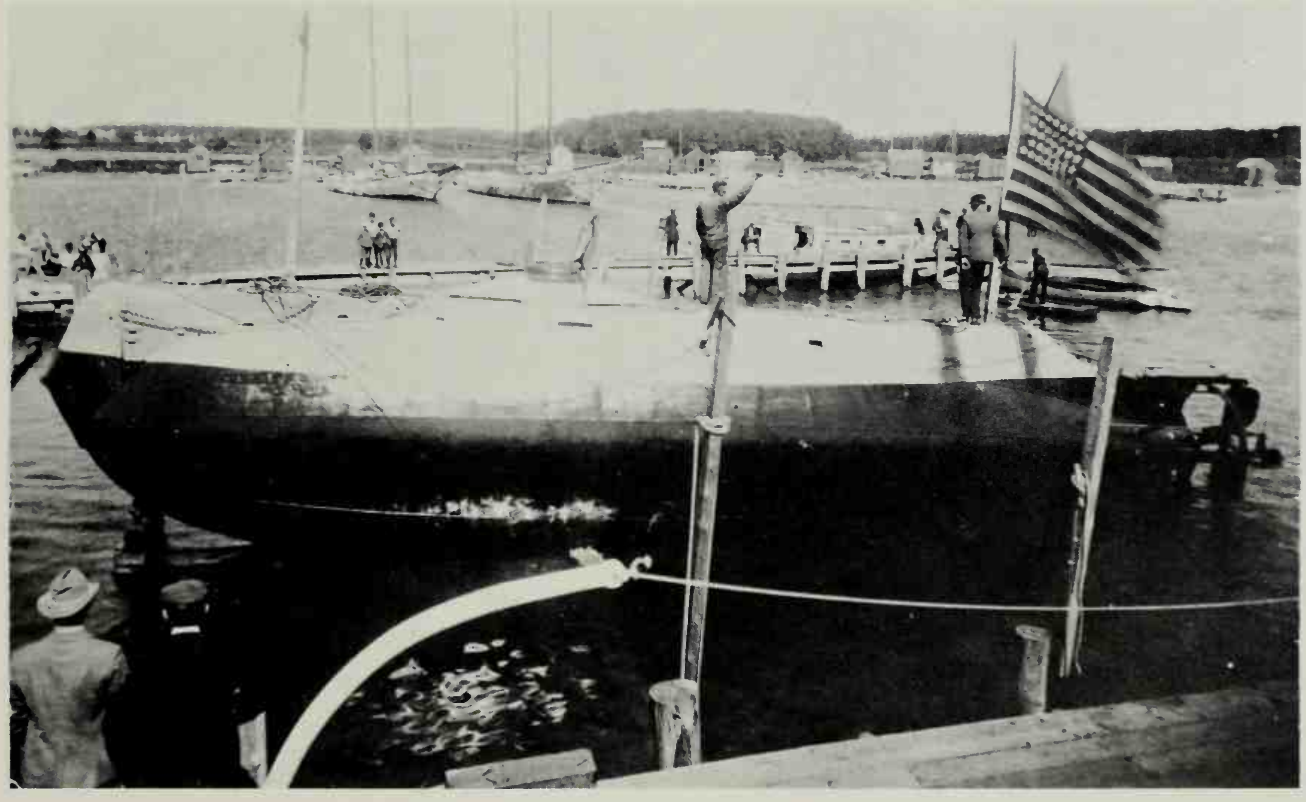

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292. The *Holland* in the Narrows, April 15, 1898.
293. The *Holland* in Greenport, L.I., September 1899.

The *Fenian Ram,* which Holland launched in the waters of the Hudson River in 1881, was powered by an internal combustion engine, made nine knots on the surface and seven below, and was, no question about it, an excellent beginning. Holland gadded about in test runs under the waters of New York Harbor and every now and then would scare the daylights out of unsuspecting ferryboat skippers by surfacing, like some Loch Ness monster, nearby. But the Fenian Society broke up about 1883, and Holland, since he had had no luck in interesting the Navy, had to forget about submarines for a while. Finally, in 1895 he got a Navy contract and started work on the *Plunger.* But he quickly realized that the specifications set for him were impossible to meet, so he abandoned her before completion and turned to what was to be his *pièce de résistance,* the *Holland.* *Illustration 291, p. 242*

The *Holland* was small—only 53.3 feet long—but she was a true, modern submarine. Her inventor had endowed her with the two crucial features all previous efforts lacked: perfect control over equilibrium, and separate, efficient modes of propulsion for travel on and under water. The *Holland* had a main ballast tank amidships that, when she submerged, was full—no water sloshed around to knock her about and the ship balanced, as it were, on this center of gravity; other, smaller tanks abaft and forward of the main ballast tank permitted further adjustment. The control was so complete that Holland designed his submarine to dive and not just sink like a lump of lead as, e.g., Nordenfelt's had; she drove downward on a slant pushed by the propeller and directed by the horizontal fins, much as a plane is maneuvered in the air. A century earlier, to increase the *Nautilus'* range, Fulton had used wind on the surface and muscle below; Holland's two different modes of propulsion were electric motors for under the water, and for surface travel a gasoline internal-combustion engine—which also served to recharge the batteries. The surface speed was nine knots, the underwater seven, and the cruising range one thousand miles. After three years of continuous trials the Navy finally accepted her in 1900.

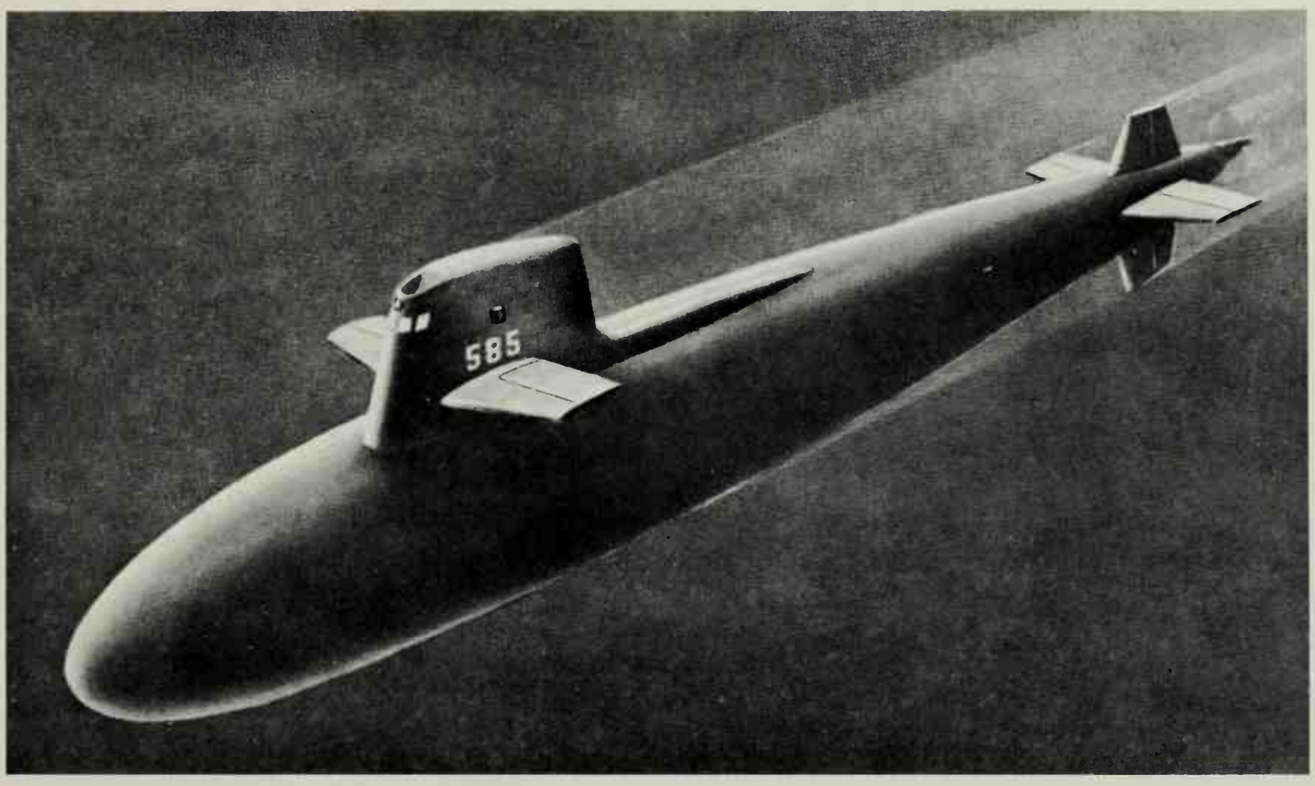
Just about the time that the *Holland* had made the grade in America, Max Laubeuf was having equal success with his *Narval* in France. Though the two ships necessarily shared the basic features, wherever there was room to differ, they differed. Instead of Holland's ballast tanks, Laubeuf built the *Narval* with two hulls, one inside the other, and used the space between for ballast. Instead of a gasoline engine, the *Narval* used steam when traveling on the surface. Steam was safer and produced more power than a gasoline engine but, what with banking the fires and other such preliminaries, it made diving slow work, whereas the *Holland* went down as quickly and easily as a fish.

The *Holland* and the *Narval* set the pattern. The next half-century saw steady improvement but no radical changes. Perhaps the most important innovation was the one, introduced by the Germans, of replacing Holland's gasoline motor, a serious fire hazard because of the fumes given off, with more efficient and less dangerous diesels.

Holland had conceived of a craft equally at home on or under the water. The submarines that were spawned by his designs, and that served up through World War II, were not exactly what he had in mind. They were the "fleet type," craft intended chiefly for travel on the surface and for only limited periods below. He had made his submarines in the shape of a fish so they could slip unimpeded through the water. "Fleet" submarines, designed to spend most of the time on and not under the water, came to look almost like surface ships, with a bridge, life rails, a gun, and whatnot, placed on top of the hull. The diesels were beefed up till they could turn out an impressive twenty-one knots, while the speed submerged, with so much superstructure to offer resistance, was only nine, not much more than the original *Holland* did. During World War II, improved methods of fighting the undersea menace forced submarines, whether they liked it or not, to pass more and more time below. This challenge the Germans met with the snorkel, a long air hose that, extending just above the surface, permitted the diesels to breathe and so be used underwater.

But the snorkel was an expedient, not an ultimate answer. That came with the availability of atomic power, which finally enabled the submarine to revert to Holland's original conception of a vessel designed to live underwater. The latest undersea craft look and behave much more like the original *Holland* than, e.g., the submarines of World War

II did. They are driven by the first form of mechanical power ever used on boats, steam, but instead of a fire, which needs air, an atomic pile generates the heat to make the steam. As a result, today's submarines are truly submarine. The only factor that limits their stays underwater is the human one—the amount of time the crews can put up with their steel-encased existence, living under manmade light and breathing manmade air.



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294. The United States Navy's atomic-powered submarine *Skipjack.*

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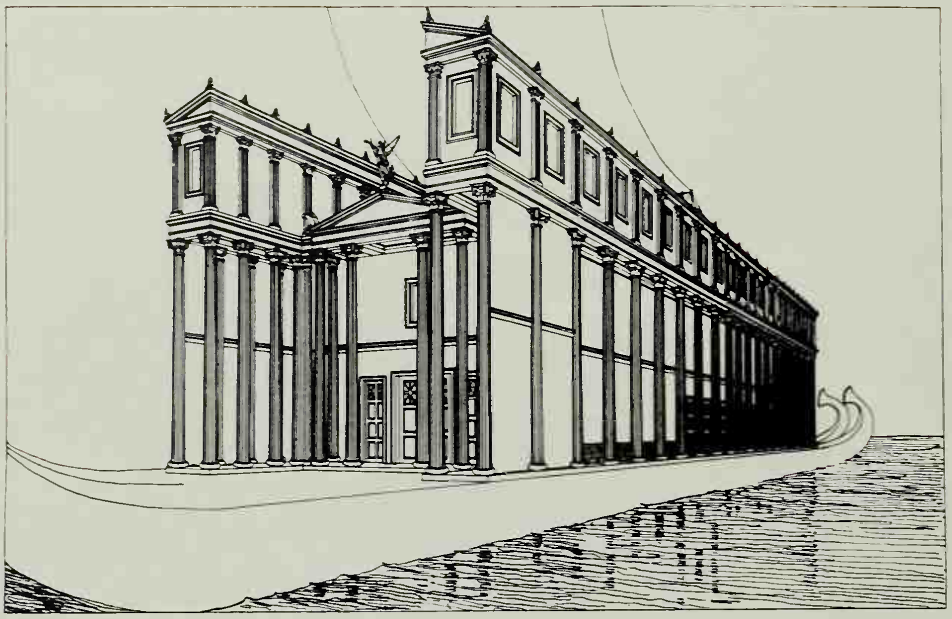

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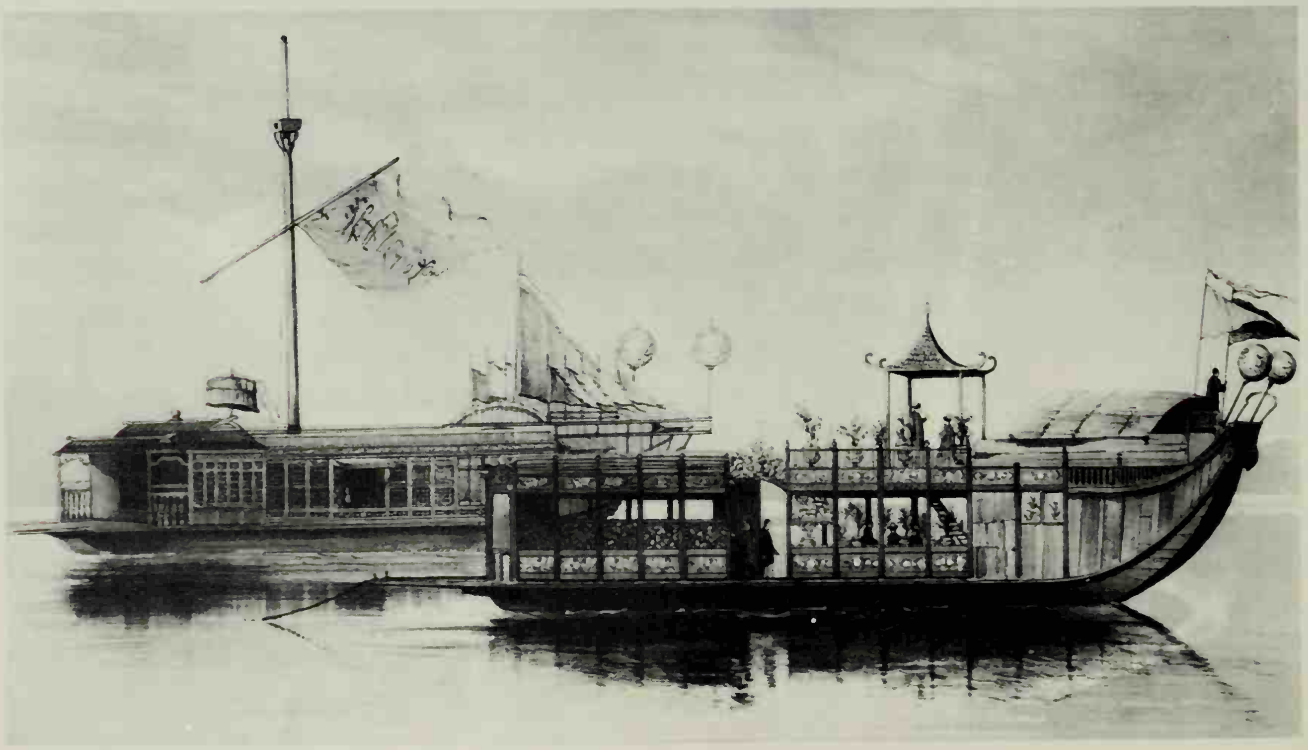

295. A reconstruction of the floating palace Ptolemy IV (reigned 221–203 B.C.) built for dallying on the Nile.

296. Sketch, made in the early nineteenth century, of a Chinese *bateau des fleurs*.

CHAPTER SIXTEEN

Sport on the Sea

OUR story started with primitive man who went down to the sea to work. It ends with modern man who, as often as not, goes down when his working hours are over.

For thousands of years the water was the special preserve of fishermen, sailors, passengers, and others who had serious reasons to be there. Aristocrats with leisure to spend might venture into streams or marshes for fishing or fowling, and royalty usually had de luxe transport at their disposal which they might use for relaxation if the spirit moved them, but, aside from these few, no one thought of the water as an amusement area. The only craft built solely and simply for dallying there were not real boats but floating living quarters, such as the palatial barges the Ptolemies of ancient Egypt kept for voyages on the Nile or the charming and exquisite houseboats the ingenious Chinese anchored in streams to use as brothels. Yachts, boats that behaved more or less like a working boat but whose purpose was not work but to provide pleasant hours on the water, did not come upon the scene until as late as the end of the sixteenth century.

"So I aboard and my boy Tom, and there very merrily we sailed to below Gravesend, and there came to anchor for all night, and supped and talked, and with much pleasure at last settled ourselves to sleep, having very good lodging upon cushions in the cabin." The words, from Samuel Pepys' famous diary, were written in 1665, but they echo the sentiments of millions of modern boat owners: Pepys had gone for a cruise just to enjoy himself; Pepys was a yachting enthusiast.

Compare Illustration 206, p. 184

As a matter of fact, the sport had come to England only five years earlier, from Holland. There, where waterways were as common as roads, people who could afford it kept private boats as a convenient means of transportion, much as we keep cars today. By the seventeenth century, throngs of their handsome, meticulously maintained yachts (the word means "hunter"; hunters travel fast and with a minimum of encumbrance) could be seen in all the major harbors. Since the whole country in those days was rabidly navy-minded, Dutch yachts were made to look like miniature men-of-war: they had the same lines, they gleamed with the same ornate gilded decoration, they even mounted baby cannon. What's more, the yachtsmen's standard sport was not to race but to form up into squadrons and execute intricate naval maneuvers, and even to engage in mock combat, with admirals feverishly hoisting signals, guns noisily popping, fighting parties gallantly boarding, and whatnot.

In 1660, England, deciding to restore her monarchy, recalled Charles II from the continent. Since the age of twenty-one he had lived in Europe, a part of the time in Holland where he had gotten to know the joys of yachting. As soon as word of Charles' elevation to the throne came through, the Prince of Orange put at his disposal the finest yacht available, and Charles waxed so enthusiastic about it that the Dutch, with a diplomatic eye on future foreign policy, presented him with a beautiful fifty-footer, the *Mary*. She was England's first and only yacht. But not for long—the bug had bitten Charles for fair, and during his reign he had British architects build for him over a dozen more. He put one at Pepys' disposal—Pepys was a high official of the Admiralty—and, as we've seen, made a fellow aficionado out of him. By the time Charles died there were numerous other enthusiasts, and by 1720, only thirty-five years after his death, there were enough among the Irish alone to form the world's first yacht club, the Cork Water Club.

Compare Illustration 141, p. 116

As was to be expected, for a long time England's yachts were modeled on Holland's. And at first English yachtsmen, too, had fun on the water playing at naval maneuvers. Inevitably some became interested in speed, and to satisfy them designers discarded the sluggish Dutch-derived lines and turned for inspiration to the fast-stepping cutters that smugglers and the Government's agents played hare and hounds in. Both types, since they had to go out in all kinds of weather, were ruggedly built, and the yachting versions for no real reason were constructed the same way; it wasn't until the beginning of the nineteenth century that marine architects went in for lighter timbers and slighter build. At the same time, they increased the size of the sails and added extra ones until a cutter yacht with every stitch drawing looked like a mass of billowing canvas. Yet the heavy hand of the Navy was somehow hard to shake off. Bigger yachts still carried four-pounders or even six-pounders, the crews were disciplined like British tars, and the yacht clubs (the Royal Yacht Club had been founded in 1812 and others were fast springing up) continued to go in for elaborate pseudonaval reviews.

Across the water, America had her own smugglers and revenue agents and others with a special interest in speed, and she conveniently had just the ship to suit them all: the famed sharp-built schooners called "Baltimore clippers." The most extreme of these, so extreme that yachting committees today would very likely disqualify them as being too dangerous, were the pilot boats (above, p. 142), and the first American yachts were either closely modeled on these in hull and rig or were actual pilot boats converted. Then science entered the scene, brought in by that redoubtable inventor whose name has already been mentioned a number of times, Robert Livingston Stevens.

Stevens built scale models of different types of hull, studied their performance, and came up with an unorthodox design for his *Onkahye,* the first American yacht that was not just an adaptation of some working boat. This ninety-six-foot topsail schooner was completed in 1840, but didn't prove quite as successful as her owner had hoped. His second try didn't turn out much better; her greatest claim to fame was that the New York Yacht Club was founded in her cabin in 1844. The next year he launched the *Maria,* probably the first racing machine pure and simple. She was a giant of a sloop, better than one hundred feet long on deck and with a centerboard that went twenty-four feet deep. The mast—a hollow spar—was ninety-two feet tall and the main boom measured ninety-five feet. Stevens added such futuristic touches as track and slides for the mainsail and outside ballast in the form of lead strips placed along the planking from keel to bilges. Reports have it that the *Maria* did sixteen knots—but only in smooth water.

Most designers, however, stuck to the schooner rig and had a special fondness for beamy centerboarders, which they fitted with sails so cut that they could be trimmed flat for good performance on the wind. In 1850, Stevens and his brothers decided to challenge Britain to

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297. Dutch yachts of the seventeenth century. The smaller in the foreground has the short-gaffed rig, the larger behind it the long-gaffed.

298. The *Portsmouth*, one of the yachts built for the British Navy during the reign of Charles II.

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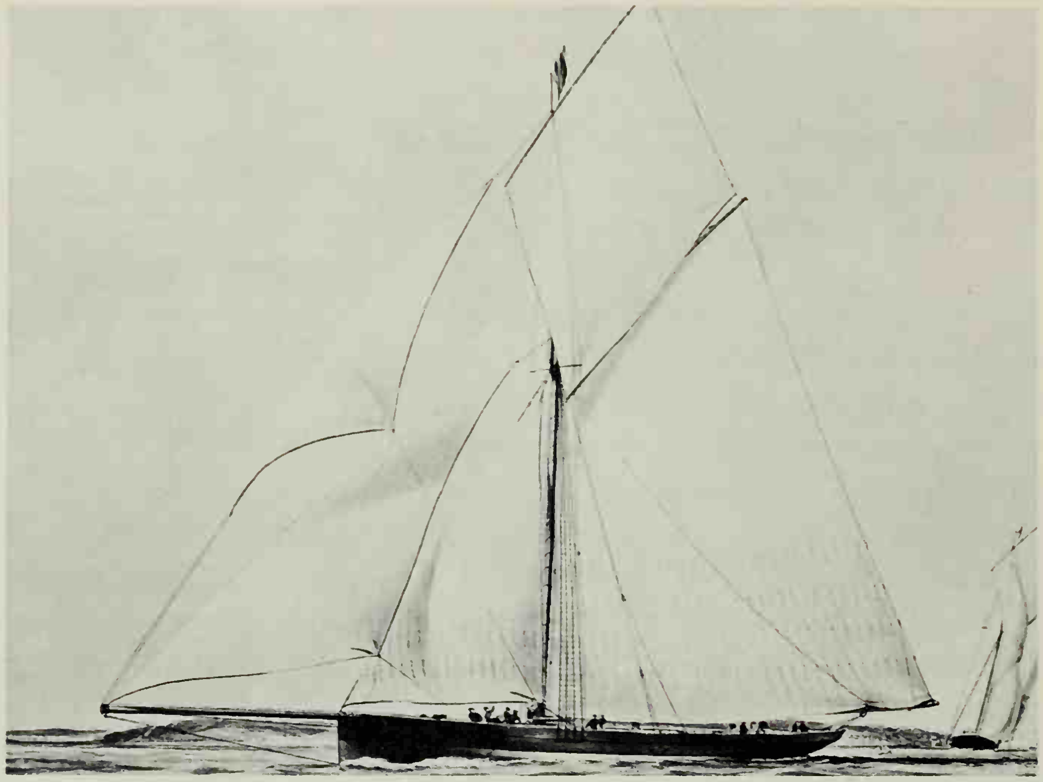

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299. The *Julia,* an English cutter yacht, in a lithograph of 1854.

300. The *Maria,* probably the first boat designed purely and simply as a racing machine.

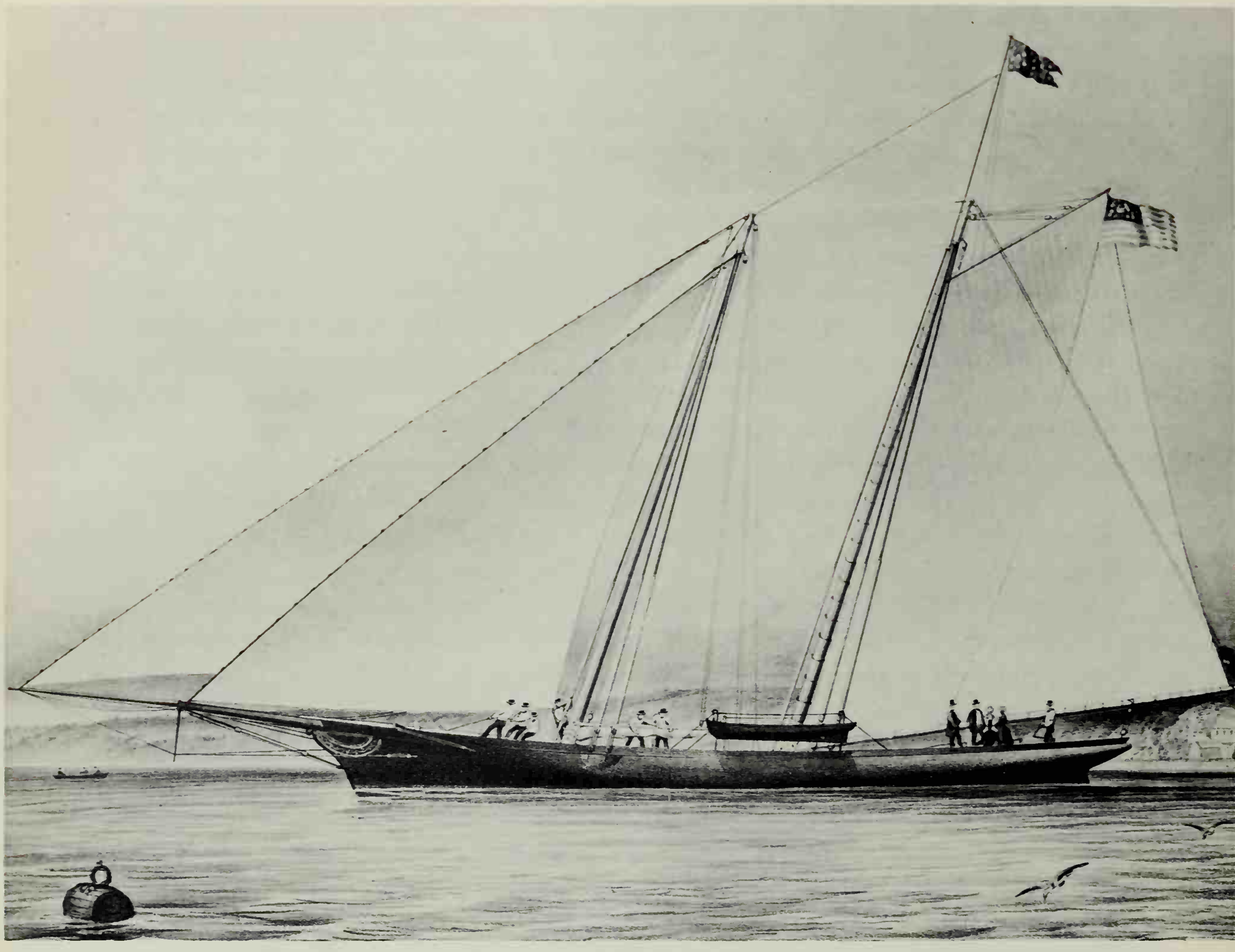
a race and, along with a group of friends, hired George Steers, one of the best naval architects of the day, to design a craft. The result was the *America*—and history. In 1851 she was sent to England, outraced the best English yachts handily, and was honored with the famous cup which the British have been trying with no success to win back ever since. What's more, she started a revolution among English yachtsmen. The old cutters with their baggy sails went by the board, and there was a scramble to get schooners with trim, flat-setting sails.

Then a new factor made itself felt, one which ever since has reigned over yacht design with an iron hand: the racing rules. Racing had by this time become the yachtsmen's chief interest. Now, it so happens that, by the immutable physical laws that govern the movement of bodies through water, a longer boat will go faster than a shorter. So yacht clubs, whose rosters inevitably included craft of different sizes, began setting up systems of measurement for rating and handicapping contestants. During the second half of the nineteenth century, the basis for the rules had to be changed a number of times since canny architects were forever figuring out ways of getting around them with results that weren't always beneficial to good yacht design. The British rules, for example, produced the so-called "planks on edge" craft, which were unhealthily deep and slender, while the American produced the so-called "skimming dishes," which were unhealthily shallow and beamy.

About 1870 or so a new kind of owner joined the ranks. Up to now yachting had been the private preserve of the very rich, the only people who could afford to buy and maintain big, custom-built vessels; the situation was aptly summed up in J. P. Morgan's famed quip to the effect that, if a person had to ask what a yacht costs, he couldn't afford one. But the long period of peace and prosperity after the Civil War brought into being both here and in England the small boat owner. In this group were some whose prime interest was speed; they started a movement which has led to the multifarious small racing sailboats that we see today. There were even more in the group who merely wanted what Samuel Pepys had been after, to spend some pleasant hours or days on the water; they started a movement which has led to the multifarious craft for cruising that we see today. For, in shipyards all over the country, designers, often using some local type of working boat as their starting point, began turning out a steady stream of varied models to satisfy both demands.

At the same time, the building of the millionaires' highly developed racing machines went on as before. In a reversal of the earlier state of affairs, after 1870 it was English design that influenced American: racing schooners bowed out in favor of slender, deep cutters and sloops, a type that reached its apogee in the great J-boats built to defend the *America's* Cup in the thirties.

The first power yachts were big steam-driven palaces maintained by wealthy owners as a private means of transportation—the sort of thing, but on a much grander scale, that Dutch owners had gone in for two and a half centuries earlier. This was about the limit of the power boat's use as a pleasure craft so long as only steam was available; stoking a furnace was hardly the way to spend Sunday afternoon on the water. By the end of the nineteenth century, however, the internal combustion engine had made its debut, and this changed things dramatically. In Germany, Gottlieb Daimler, of automobile fame, launched a powerboat in 1885 and, three years later, G. Priestman in England was carrying out trials of one of his own design. Both these men were working with expensive, custom-made racing craft.



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301. The *America* in a lithograph made shortly after winning the famous cup in 1851.

It was in America that a different and ultimately far more important tack was being taken.

In 1894, Christopher Columbus Smith, a builder of small wooden boats for men who went hunting in the marshes of Michigan's St. Clair River, tried mounting a small naptha engine in one of his boats. He wasn't able to achieve any appreciable success until a decade later, after the perfecting of the carburetor had helped the internal combustion motor no end. By 1906, Smith's Chris-Craft Corporation was turning out twenty-six-foot boats that could do eighteen miles per hour. By 1905 there were enough craft on the market for the first National Boat Show to be held. Those were the days! You could get a fourteen-foot boat, steel or wood hull, powered by an inboard engine, for one hundred dollars; three years later, do-it-yourselfers were offered a knockdown kit which gave them even more boat for half that price.

The emphasis during these years was on speed. In 1903 the British International Trophy Race (the Harmsworth Trophy) held its first meet, and in 1904 America's Gold Cup Race was first held. In 1912 the hydroplane (a hull so built that it planes over the water instead

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302. The J-boat *Ranger,* designed in 1937, one of the fastest of the class.

of cutting through it) made its appearance and raised the potential speed to new levels; by the end of World War I, the racing record was up almost to the seventy-mile-per-hour mark. It took until after the war for the Motorboat Show to put on an exhibit of motor cruisers on any sizable scale. Even in this field speed was not forgotten: in the twenties boats such as the Sea-Skiffs, which combined strength with speed, appeared on the market. (Cynics like to point out that this type of craft added to the joys of yachting that of running in cases of whiskey at a speed comfortably in excess of the local Coast Guard patrol's.) By 1930 there were 1½ million privately owned boats in the United States alone; things had come a long way since Charles II's dozen or so yachts. And this does not include boats powered by an-

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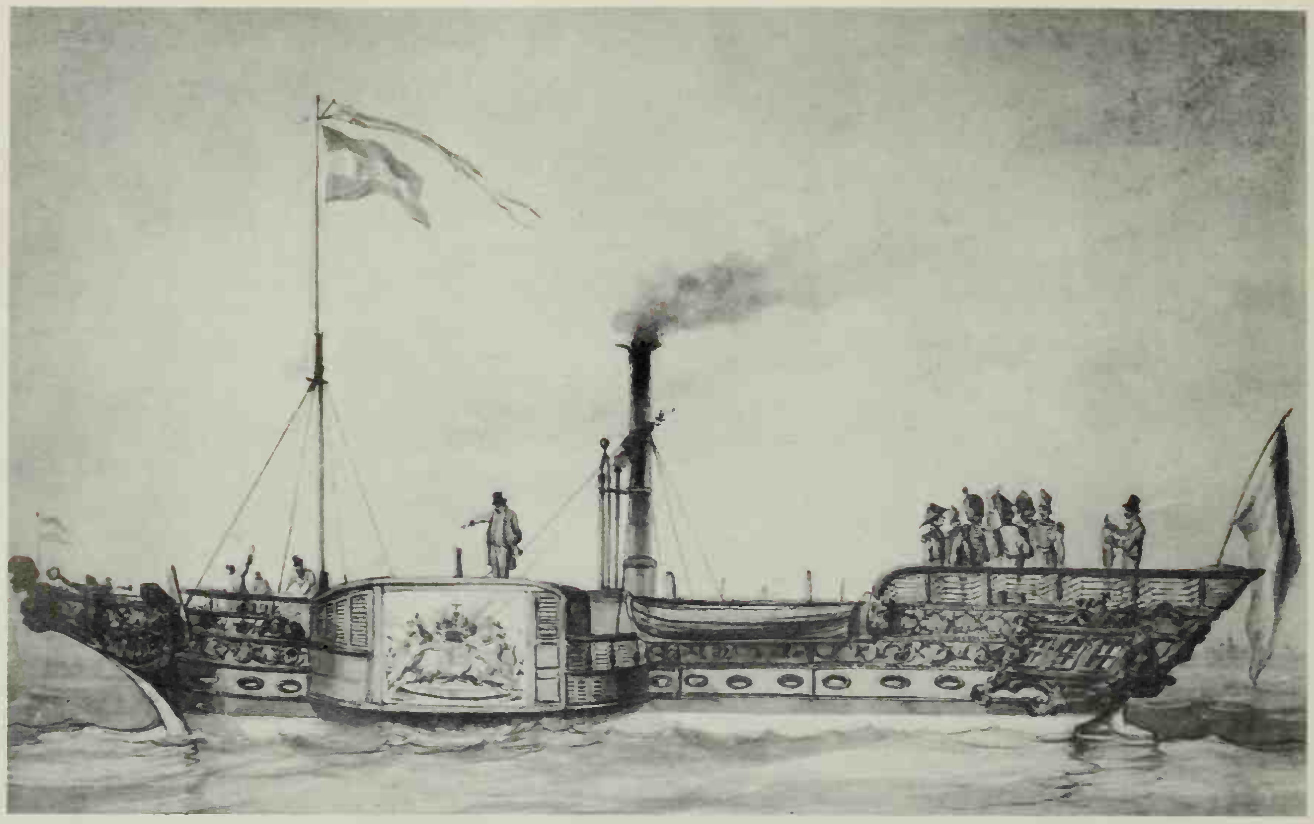

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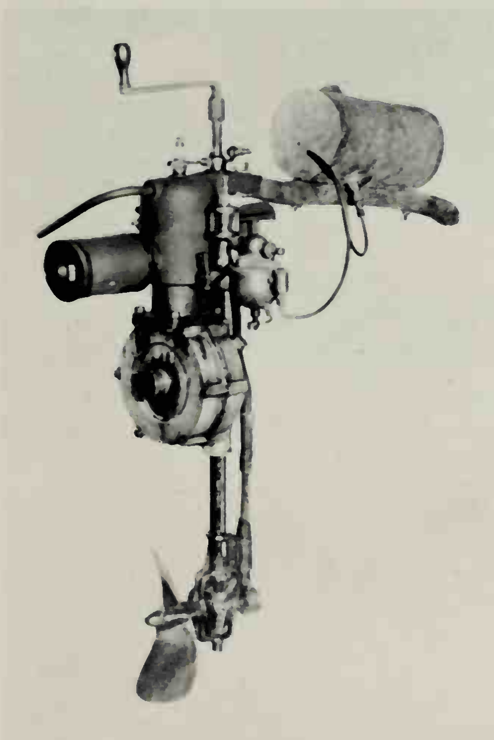
303. The *Leeuw*, a steam-powered yacht built for the Dutch Royal Family in 1826–27.

304. Motorboating in the style of the 1900s: the chauffeur takes the ladies for a spin.

other device that has since raised the figure to astronomical heights—the outboard motor.

There are reports that Daimler displayed an outboard of his make in the 1893 Chicago World's Columbian Exposition. Be that as it may, the first public demonstration was made by a Frenchman who, in 1902, put-putted down the Seine with his *Motogodille* "power-scull." Since the contraption was seven feet long—the propeller reached four feet below the bottom of the boat—and speed was regulated by tilting the unit so that the propeller rode higher or lower in the water, it's not surprising that it wasn't exactly a *succès fou.* The first commercially successful outboard was the Waterman Porto Moto, a two-horsepower, single-cylinder affair weighing only forty pounds, which was able to drive an eighteen-foot boat seven miles per hour and, so the boast ran, to run for four hours on one gallon of gasoline. The Waterman engine was put on the market in 1907 but, though the company lingered in business until 1920, it never really caught on.

The motor that did catch on was Ole Evinrude's Detachable Rowboat Motor, which he designed in 1906 and displayed at the 1909 show, a 1½-horsepower one-cylinder unit that weighed sixty-two pounds and for which he charged sixty-two dollars—a dollar per pound, as he explained. It was so successful that, by 1914, Evinrude was able to sell out—with a rockbound promise to the purchaser that he would stay out of the business until after at



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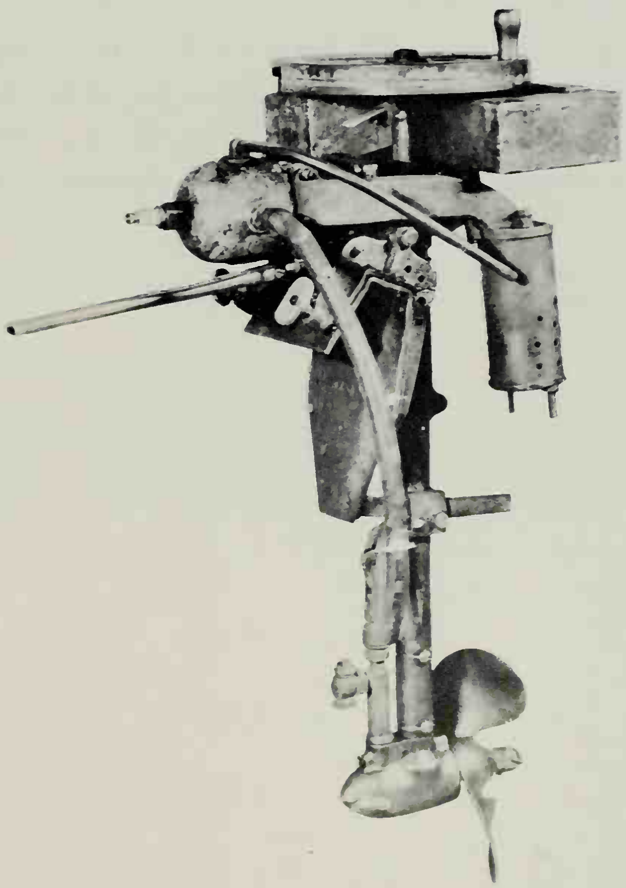

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EARLY OUTBOARDS

305. The first commercial outboard, the Waterman engine of 1905.

306. The original Evinrude of 1909.

least five years. In 1921 he was back, marketing his successful Elto (Evinrude Light Twin Outboard), a lightweight (forty-seven-pound) twin-cylinder engine. By 1922 the company that made the Johnson motor had joined the swim with their well-known line. A few years later, however, came the Great Depression, and the outboard, as so many other things, had to wait until the postwar boom days to come into its own.

Today the noisy midget has a future brighter than many a giant of the water. The reason is deep-seated: fundamental changes have taken place in the traditional role the sea has played in the lives of men.

There was a time when the sea provided the most practicable way, often the only way, to go from place to place. Today the air has taken over. The modern ocean liner, that triumph of merchant ship design, stays alive only by serving as resort and health center rather than passenger carrier.

There was a time when the sea was the stage for much of the drama of war. Today the *Missouri* and her sisters, those mighty battleships that marked a milestone in the development of the man-of-war, have, like the dinosaurs, become fossils, the thunder of their guns silenced by guided missiles and other weapons of the air.

But in return for these losses, the sea has gained a great new role: it has become an immense playground. For this it has two unique qualifications: its vast expanse offers plenty of space, and by and large it is democratically open to everyone; there are no "no trespassing" signs on the water, no bars of color, race, or creed. Among all the uncertainties of the future one thing is sure: men will have more and more leisure, and more and more of it will be spent on the sea. In the new order of things, the powerboat's raucous put-putting and the outboard's angry whine have a place as significant as the turbine's deep-throated thrum. Hard on the eardrums? Yes, but so is most of modern progress.

SUGGESTED READING

For those who may wish to go deeper into the various phases of the subject, I recommend the following works:

Primitive Craft

James Hornell, *Water Transport* (New York: The Macmillan Company, 1946)

The Ancient World

Lionel Casson, *The Ancient Mariners* (New York: Macmillan, 1959)

R. C. Anderson, *Oared Fighting Ships* (London: Percival Marshall & Company, 1962)

The Sailing Ship

Romola and R. C. Anderson, *The Sailing-Ship* (London: Harrap, 1926; reprinted, New York: W. W. Norton & Company, 1963)

G. S. Laird Clowes, *Sailing Ships: Their History and Development,* Parts I, II (London: the Science Museum, 1932, 1948)

G. de la Röerie and J. Vivielle, *Histoire des navires de la rame à la helice* (Paris: 1946)

H. I. Chapelle, *The History of American Sailing Ships* (New York: Norton, 1935) and *History of the American Sailing Navy* (New York: Norton, 1949)

The Galley

Anderson, *Oared Fighting Ships*

de la Röerie and Vivielle, *Histoire des navires*

Frederic C. Lane, *Venetian Ships and Shipbuilders of the Renaissance* (Baltimore: Johns Hopkins Press, 1934)

Eastern Craft

Hornell, *Water Transport*

H. Warington Smyth, *Mast and Sail in Europe and Asia* (London: William Blackwood & Sons, 1929)

Small Craft

Hornell, *Water Transport*

Smyth, *Mast and Sail*

D. Phillips-Birt, *Fore and Aft Sailing Craft and the Development of the Modern Yacht* (London: Seeley Service & Company, 1962)

H. I. Chapelle, *American Small Sailing Craft* (New York: Norton, 1951)

The Age of Power

J. T. Flexner, *Steamboats Come True* (New York: The Viking Press, 1944)

H. P. Spratt, *Outline History of Transatlantic Steam Navigation* (London: the Science Museum, 1950) and *Merchant Steamers and Motor-Ships* (London: the Science Museum, 1949).

In *The Society of Naval Architects and Marine Engineers: Historical Transactions 1893–1943* (New York: the Society, 1945), there is a series of articles which conveniently summarize the history of various types of power-driven merchantmen and naval vessels and the history of the submarine.

Yachts

Phillips-Birt, *Fore and Aft Sailing Craft*

Chapelle, *History of American Sailing Ships*

William Taylor and Stanley Rosenfeld, *The Story of American Yachting* (New York: Appleton-Century-Crofts, 1958)

Much information on all phases of the subject can be found in the pages of the two foremost periodicals devoted to maritime history, *The Mariner's Mirror,* published in London, and *The Amerian Neptune,* published in Salem, Mass.

ILLUSTRATIONS AND SOURCES

BM = British Museum, London; BN = Bibliothèque Nationale, Paris; ILN = Illustrated London News; Köster = A. Köster, *Das antike Seewesen* (Berlin 1923); MM = Musée de la Marine, Paris; NMM = National Maritime Museum, London; Paris = F. E. Paris, *Essai sur les constructions navales des peuples extra-européens* (Paris 1841); PM = Peabody Museum, Salem. Where no source is given, the photos are the author's.

Chapter One

1. Assyrian soldiers swimming on skin floats. Relief from the palace of Ashur-nasir-pal II, King of Assyria from 883 to 859 B.C., at Nimrud, now in the BM. Photo Mansell Collection.

2. An ancient Assyrian *quffa.* Relief from the Palace of Sennacherib, King of Assyria from 705 to 681 B.C., now in the BM. Photo Mansell Collection.

3. Hercules on a raft buoyed by pot floats. Carvings on Etruscan gems of the sixth century B.C. Photo courtesy of the German Archaeological Institute at Rome.

4. Hercules in a pot coracle. From an Athenian vase of about 480 B.C. in the Vatican Museum. Photo Alinari.

5. Wuzurees crossing the Indus on pot coracles. ILN February 13, 1864, p. 168.

6. Assyrian soldiers hunting down enemies. Relief from the Palace of Sennacherib (see illustration 2).

7. Model of a seagoing Formosan raft. Photo courtesy of the MM.

8. Two big dugouts from Ferrara, Italy. In the National Archaeological Museum at Ferrara.

Chapter Two

12. (COLOR) An ancient Egyptian reed raft. Copy in the BM of a fresco of about 1400 B.C. in the tomb of Nebamun at Thebes.

13. (COLOR) Modern reed boats from Sardinia.

14 and 15. (COLOR) Nile boats painted on Egyptian pots of about 3000 B.C. In the collection of the BM.

16. (COLOR) Lowering (or raising) the mast of a river boat of about 2500 B.C. Tomb relief in the Cairo Museum. Photo courtesy of Richard Scheuer.

17. A large Egyptian river boat of about 2500 B.C. Relief from the tomb of Ti at Sakkara. Photo Marburg.

18. Seagoing ships of about 2550 B.C. Relief from the pyramid of Sahure at Abusir. Photo courtesy of the Science Museum, London.

19. Contemporary model of a river boat of 2000 B.C. Model, now in the Metropolitan Museum of Art, New York City, found in the tomb of Mehet-Re at Thebes. Photo courtesy of the Museum.

20. Egyptian shipwrights at work, about 2000 B.C. Relief from the tomb of Khnemhotpe at Beni Hasan. Reproduced from Köster, Fig. 1.

21. Egyptian shipwrights completing a boat, about 2500 B.C. Relief from the tomb of Ti at Sakkara. Archives Photographiques, Paris.

22. (COLOR) Egyptian river boat of about 1450 B.C. Copy in the BM of a fresco in the tomb of Kha'emwese at Thebes.

23. The ships of Hatshepsut's expedition; about 1500 B.C. Relief on her tomb at Deir-el-Bahari; reproduced from A. Mariette, *Deir-el-Bahari* (Leipzig: 1877), pl. 6.

24. Great barge that hauled Hatshepsut's obelisks. Relief on her tomb at *Deir-el-Bahari;* reproduced from Carl V. Sølver's reconstruction in *The Mariner's Mirror,* Vol. 26 (1940), p. 240, fig. 2.

Chapter Three

25. Merchantman on a seal of about 2000 B.C. Reproduced from Sir Arthur Evans, *The Palace of Minos at Knossos,* Vol. 1 (London: The Macmillan Company, 1921) p. 118, fig. 87-7.

26. Galley on a seal of about 1600 B.C. Reproduced from Evans, *The Palace of Minos,* Vol. 2, Part 1, p. 243, fig. 139.

27. Warships of about 2000 B.C. Reproduced from Evans, *The Palace of Minos,* Vol. 2, Part 1, p. 241, fig. 138.

Aegean Warships, 1200–800 B.C.

28. Galley of about 1200–1100 B.C. Reproduced from *Archaiologike Ephemeris* (1914), pp. 108–9, figs. 14–15.

29. Galley of about 1200–1100 B.C. Reproduced from O. Frödin and A. Persson, *Asine. Results of the Swedish Excavations 1922–1930* (Stockholm: 1938) p. 301, fig. 207-2.

30. Galley of about 850–800 B.C. On a cup in the Eleusis Museum (No. 741). Reproduced from Köster, pl. 30.

Greek Warships, 800–700 B.C.

31. Galley, probably twenty-oared. From an Athenian vase in the Louvre (No. A517). Reproduced from Köster, pl. 18.

32. Galley, probably fifty-oared. From a bowl found at Thebes in the BM (No. 1899.2-19.1). Reproduced from Köster, pl. 19.

33. After portion of a galley. From an Athenian vase in the Louvre (No. A531). Reproduced from Köster, pl. 24.

34. Forward part of a galley. From an Athenian vase in the Louvre (No. A527). Reproduced from Köster, pl. 21.

Greek Warships, 600–500 B.C.

35. Galley, probably twenty-oared. From an Athenian cup in the Louvre (No. F123). Photo Hirmer.

36. Galley, probably twenty-oared. From an Athenian Bowl in the Metropolitan Museum of Art, New York (No. 07.286.76, Rogers Fund 1907). Photo courtesy of the Museum.

37. Galley, probably fifty-oared. From an Athenian pitcher in the Louvre (No. F62). Photo Giraudon.

Two-Banked Warships, 700–500 B.C.

38. A two-banked Phoenician galley. Relief from the Palace of Sennacherib (see Chapter One, illustration 2); photo courtesy of the BM.

39. A two-banked galley, probably fifty-oared. From an Etruscan pitcher of the sixth century B.C. in the BM (No. B60). Reproduced from H. B. Walters, *Catalogue of*

the Greek and Etruscan Vases in the British Museum, Vol. II, *Black-Figured Vases* (London: 1893), pl. 1.

40. A two-banked galley of about 575–550 B.C. On a Corinthian vase in the National Museum, Athens (No. 281).

41. A *hemiolia* "one and a half-er" of about 540–500 B.C. On an Athenian cup in the British Museum (No. B436). Photo courtesy of the BM.

The Trireme

43. The starboard side of a trireme. Relief of the fifth century B.C. in the Acropolis Museum, Athens.

44. Reconstructed cross section of a trireme. Photograph of a model made by J. S. Morrison of Trinity College, Cambridge; photo courtesy of Mr. Morrison.

45. The starboard rowers as seen from inside the hull.

Greek Warships, 300–200 B.C.

46. Prow of a warship of about 253 B.C. Reproduced from G. F. Hill, *Select Greek Coins* (Paris: 1927), pl. xlvi-5.

47. Stern of a Rhodian warship of about 200 B.C. Reproduced from C. Blinkenberg, *Triemiolia* (Det Kgl. Danske Videnskabernes Selskab. Archaeologisk-kunsthistoriske Meddelelser, II.3, Copenhagen: 1938), fig. 3.

Roman Warships

48. One of the heavy ships that fought in the Battle of Actium in 31 B.C. Relief found at Palestrina and now in the Vatican Museum. Photo Anderson.

49. Two-banked Liburnians and a trireme. A detail of the relief decorating the Column of Trajan (reigned A.D. 98–117) in Rome. Photo courtesy of the Fototeca Unione, Rome.

50. (COLOR) Warship of the first century A.D., probably Liburnian. Fresco from the Temple of Isis in Pompeii and now in the Naples Archaeological Museum. Reproduced from F. Niccolini, *Le case ed i monumenti di Pompeii*, Vol. 1 (Naples: 1854) pl. 4.

The Dromon *and Greek Fire*

51. Two-banked galley of the twelfth century. Miniature (Empress Costanza en route to Messina) from a manuscript (Pietro da Eboli, *Liber ad honorem Augusti*) of about A.D. 1195–96 in the Stadtbibliothek, Berne (Cod. Bern. 120, fol. 119).

52. A flame thrower in action as pictured in a fourteenth-century manuscript. Miniature (ship of the fleet of Emperor Michael II of Byzantium [reigned A.D. 820–29] destroying an enemy) from a manuscript of Ioannes Scylitzes in the Biblioteca Nacional, Madrid. Photo courtesy of the Biblioteca.

CHAPTER FOUR

Greek Merchantmen, 550–450 B.C.

53. A merchantman being overhauled by a pirate galley. From the same cup as Chapter Three, illustration 41.

54. A merchantman approaching shore. From the Tomba della Nave, dated about the middle of the fifth century B.C. or a little earlier. The fresco is now in the Tarquinia Museum. Photo courtesy of Dr. Mario Moretti.

55. Reconstruction of the above.

Greco-Roman Ship Construction

56. A piece of planking from a wreck of the second century B.C. Reproduced from F. Benoît, *L'épave du Grand Congloué à Marseille* (Paris: 1961) fig. 82.

56A. Reconstruction of the above.

57. A shipwright finishing up a hull; second or third century A.D. Relief on a tombstone in the Ravenna Museum.

58. Model of a huge Roman barge of about A.D. 40. In the Museo Storico Navale, Venice. Photo courtesy of the Museum.

59. A Roman anchor and barge of about A.D. 40. Photo courtesy of the Fototeca Unione, Rome.

Merchantmen, A.D. *100–200*

60. Merchantmen of about A.D. 200. Relief in the Torlonia Museum, Rome. Photo courtesy Fototeca Unione.

61. Merchantman approaching port; first century A.D. Relief on a tombstone in the cemetery at Pompeii.

62. (COLOR) Merchantman leaving port; about 200 A.D. Mosaic in the Antiquarium, Rome.

63. (COLOR) Etruscan fishing skiff of the fifth century B.C. Detail of a fresco in the Tomba della Caccia at Tarquinia.

64. (COLOR) Harbor craft used for hauling grain; second or third century A.D. Fresco found at Ostia and now in the Vatican Museum; photo courtesy of the Museum.

65. A big merchantman under sail; second century A.D. Relief on a sarcophagus in the National Museum, Beirut. Photo Alinari.

66. Merchantman at the entrance of a harbor; second to third century A.D.

Small Craft of the Ancient World

67. Boat towed from a towpath, third century A.D. Relief in the Musée Calvert, Avignon. Photo Alinari.

68. Skiff warping a vessel into harbor, second century B.C. Relief on a tomb in the Isola Sacra, the cemetery for Portus, Rome's harbor. Photo courtesy Fototeca Unione, Rome.

69. Harbor craft of the second to third century A.D.

The Fore-and-Aft Rig in the Ancient World

70. Boat rigged with the "Arab lateen"; second or third century A.D. Relief on a tombstone found in the Peiraeus and now in the National Museum, Athens. Photo courtesy of the Museum photographer, A Stamatopoulos.

71. A sprit-rigged small boat of the first or second century A.D. Relief found at Lampsacus and now in the Archaeological Museum, Istanbul. Photo courtesy of the Museum.

72. Vessel with two spritsails; second or third century A.D. Relief found at Çemberli-Tas and now in the Archaeological Museum, Istanbul.

73. Three merchantmen at the entrance to Rome's harbor; third century A.D. Relief on a sarcophagus probably from Ostia and now in the Ny-Carlsberg Glyptothek, Copenhagen. Photo Alinari.

74. Detail of the foregoing.

CHAPTER FIVE

75. The Gokstad ship, about A.D. 900, reconstructed. Photo courtesy of the Universitetets Oldsaksamling, Oslo.

The Oseberg Ship, about A.D. *800*

76. The ship as discovered in 1903.

76A. The ship fully reconstructed. Photos courtesy of Dr. Thorleif Sjövold of the Universitetets Oldsaksamling, Oslo.

The Boats of the Bayeux Tapestry, Eleventh Century A.D.

77. One of Harold's ships.

78. One of William's ships. Photos Giraudon.

Twelfth-Century Vessels.

79. Miniature from a manuscript in the BM (Harley 4751, fol. 69); photo courtesy of the Museum.

80. A seal of the town of La Rochelle; photo Giraudon.

Thirteenth-Century Men-of-War

81. Seal of the town of Sandwich. In the collection of the BM; reproduced from G. S. Laird Clowes, *Sailing Ships: Their History and Development,* Part I (London: 1932), p. 34.

82. Modern model in the collection of the Science Museum, London. Photo British crown copyright.

83. Thirteenth-century warship. Miniature from a manuscript dated A.D. 1271 in the Fitzwilliam Museum, Cambridge (Marlay Add. I, fol. 86); photo courtesy of the Museum.

84. Fourteenth-century cogs. Miniature from a manuscript in the BM (Roy 10 E IV, fol. 19); photo courtesy of the BM.

85. (COLOR) Fifteenth-century cogs. Miniature from a manuscript in the BN (MS Fr. 2643, fol. 118); photo courtesy of the BN.

86. (COLOR) Galleys of about 1400 in action. Detail of a fresco, done about 1406, by Spinello Aretino in the Palazzo Pubblico, Siena.

87. (COLOR) Venetian galley of the fifteenth century. Detail from a painting (The Story of St. Ursula) in the Accademia di Belle Arti, Venice, done between 1490–95 by Vittore Carpaccio.

88. Galley as pictured on a panel of a bronze door in the Basilica of St. Peter, Rome, done about 1445 by Antonio Filarete. Photo Anderson.

89. (COLOR) Square-rigged vessel of the fourteenth century. Detail of a fresco (Life of St. Nicholas of Bari) in the Chapel of the Castellani in the Church of Santa Croce, Florence.

90. (COLOR) Small open boat with a single lateen; twelfth century. Detail of a mosaic (Life of St. Mark) in the Chapel of St. Zeno in the Basilica of St. Mark, Venice.

91 and 92. Modern model of a Venetian *a zenzile* galley of the fifteenth or sixteenth century. In the Museo Storico Navale, Venice; photo courtesy of the Museum.

93. (COLOR) A two-masted lateener of the middle of the fourteenth century. Painting (Life of St. Nicholas of Bari) by Ambrogio Lorenzetti done between 1333–35; in the Uffizi Gallery in Florence.

94. (COLOR) Painting (Life of St. Nicholas of Bari) by Fra Angelico (1387–1455) in the Vatican Pinacoteca, Rome. Photo courtesy of the Vatican Museum.

95. A large merchant galley. Woodcut from Bernhard von Breydenbach's *Peregrinatio in Terram Sanctam,* first published in 1486.

96. A big single-masted lateener; fifteenth century. Detail of a fresco (Life of St. Ranieri) by Andrea da Firenze in the Camposanto, Pisa (now almost completely destroyed). Photo Anderson.

97. A three-masted lateener of the thirteenth century. Detail of a mosaic (St. Mark approaching Egypt) in the Basilica of St. Mark, Venice. Photo Anderson.

98. A big single-masted lateener showing northern influence. Relief (the saint calming a storm) from the shrine of St. Peter Martyr in the Portinari Chapel of the Church of San Eustorgio, Milan. Carved by Giovanni di Balduccio between 1336 and 1339. Photo Alinari.

99. A three-masted lateener. Sketch done about 1535–38. Reproduced from C. Huelsen and H. Egger, *Die römischen Skizzenbücher von Marten van Heemskerck* (Berlin: 1913), Plate fol. 24v.

100. Illustration from a manuscript (*Fabrica di Galere* "The Construction of Galleys") of the fifteenth century in the National Library, Florence (Ms Cl. xix.7, fol. 49 r.). Photo courtesy of the Library.

101. (COLOR) Vessel of about 1400 with a stern rudder. Detail of a fresco, done about 1406, by Spinello Aretino in the Palazzo Pubblico, Siena.

CHAPTER SIX

102. (COLOR) A Mediterranean two-masted square-rigger of about 1400. Painting (Miracle of St. Nicholas of Bari) by Gentile da Fabriano in the Vatican Pinacoteca, Rome. Photo courtesy of the Vatican Museum.

103 and 104. (COLOR) Carracks of the late fifteenth century. Details from a painting (Life of St. Ursula) in the Accademia di Belle Arti, Venice, done between 1490–95 by Vittore Carpaccio.

105. A big Mediterranean two-masted square-rigger of about 1450. Detail of a fresco (Miracle of St. Louis of Toulouse) by Benedetto Bonfigli in the Palazzo dei Priori, Perugia. Photo Anderson.

106. A three-masted carrack of the late fifteenth century. Bronze relief (Jonah cast into the sea) done in 1484 by Bartolomeo Bellano; in the Church of St. Anthony, Padua. Photo Anderson.

107. Detailed representation of a late fifteenth-century carrack. Print by the Dutch printmaker "W.A.," done about 1470. Photo courtesy of the Cabinet des Estampes, Brussels.

108. A northern three-master of the fifteenth century. Copy in the MM of a relief of the Hôtel Jacques-Coeur in Bourges, built 1443–51. Photo courtesy of the Museum.

109. A monster Venetian carrack of the sixteenth century. Relief by Alessandro Vittoria on the monument to Alessandro Contarini (d. 1553), a Venetian military commander, in the Church of St. Anthony, Padua. Photo Böhm.

110. A late fifteenth-century carrack. Detail from a painting (Return of Odysseus) by Pinturicchio in the National Gallery, London. Photo courtesy of the Gallery.

111. A large caravel of the sixteenth century. From a manuscript (Premières oeuvres de Jacques Devaulx, written in 1583) in the BN (MS Fr. 150, fol. 21 r). Photo Giraudon.

CHAPTER SEVEN

112. (COLOR) A fifteenth century man-of-war equipped with guns. From a manuscript in the BN (Ms Fr. 38, fol. 157 v). Photo courtesy of the BN.

113. (COLOR) Early sixteenth-century carracks armed with guns. From a manuscript in the BN (Ms Fr. 1672, fol. 9 v). Photo courtesy of the BN.

114. Iron gun of 1545. In the Tower of London. Photo courtesy of the Science Museum, London.

115. A heavily armed sixteenth-century carrack. Engraving by John Gallé (1600–76) from a drawing by John Stradanus (1523–1605).

116. The *Henry Grace à Dieu* as rebuilt in 1545. From the Anthony Roll (*A Declaration of the Royal Navy,* presented to King Henry VIII in 1546 by Anthony Anthony, a naval officer) in the Pepysian Library, Magdalene College, Cambridge; photo courtesy of the Library.

117. (COLOR) Portuguese carracks of the early sixteenth century. Detail of a painting said to have been done by Cornelis Anthoniszoon in 1521. In the NMM.

118. (COLOR) An early sixteenth-century Dutch warship. Painting by A. Storck (1635–1710) in the Galleria Nazionale di Parma.

119. An early Flemish galleon. Print from a series engraved by Frans Huys after drawings done about 1560 by Peter Breughel the Elder. Photo courtesy of the Cabinet des Estampes, Brussels.

120. A Flemish galleon trailing a galley. From the same series as illustration 118.

121. The *Grand Mistress*, an English galleon built in 1545. From the portion of the Anthony Roll (see illustration 117) in the BM (Ms Add. 22047). Photo courtesy of the BM.

122. The *Ark Royal*, flagship of the English fleet in 1588. From a contemporary print in the BM. Photo Mansell Collection.

123. Modern model of an English galleon. In the Science Museum, London. Photo British crown copyright.

124. Dutch and Spanish warships of the early seventeenth century. Painting by Cornelis Vroom (1591–1661) in the Rijksmuseum, Amsterdam. Photo courtesy of the Museum.

125. The *Sovereign of the Seas*. Engraving by John Payne published in 1638. Photo courtesy of the Science Museum, London.

126. *De Zeven Provinciën*. Detail of a pen drawing by Willem van de Velde the Elder in the Rijksmuseum, Amsterdam. Photo courtesy of the Museum.

128, 129 and 130. The construction of a seventeenth-century French warship. Three drawings from the *Atlas de Colbert: Dessins pour la construction des navires*, a manuscript in the Bibliothèque du Service Hydrographique, Paris (No. 1513, plates 29, 47, 48). Photo courtesy of the MM.

131 and 132. A Dutch two-decker of 1698. Contemporary model in the Rijksmuseum, Amsterdam. Photo courtesy of the Museum.

133. The *Victory* in 1792. Detail of a painting by Monamy Swaine in the NMM. Photo courtesy of the Museum.

134. The *Constitution* in 1931. Photo courtesy of the U. S. Navy, Office of Naval History.

135. Model of a Dutch seventeenth-century pinnace. In the Scheepvaart Museum, Amsterdam. Photo courtesy of the Museum.

136. A bomb-ketch of the late seventeenth century. Reproduced from Henri Sbonski de Passebon, *Plan de plusieurs bâtimens de mer* (Paris: 1690), pl. 18.

137. Convicts go aboard a prison ship. From *Fifty Plates of Shipping and Craft*, drawn and etched by E. W. Cooke (London: 1829).

138. (COLOR) The *Gouden Leeuw*. Detail of a painting (The Battle of Texel) done by Willem van de Velde the Younger in 1687; in the NMM.

139. (COLOR) The guns of a three-decker. Detail of a modern model in the NMM.

140. (COLOR) The *Victory* today.

141. Two royal English yachts. Detail of a painting (Royal Visit to the Fleet, June 5, 1672) done by Willem van de Velde the Younger in 1674; in the NMM.

Chapter Eight

142. (COLOR) A galeass of the Spanish Armada. Detail of a painting, probably contemporary, in the NMM.

143. (COLOR) The *Bucentaur* in its eighteenth-century form. Detail of a painting ("Departure of the Bucentaur for the Lido") by Francesco Guardi in the Louvre.

144. The Battle of Lepanto. Print, done in 1590, after a drawing by Stradanus (see illustration 115).

145. Galley of the early seventeenth century. Detail from a print of 1607. Photo courtesy of the Cabinet des Estampes, Brussels.

146. A Venetian brigantine of the sixteenth century. Modern model in the Museo Storico Navale, Venice. Photo courtesy of the Museum.

147, 148 and 149. A standard French galley of the eighteenth century. From a manuscript in the Bibliothèque du Service Hydrographique, Paris (No. 1489, figs. 24, 22, 21). Photos courtesy of the MM.

150. The *Styrbjörn*, a Swedish *hemmema* of 1789. Modern model in the Sjöhistoriska Museum, Stockholm. Photo courtesy of the Museum.

151. Portuguese galley used in India. Reproduced from Theodore de Bry, *Indiae Orientalis, in qua Iohan Hugonis Lindscotani Navigatio in Orientem etc.* (Frankfort: 1599), pl. xvii.

152. Ceremonial barge of Udaipur. Photo courtesy of the Science Museum, London.

153. Galley of Cambodia. Detail of a relief (Battle between Chams and Khmers) of the twelfth century A.D. on a wall of the Bayon in Angkor Thom. Photo Giraudon.

154. Chinese war galley of the early nineteenth century. Modern model in the MM. Photo courtesy of the Museum.

155. A Malay trireme as sketched about 1767. Paris, pls. 103, 104.

156 and 157. The Korean "turtle boat" of 1598. Reproduced from H. H. Underwood, *Korean Boats and Ships*, Transactions of the Korean Branch of the Royal Asiatic Society, Vol. 23 (London: Kegan Paul, Trench, Trubner & Co., 1935), figs. 47 and 48.

Chapter Nine

158. Dutch East Indiamen of the seventeenth century. Grisaille done in 1649 by Willem van de Velde the Elder. In the NMM; photo courtesy of the Museum.

159. The *Princess Royal*, a British East Indiaman. Detail of a painting done in 1770 by J. Cleveley the Elder. In the NMM; photo courtesy of the Museum.

160. *Thetis*, a West Indiaman of the early nineteenth century. From Cooke (see illustration 137).

161. Small merchantman of the sixteenth century. Drawing by Hans Holbein the Younger done about 1532 and now in the Städel Institute, Frankfort. Photo courtesy of the Science Museum, London.

162. English flute of the seventeenth century. Detail of a grisaille done in 1677 by J. Peeters. In the NMM; photo courtesy of the Museum.

163. French *pinasses* of the seventeenth century. From a manuscript in the Service Hydrographique, Paris: J. Jouve, *Desseins des differentes manières de vaisseaux que l'on voit . . . depuis Nantes jusqu'à Bayonne* (1679), p. 17. Photo courtesy of the MM.

164. (COLOR) A Danish timber bark. Detail of a painting done in 1736 by Samuel Scott. In the NMM.

165. A Prussian snow of the early nineteenth century. From Cooke (see illustration 137).

166. (COLOR) A French brig of about 1800. Watercolor sketch from a notebook of Antoine Roux in the PM.

167. A *polacre* of the seventeenth century. From a manuscript in the BN: J. Jouve, *Desseins de tous les bastimens qui naviguent sur la Mediterranée* (1679). Photo courtesy of the BN.

168. A *saique* of the seventeenth century. See illustration 167. Photo courtesy of the MM.

169. Modern model in the MM. Photo courtesy of the Museum.

170. (COLOR) Watercolor sketch by Antoine Roux in the PM.

171. An American topsail schooner. Oil painting of 1794 in the PM. Photo courtesy of the Museum.

171A. A three-masted Baltimore schooner of about 1825. Lithograph by J. Rogers in the NMM. Photo courtesy of the Museum.

172. The cargo arrangement aboard the slaver *La Vigilante.* From F. Paris, *Souvenirs de marine* (Paris: 1882–1908), Part 4, pl. 194.

173. The packet *Dreadnought.* Oil painting by J. E. Butterworth in the PM. Photo courtesy of the Museum.

174. The *Dreadnought* moored at South Street, New York. Contemporary photograph in the collection of the PM.

175. (COLOR) A *xebec* of about 1800. See illustration 166.

176. A Dutch whaler. Detail of a grisaille by A. van Salm in the NMM; photo courtesy of the Museum.

177. "South Sea Whale Fishery," a colored engraving painted by Garnery and engraved by Duncan. Photo courtesy of the PM.

CHAPTER TEN

178. The clipper *Sea Witch.* Contemporary painting by a Chinese artist, in the PM. Photo courtesy of the Museum.

179. The "down-easter" *Samuel Skolfield.* Photo courtesy of the PM.

180 and 182. The *Great Republic.* Photos courtesy of the PM.

181. (COLOR) The tea clipper *Cuttysark.*

183. The seven-masted schooner *Thomas W. Lawson,* as photographed in 1902. Photo courtesy of the PM.

184. The iron barque *Macquarie.* Photo courtesy of the Scheepvaart Museum, Amsterdam.

CHAPTER ELEVEN

185. (COLOR) An Arab passenger boat of the thirteenth century. From a manuscript (*Les séances de Hariri*) in the BN (Ms Arab. 5847, fol. 119 v.). Photo courtesy of the BN.

186 and 187. Arab *būms.* Photos courtesy of Alan Villiers.

188. An Arab *baghalah* of the early nineteenth century. From Paris, pl. 3.

189. Indian merchantman of the early nineteenth century. From Paris, pl. 13.

190 and 191. Indian ships of the second century A.D. Reproduced from the *Madras Journal of Literature and Science* 1858, pl. x, figs. 74, 81.

192. An Indian vessel of about A.D. 600. Detail of a fresco in Ajanta Cave No. 1. Photo courtesy of the Victoria and Albert Museum, London.

193. (COLOR) A dhoni of the early nineteenth century from the Coromandel Coast. From Paris, pl. 22.

194. A Ceylonese *yathra dhoni.* Photo courtesy of the Science Museum, London.

195. An Indian vessel of the eighth or ninth century A.D. Detail of a relief on the wall of the Buddhist temple at Boro Budur, Java. Photo Goloubew.

196. A nineteenth-century sailing vessel of southern Celebes. Photo courtesy of the Koninklijk Instituut voor de Tropen, Amsterdam.

197. Chinese war junks of the nineteenth century. From Paris, pl. 51.

198. A southern Chinese junk. Science Museum, London. Photo British crown copyright.

199. A northern Chinese junk. Lent to the Science Museum, London, by Sir Frederick Maye. Photo courtesy of the Museum.

200. A Japanese coaster of the early nineteenth century. Model in the MM. Photo courtesy of the Museum.

CHAPTER TWELVE

201. A Dutch *buss* of the fifteenth century. Photo courtesy of the Science Museum, London.

202. Dutch sprit-rigged craft of about 1416. Miniature (Voyage of St. Julian) from the Turin Book of Hours by Hubert van Eyck.

203. Dutch sprit- and gaff-rigged craft of the seventeenth century. Detail of a painting (Coast Scene: Calm) done in 1661 by Willem van de Velde the Younger; in the National Gallery, London. Photo courtesy of the Gallery.

204. (COLOR) Dutch sprit-rigged craft of the seventeenth century. Painting ("Bateaux en Mer pendant la Tempête") by Aelbert Cuyp in the Louvre.

205. An early Dutch leg-of-mutton sail. Detail of a painting done in 1629 by A. Willaerts; in the Dordrecht Museum. Reproduced from E. Chatterton, *Fore and Aft Craft* (London: 1927) fig. 12.

Dutch Craft with Short Gaffs

206. A yacht of the seventeenth century. Detail of a drawing done in 1660 by A. Storck. Photo courtesy of the Scheepvaart Museum, Amsterdam.

207. Contemporary model of a *tjalk* of 1890. In the Scheepvaart Museum. Photo courtesy of the Museum.

208. A Dutch galliot of the early nineteenth century. From Cooke (see illustration 137).

209. Norway fishing boat of the nineteenth century. From R. T. Pritchett, *Pen and Pencil Sketches of Shipping and Craft All Round the World* (London: 1899), p. 66.

210. A Yorkshire coble. From Pritchett, p. 23.

211. A Hastings lugger. From J. D. Harding, *Sketches at Home and Abroad,* no. 26 (done about 1831).

212. A Humber keel, as photographed in 1905. Photo courtesy of E. W. Carter, Gainsborough.

213. Seventeenth-century boats used on the Loire. From Jouve, p. 6 (see illustration 163). Photo courtesy of the MM.

214. A nineteenth-century Thames barge. From Cooke (see illustration 137).

215. Model of a *bisquine* of Normandy. In the MM. Photo courtesy of the Museum.

216. (COLOR) Winslow Homer's "Breezing Up," in the National Gallery, Washington, D.C. (gift of the W. L. and May T. Mellon Foundation); photo courtesy of the gallery.

216A. A New Haven sharpie. Chief of Engineers Photo in the National Archives, Washington.

217. A Chesapeake Bay bugeye. Photo courtesy of Frank A. Moorshead, Jr.

218. Replica of a Block Island cowhorn. Photo courtesy of the PM.

219. A New Hampshire gundalow. Photo courtesy of the PM.

220. A Barnegat sneakbox. From N. H. Bishop, *Four Months in a Sneak-Box* (Boston: 1894), p. 302.

221. (COLOR) Boats on the beach at Sorrento in 1794. Painting by F. Hackert in the Museo di San Martino, Naples.

222. A Portuguese *muleta* of the late eighteenth century. From P. Ozanne's book of engravings, *Mélanges des vaisseaux* (Paris: 1780).

223. (COLOR) A Marseilles barquette of about 1800. Watercolor sketch from a notebook of Antoine Roux in the PM.

224. Italian fishing boats of the late fourteenth century. Detail of a fresco ("The Miracle of the Fish") by Giusto Menabuoi in the Baptistery at Padua.

225. (COLOR) Swordfishing in the eighteenth century. Detail of a painting done in 1785 by Oliver Le May; in the Musée des Beaux Arts, Valenciennes.

226. *Tartanes* of the eighteenth century. From Adrian Manglard, *Raccolta di Vedute e Composizioni del celebre Manglard* (Rome: 1753). Photo courtesy of the Vatican Library.

227. (COLOR) A *trabaccolo* of about 1800. Watercolor from a notebook of Antoine Roux in the PM.

228. A modern *trabaccolo.*

229. (COLOR) A Venetian *bragozzo.*

230. (COLOR) Gondolas of the eighteenth century. Detail of a painting ("View of the Grand Canal") by Canaletto; in the Galleria Corsini, Rome.

231. (COLOR) A modern Greek caïque.

232. A Turkish craft of the seventeenth century. From Nicolas Witsen's *XXX Platen von vreemde Vartuigen* (about 1671), pl. 26 lower. Photo courtesy of the NMM.

233. Model of a Turkish craft of the nineteenth century. In the MM. Photo courtesy of the Museum.

234, 234A. (COLOR) Modern *ghayassahs.*

235 and 236. A modern *nuggar.* Photos, from the collection of James Hornell, courtesy of the University Museum of Archaeology and Ethnology, Cambridge, England.

237. Sixteenth-century ceremonial barge on the Ganges. Miniature (Mogul Akbar's procession of boats at Agra in 1562) from a manuscript of 1590 (*History of Akbar*) in the Victoria and Albert Museum, London. Photo courtesy of the Museum.

238. *Patelas* and a *dinghi* on the Ganges in the nineteenth century. From Paris, pl. 36.

239. (COLOR) A nineteenth-century *patela* of Calcutta. From Paris, pl. 34.

Burmese River Craft

240. A modern model of a rice boat of the Irrawaddy. Photo courtesy of the Science Museum, London.

241. Sketch done in the late nineteenth century. From Pritchett, p. 151 (see illustration 209).

242. (COLOR) Boats of Macao serving as living quarters. From Paris, pl. 67.

243. A Cantonese waterborne duck farm of the nineteenth century. From Paris, pl. 68.

244. (COLOR) Early nineteenth-century harbor boats of Manila. From Paris, pl. 73.

245. Japanese sailing craft of the nineteenth century. Print from a series ("Views of the Fifty-Three Stations on the Journey from Tokyo to Kyoto") by Kuniyoshi (1797–1861). Photo courtesy of the Victoria and Albert Museum, London.

246. Japanese beach boat of the nineteenth century. Ink drawing by Hokusai (1760–1849) in the Victoria and Albert Museum, London. Photo courtesy of the Museum.

247. A nineteenth-century Malay coaster. From Paris, pl. 86.

248. A modern Javanese *prau.* Photo courtesy of the Koninklijk Instituut voor de Tropen, Amsterdam.

249. A double-outrigger canoe of Java. Photo of J. G. Rooiman, reproduced by courtesy of the Koninklijk Instituut voor de Tropen.

Single-Outrigger Canoes

250. Model of the Anchorite Island type. In the BM; photo courtesy of the Museum.

251. (COLOR) Sketch of a type found near Vanikoro, in the southern Pacific. From Paris, pl. 115.

252. Model of the type used in the Trobriand Islands, in the southwestern Pacific. In the BM; photo courtesy of the Museum.

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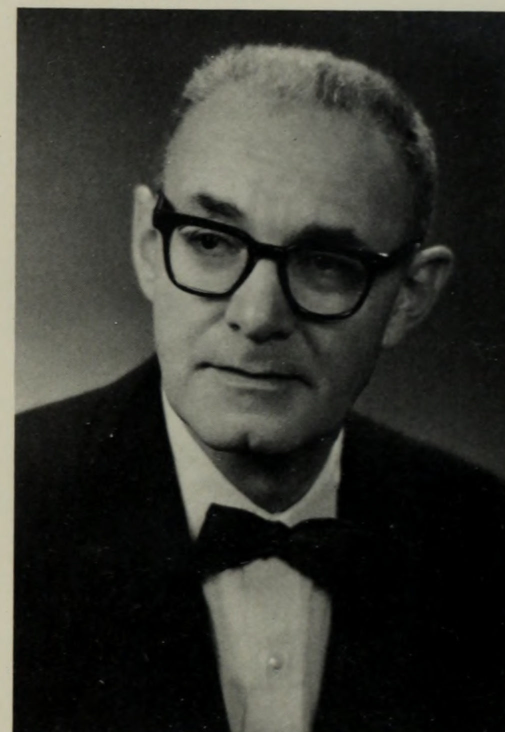

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